Institution:	**Loughborough University**
Unit of Assessment:	**C16 Architecture, Built Environment and Planning**
Title of case study:	**Improving the quality of UK NHS healthcare estates**

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

Research at Loughborough University (LU) (1995–2013) has transformed the development of the new National Health Service (NHS) Universal Premises Assurance Model (PAM) which has:

- Established a UK system-wide, consistent multi-criteria asset management software tool for board-level assurance of the premises in which NHS healthcare is delivered, as now endorsed by the Institute of Healthcare Engineering and Estate Management (IHEEM) and the Health Estates Facilities Management Association (HefmA);
- Provided benchmarking tools that Trusts can use to improve the management and allocation of resources;
- Established a basis for National Institute for Health and Care Excellence (NICE), Care Quality Commission (CQC) and Monitor to enforce compliance with national standards and drive premises-related performance improvements throughout the system; and
- Been adopted by NHS Property Services as part of their governance and assurance of their £40bn asset portfolio, covering estate, property and facilities.

2. Underpinning research (indicative maximum 500 words)

In the face of enormous financial, capacity and technological challenges and growing incidences of non-compliance with national standards, the Department of Health (DH) Estates and Facilities Division (EFD), in 2009, recognised a need for a robust and evidence-based quality assurance assessment tool for board-level assurance of the NHS estate, valued at almost £40bn with £7bn annual running costs. A software-based tool was developed and launched in April 2010 by the DH to provide such baseline quality assurance of the NHS estate. However, the tool applied to Acute Trusts only; did not integrate existing generic toolkits, standards and guidance; and was cumbersome to use because of the number and wording of questions and the lack of compliance evidence. The limitations of the original system provided the backdrop for, and LU's involvement in, the development of the new Universal NHS PAM.

The DH commissioned (2011-12) Andrew Price (Professor; 1981 to date), Grant Mills (Research Associate; 2002 to date) and Sameedha Mahadkar (Research Associate; 2008-2013) in the School of Civil and Building Engineering (CBE) to develop better ways to strategically manage and assure healthcare assets by improving the functionality of the existing tool, broadening its user base and integrating existing toolkits. To achieve these goals, knowledge from the following LU Health and Care Infrastructure and Innovation Centre (HaCIRIC) and related research projects was applied directly in optimising the care model design, estates and accessibility, and also synthesised into an integrated and rigorous Strategic Asset Management (SAM) framework, which was then mobilised as a theoretical lens for the consultative evidence-based multi-criteria approach to the co-development with DH of the Universal NHS PAM:

- Andrew Price, Francis Edum-Fotwe (Research Fellow, now Lecturer; 1996 to date), and Ninatubu Lema (then Research Student, now Professor and Deputy Principal at College of Engineering and Technology, University of Dar es Salaam) developed a significant theoretical base and advanced definitions/approaches for strategy, quality, benchmarking and assurance **[G1] [R1]**;
- Simon Austin (Professor; 1984 to date), Derek Thomson (Research Associate, 1999 to 2005, Lecturer, 2011 to date) and Mills developed theory on the content, structure and measurement of value and a standardised quality assurance assessment approach **[G2] [G3] [R2]**;

- Price's 'SAM' project **[G4]** evaluated existing approaches and developed new theory on optimal decision making processes and how healthcare infrastructure value is defined. It developed specifications for new knowledge and tools to scale, scope and distribute infrastructure, and for effective stakeholder engagement **[R3]**;
- Price's IMCRC project **[G5],** along with LU funding, supported over 10 PhDs, e.g. in ventilation (Zulfikar Adamu, now Lecturer, 2013 to date) **[R4]**; lighting simulation (Shariful Shikder, subsequently Research Associate, Aug 2009 to April 2013) **[R5]**; and daylighting (Md Ashikur Joarder, subsequently Research Associate, Jan – Dec 2012) **[R6]**: developed/applied modelling, simulation and visualisation to support the evidenced based design, policy and assurance of efficient and sustainable healthcare environments that enhance patient safety and experience; and
- Price, Mills, Mahadkar and Nebil Achour (Research Associate, 2007 to date) developed: effective and sustainable evidence and model-supported approaches to healthcare planning and strategic asset management; new theory on the interconnectivity of hospital systems and critical lifelines; and metrics for evaluating the resilience of hospitals to multiple hazards **[G6]**.

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

Related peer-reviewed publications include 20 Journal and 59 Conference papers. The 6 journal papers cited below evidence the quality of the underpinning research.

