Institution:
University of Cambridge

Unit of Assessment:
UoA15

Title of case study:
Inclusive Design

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

The i~design research programme, which has been running in the University of Cambridge Department of Engineering (DoEng) since 2000, sought to understand population diversity in order to better inform design decisions for mainstream everyday products and services. Impact from this programme, since 2008, includes: skills embedded in companies through direct training of over 280 designers and design managers from industry; direct involvement in the improved design of more than 10 new products and services that have gone into production; educational resources for teaching Design and Technology trialled in nine secondary schools; over 800 wearable impairment simulators sold; and extensive web-based guidance, methods and tools for inclusive design accessed in over 170 countries.

2. Underpinning research (indicative maximum 500 words)

Inclusive design is defined as the *"design of mainstream products and/or services that are accessible to, and usable by, people with the widest range of abilities within the widest range of situations without the need for special adaptation or design"* in BS7000-Part 6 "Design management systems – Managing inclusive design" (2005). This definition was drafted by Professor John Clarkson (appointed as DoEng Lecturer in 1995, Director of the DoEng Engineering Design Centre (EDC) from 1997 and promoted to Professor in 2005) and his collaborator, Professor (now Emeritus) Roger Coleman from the Helen Hamlyn Centre at the Royal College of Art (RCA). The definition came from their first collaborative EPSRC research project, i~design 1 (Ref a). The new standard created the context for subsequent EPSRC-funded projects, i~design 2 and 3 (Ref b and c) and a knowledge transfer programme, KT-EQUAL (Ref d). Clarkson was the Principal Investigator for all these projects, which, together, sought to cre ate:

- an understanding of diversity in the population and guidance for designers to address such a range of user abilities;
- a design process framed around specific inclusive design activities that answer the question 'what do I actually do?';
- a range of 'simulators' to enable designers to experience the impact of some common capability losses;
- an 'exclusion audit' method and calculator to calculate preventable design exclusion.

i~design 1, "Inclusive Design for the Whole Population" (2000-2003): a research programme with the RCA, Central St Martin's College of Art and Design, and the Design Council. The goal was to lay the groundwork for an inclusive design knowledge base accessible to both academia and industry. Major outcomes of the programme included: (1) a policy paper – *Living Longer: The new context for design* (Design Council, 2002); and (2) two books – *Inclusive Design: Design for the Whole Population* (Springer, 2003) and *Countering Design Exclusion: An introduction to inclusive design* (Springer, 2003). The second book, written by Clarkson's DoEng team, presented a system of metrics to allow for the quantification of inclusivity. This was recognised as a crucial and unique element needed to bring rigour to an inclusive design process, and differentiate it from the more aspirational universal design and design for all approaches (Ref 1).

i~design 2, "Providing Tools to Improve Quality of Life for the Wider Population" (2004-2008): a research programme with the RCA, Universities of York and Dundee, and the Design Council; where the focus shifted to developing a business case for inclusive design and tools to assist designers in designing and evaluating new products. Major outcomes from Clarkson's DoEng team included: a deeper understanding of the influence of user experience and capability on exclusion (Ref 2 and 3); simulators to emulate capability loss (Ref 4); an Inclusive Design Toolkit (sponsored by BT); and, from the wider team, a further book, *Design for Inclusivity: a practical guide to accessible, innovative and user-centred design* (Gower, 2007).

i~design 3, "Extending Active Living Through More Effective Inclusive Design" (2006-2010): a research programme with the RCA, Loughborough University and the University of Cambridge Department of Psychiatry. The primary goal was to design and pilot a national user survey that enables more informed decision-making for inclusive product design. Major outcomes from

Clarkson's DoEng team included: the specification for a user survey (Ref 5); a revised edition of the Inclusive Design Toolkit (again sponsored by BT); and results from a national survey of nearly 400 users.
KT-EQUAL, "Knowledge Transfer for Inclusive Design" (2009-2013): a knowledge transfer programme with the Universities of Sheffield, Edinburgh, Bath, Salford and Reading, Loughborough University and the University of Cambridge Department of Psychiatry; details of specific outcomes follow in section 4 of this document.
Dr Nathan Crilly (appointed as Lecturer in the DoEng in 2007, having been a Research Associate in Clarkson's team, and, in 2013, won an EPSRC Early Career Fellowship) contributed to the work on inclusive design, focusing on creativity and communication. He has investigated how designers intend products to be experienced and how they are subsequently experienced by consumers. Using an interdisciplinary approach, he has tracked the transition from the goal and the reality with a view to better understanding the relationships and communication that takes place between the involved parties (Ref 6).