R1 Lema, N.M. and Price, A.D.F., (1995) "Benchmarking: Performance improvement towards competitive advantage", *ASCE Journal of Management in Engineering*, 11(1), 28-37. DOI: 10.1061/(ASCE)0742-597X(1995)11:1(28) [impact factor 0.75, 2011, 65 citations]

R2 Thomson, D.S., Austin, S.A., Devine-Wright, H. and Mills, G.R., (2003) "Managing value and quality in design", *Building Research & Information* 31(5), 334-345. DOI: 10.1080/0961321032000087981 [impact factor 1.476, 74 citations]

R3 Mahadkar, S., Mills, G. and Price, A.D.F., (2012) "Stakeholder consultation practices within healthcare infrastructure planning: A conceptual approach to strategic asset management", *Journal of Built Environment Project and Asset Management*, 2(2), 127-145. DOI: 10.1108/20441241211280882 (Highly Commended Award Winner at the Literati Network Awards for Excellence 2013).

R4 Adamu, Z.A., Price, A.D.F. and Cook, M.J., (2012) "Performance evaluation of natural ventilation strategies for hospital wards – A case study of Great Ormond Street Hospital", *Building and Environment*, 56, 211-222. DOI: 10.1016/j.buildenv.2012.03.011 [impact factor 2.281]

R5 Mourshed, M., Shikder, S. and Price, A.D.F., (2011) "Phi-array: A novel method for fitness visualization in evolutionary design optimization", *Advanced Engineering Informatics*, 25(4), 676-687. DOI: 10.1016/j.aei.2011.07.005 [impact factor 1.489]

R6 Joarder, M.A.R. and Price, A.D.F., (2012) "Impact of daylight illumination on reducing patient length of stay in hospital after coronary artery bypass graft surgery", *Lighting Research & Technology*, 45(4), 435-449. DOI: 10.1177/1477153512455940 [impact factor 1.551]

Details of research grants

G1 McCaffer, Thorpe and Price, *Scoping Study of the Strategic Planning Process within Construction*, EPSRC Grant GR/L90446/01, 1998–1999, £41,100.

G2 Austin, Price and Mills, *Managing Value Delivery in Design* (VALiD), EPSRC-IMRC grant, 2002–05, £307k [part of EPSRC Grant GR/R64490/01: *A Centre for Innovative Manufacturing and Construction Research* (2001–6) £2,850,001].

G3 Austin, *VALiD: Managing Value in Design*, DTI Grant 39/12/16 cc2323, 2002–2005, £259,250.

G4 Price, *Strategic Asset Management (SAM) and the Integration of Contestable Health and*

Social Care Service and Estates Design, EPSRC-HaCIRIC grant, 2008-11, £214K [part of EPSRC Grant EP/D039614/1: *Health and Care Infrastructure Research and Innovation Centre* (HaCIRIC) (2006 –11) £7,236,672]

G5 Price, *Built Environment Design Evidence Base to Continuously Improve the Delivery of Patient Safety*, EPSRC-IMCRC grant, 2008-2011, £453K [part of EPSRC Grant EP/E002323/1: *A Centre for Innovative Manufacturing and Construction* (2006–11) £17,848,836.]

G6 Price, *Optimising Healthcare Infrastructure Value* (OHIV), EPSRC-HaCIRIC grant, 2011-2013, £350k [part of EPSRC Grant EP/I029788/1: *Health and Care Infrastructure Research and Innovation Centre (HACIRIC) Extension* (2011–13) £3,876,562.]

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

The Universal NHS PAM is a software-based multi-criteria asset management tool that provides a nationally consistent approach to examining estates' condition, performance and efficiency; and providing board-level quality assurance of healthcare premises. The Universal NHS PAM comprises five domains of national indicators: Finance and Value for Money; Safety; Effectiveness; Patient Experience; and Board Governance. The impact of LU's research has led to the development of a functionally coherent and responsive Universal NHS PAM. Specifically, the SAM framework informed the functional suitability of the layout in the Universal NHS PAM. Using the SAM framework as a theoretical lens: a comprehensive review, evaluation and mapping of relevant standards, guidance and regulations was undertaken and resulted in the development of Compliance Checklists, which are integrated into the five domains of the Universal NHS PAM; a systematic and critical evaluation of current practice within several NHS Trusts was undertaken and resulted in the development of Compliance Evidence for the Universal NHS PAM; a more consistent Maturity Matrix was developed and the Self-Assessment Questionnaire was rationalised to improve functionality within all five Universal NHS PAM domains. **[C1]**