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

1. Keates, S. and Clarkson, P.J. (2003) 'Countering design exclusion: bridging the gap between usability and accessibility' in *Universal Access in the Information Society*, 2(3), 215-225, DOI: 10.1007/s10209-003-0059-5
2. *Langdon, P., Lewis, T. and Clarkson, P.J. (2007) 'The effects of prior experience on the use of consumer products' in *Universal Access in the Information Society*, 6(2), 179-191, DOI: 10.1007/s10209-007-0082-z
3. *Persad, U., Langdon, P.M. and Clarkson, P.J. (2007) 'Characterising user capabilities to support inclusive design evaluation' in *Universal Access in the Information Society*, 6(2), 119-135, DOI: 10.1007/s10209-007-0083-y
4. *Cardoso, C. and Clarkson, P.J. (2012) 'Simulation in user-centred design: helping designers to empathise with atypical users' in *Journal of Engineering Design*, 23(1), 1-22, DOI: 10.1080/09544821003742650
5. Johnson, D., Clarkson, P.J. and Huppert, F. (2010) 'Capability measurement for inclusive design' in *Journal of Engineering Design*, 21(2-3), 275-288, DOI: 10.1080/09544820903303464
6. Crilly, N., Maier, A. and Clarkson, P.J. (2008) 'Representing artefacts as media: modelling the relationship between designer intent and consumer experience' in *International Journal of Design*, 2(3), 15-27, URL: http://www.ijdesign.org/ojs/index.php/IJDesign/article/view/429/220

*Research outputs that best represent the quality of the research.

EPSRC Research Grants:
a) "Inclusive Design for the Whole Population", 2000-3, GR/M69470/01, GBP 187k
b) "i~design 2", 2004-08, GR/S96395/01, GBP617k
c) "i~design 3", 2006-11, EP/D079322/1, GBP993k
d) "KT-EQUAL", 2009-13, EP/G030898/1, GBP1,873k.

The excellence of Clarkson's research on inclusive design led to his election as a Fellow of the Royal Academy of Engineering and his receipt of an Honorary Doctorate from KU Leuven.

4. Details of the impact (indicative maximum 750 words)
The i~design research focused on understanding the principles of inclusive design and translating them into guidance, methods and tools to assist designers and encourage business decision makers to facilitate inclusive design.
Industry: activity to create impact in industry has taken a variety of forms; including awareness raising events, training workshops, design evaluation and the delivery of design tools.
Awareness raising: The DoEng EDC team authored the G3ICT "Product development and design" contents for the international e-Accessibility Policy Toolkit for Persons with Disabilities website (*2009)* in collaboration with the Irish *Centre for Excellence in Universal Design* (Ref 7). The team hosted a breakfast briefing at the Toolkit re-launch at the RCA's INCLUDE conference in London (2011) and Clarkson gave the public keynote lecture for the Institute of Ergonomics and Human Factors annual conference in Cambridge (2013). A public report (Ref 8) on the future of inclusive design, sponsored by BT (Ref 9), was launched to the press and public at BT Tower (2013) and a technology news article was filmed and broadcast by the BBC (2012).
Training/coaching: between 2008 and 2010 inclusive design training was developed and provided

by the DoEng EDC in collaboration with Sagentia, a local technology consultancy, for more than 200 designers and product managers within BT (Ref 9). The tools and methods taught were embedded in their internal product/service development process. A direct benefit of the training was the inclusive design of BT's Freestyle 750 series phone and Home Hub 2.0. The phone was well-laid-out and easy-to-read push-buttons, a clear display, and excellent acoustical performance especially in hands-free mode. The design evaluation process incorporated best-practice from the DoEng EDC's Inclusive Design Toolkit and led to a product that has been well-received by customers; the device has become a best-seller and since its launch in July 2008 sales have increased 20% over earlier versions of the handset (Ref 10). The Home Hub was designed from the outset with simple accessibility improvements to benefit all users; as a result calls to customer support were dramatically reduced. In addition, accessibility improvements to the BT.com website led to an increase in sales of over 6.5% in the first month alone (Ref 10).