A DH commission (February – May 2013) to develop a methodology for "Reporting Critical Infrastructure Risk and High Risk Backlog" (DH CIR) applied knowledge from the OHIV project to develop a significantly improved World Health Organisation (WHO) Hospital Safety Index (HSI) tool **[C2]** for evaluating the resilience of hospitals to multiple hazards and the likelihood of service continuity during emergencies. The whole-life service, standardised quality assurance assessment, flexibility and adaptability concepts developed within the SAM and VALiD projects were integrated into the "finance and value for money" domain of the Universal NHS PAM. Knowledge developed within the SAM project for a dynamic consultative approach to open scenario planning, accessibility and community engagement has been integrated into the "effectiveness" and, along with tools within the DH CIR commission, "board governance" domains of the Universal NHS PAM. Evidence from research commissioned by the European Investment Bank (EIB) on the relationship between capital investment and health gain contributed significantly to DH input into the 2012 NICE consultations **[C3]**, and is integrated into the "patient experience" domain of the Universal NHS PAM.

LU organised a peer review workshop for DH with IHEEM, at which event a Director, Trustee and Council Member of IHEEM said of the Universal NHS PAM and LU: "Supporting the industry and the patient is critical. The model [Universal NHS PAM] is timely as it minimises risk and adds value to the whole patient journey. [It] is clearly transferable across the health settings. … Loughborough University have done a great job". IHEEM subsequently endorsed the Universal NHS PAM **[C4]**.

The Universal NHS PAM applies to all NHS organisations (Acute, Mental Health and Ambulance Trusts), unlike the previous system which applied only to Acute Trusts. The Universal NHS PAM has been recommended for use by all 413 Community, Mental Health, Acute and Foundation NHS Trusts in England. The adoption rate for the previous system over the period April 2010 to May 2013 was 30%. While usage statistics are not yet available for the Universal NHS PAM, a significantly higher adoption rate can reasonably be expected. NHS Property Services, launched in April 2013 by the DH, has adopted the Universal NHS PAM for the governance and assurance of the more than 3,700 assets in its portfolio, valued at between £4.5bn to £5bn and covering estate,

property and facilities.

The Universal NHS PAM provides the evidence base and a process for effective monitoring and enforcement of compliance with national standards by NICE, CQC and Monitor who currently just use data from PAM, but over time will make full use of – and potentially take responsibility for – PAM. The Universal NHS PAM also provides access to data for systematically benchmarking and improving the management and allocation of resources. HefmA has also endorsed the Universal NHS PAM and is developing a benchmarking tool that will draw data directly from it **[C5]**.

The impact of LU's research on the development of the Universal NHS PAM has led to the appointment of Prof Price to the DH EFD Advisory Group **[C6]** and the DH Dementia Friendly Environment Working Group **[C7]**, where he advises on the: use of research to support the development of policy, standards and guidance; and allocation and monitoring of circa £50M DH Capital Funds for 106 Dementia pilot projects aimed at developing evidence to support DH Standards and Guidance.

The impact of LU's research on the development of the Universal NHS PAM is impacting directly on the way the NHS approaches policy development. It has led to the continuing collaboration between LU and DH EFD on a programme of on-going research and development to extend the functionally of the Universal NHS PAM (e.g. development of a web-based version), with annual upgrades planned to address emerging issues, update new regulations and increase the evidence base (e.g. evidence captured from National Pilots for Dementia will feed through into the Universal NHS PAM) **[C7]**.

[Text removed for publication]

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

The following sources of corroboration can be made available at request.

C1 Confidential Letter: [Text removed for publication]

C2 Letter and Email Correspondence: The World Health Organisation (WHO) demonstrating continuing collaboration after successful contribution to the revision and development of the WHO Hospital Safety Index (HSI). Coordinator of the Risk Reduction and Emergency Preparedness in Health Action in Crises.

C3 Letter from: DH regarding the input to 2012 NICE consultation.

C4 Letter from IHEEM (confirming IHEEM endorsement) and **Trade Journal Article:** Baillie J. (2013) **"**IHEEM endorses revised NHS PAM", *Health Estate Journal*, 67(3), 24-30. PMID: 23573683 (Demonstrates IHEEM support for the new version of PAM).

C5 Email from: HefmA who has endorsed the Universal NHS PAM and are developing a benchmarking tool, which will draw data directly from it.

C6 Meeting Minutes: *DH Estates and Facilities Division Advisory Group* (Demonstrates impact of research on policy development and implementation).

C7 Letter and Meeting Minutes: *DH Dementia Friendly Environment Working Group* (Demonstrates impact of research on policy development and implementation).