Nestlé designers (Ref 11) have been using methods developed by the DoEng EDC since 2009 to improve customer satisfaction and drive business success. In 2010/11 a European Consortium was convened, bringing together Nestlé, BBC, Marks & Spencer, Bayer Healthcare, Roche, RBS and Bosch-Siemens for five two-day workshops to train designers and design managers. A direct consequence of this was further engagement with Nestlé, including two extended training workshops and seven product audits leading to the redesign of packaging. The use of the DoEng EDC's Cambridge simulation gloves and glasses with the CEO provoked Nestlé's 'year of inclusive design' (2012) and the launch of a new 'After Eight' box, the first of a number of new inclusive packaging designs. *"Putting the consumer at the centre of packaging development means creating products and packaging that are easy to use regardless of age, disability or physical condition"* - Global Head of Packaging and Design at Nestlé (Ref 11).

Design tools: the DoEng Inclusive Design Toolkit website, originally launched in 2007, was redesigned by the DoEng EDC team with support from BT and re-released in 2011. It includes sections on: What is inclusive design?; Why do inclusive design?; How to get started?; Inclusive design tools; and guidance on user capabilities. An average of 14,000 page views per month were recorded for the site in 2012, accessed from more than 170 countries. Simulation gloves and glasses developed by the DoEng EDC team sold 700 glasses and 140 gloves in 2012.

Design evaluation: emporia (Ref 12) is an Austrian company that makes mobile phones for seniors, focusing on ease-of-use for people who are not interested in multimedia applications or complex menu navigation. The DoEng EDC have been active in evaluating emporia's next generation products and developing the insights necessary to facilitate the design of touch-screen devices targeted at the senior market. In particular, the DoEng EDC has been actively involved in the development of the Connect, Click and emporiaME products. As a direct result of this engagement emporia have implemented 'number navigation' and simplified the interface with a dedicated on/off button, button for the camera and button for the menu. Estimated sales of Click are 250k units (Ref 13). *"As smart as needed, as simple as possible - this was the idea behind creating emporia's latest mobile phone – emporiaCONNECT. Working closely with the University of Cambridge, emporia has designed a phone that is incredibly easy to use"* – emporia news statement 2013 (Ref 13).

Devices for Dignity (D4D, Ref 14) is a UK National Institute for Health Research programme established to deliver innovative solutions to support patients with long-term conditions, preserving their dignity and independence. In 2009, they commissioned the DoEng EDC to review existing concepts and assist in the design of a new UroDiary user interface to improve its accessibility and utility. The new diary underwent successful clinical trials in 2012 (Ref 15).

Education: an EPSRC Public Engagement Grant in 2011, entitled 'Designing Our Tomorrow (DOT)' (EP/H047948/1), led to the DoEng EDC team developing educational materials for teaching Design and Technology at Key Stage 3. This collaboration with the University of Cambridge Department of Education, RCA and Loughborough University undertook to develop, evaluate and deliver a set of teaching materials for 12 one-hour lessons focused on the inclusive design of cutlery. The resources have been trialled in seven schools in England and, via additional funding from the Irish Centre for Excellence in Universal Design, two schools in Ireland. In the UK schools, 69% of participants (n=50) had not previously examined user needs in the design process and in Ireland, 79% of participants (n=38) said that they had not specifically looked at users' needs. Post-intervention surveys reveal students' positive responses to the DOT activities focused on user needs and their enjoyment of the autonomy experienced in the project, with 89 per cent of the Irish

schools' participants saying that they enjoyed the project (Ref 16).

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

7. Senior ICT Advisor, National Disability Authority of Ireland, G3ICT
8. Public report on the future of inclusive design – Mieczakowski, A. and Clarkson, P.J. (2012) 'Ageing, Adaption and Accessibility: time for the inclusive revolution' ISBN 978-0-9545243-8-8.
9. Head of University and Regional Partnerships, BT
10. "Designs on a Bigger Market: a guide to inclusive design", PHME 59482/01/10, Leaflet published by British Telecommunications plc, 2010
11. Packaging Design Coordinator, Nestlé
12. Statement received from Chief Marketing Officer, emporia
13. "Mobile World Congress 2013: connecting generations", News item on emporia's website at http://www.emporia.eu/en/content/news/
14. Scientific & Technology Advisor, D4D
15. Results of the D4D UroDiary design intervention – Mangera, A., Marzo, A., Heron, N., Fernando, D., Abdel-Maguid, M.M., Hameed, K., Soliman, A., Bradley, M., Hosking, I. and Chapple, C. (2012) 'Development and assessment of two electronic bladder diaries; a pilot study' in Neurourology and Urodynamics, 31(6), 770-771.
16. Results of surveys of DOT school trials – Nicholl, B., Flutter, J., Hosking, I. and Clarkson, P.J. (2013) 'Joining up the DOTs: authentic teaching and learning in Design and Technology education' in *Cambridge Journal of Education*, DOI: 10.1080/0305764X.2013.811219.