Institution: University of Greenwich

Unit of Assessment: (16) Architecture, Built Environment and Planning

Title of case study: Adapting buildings to climate change

1. Summary of the impact

Climate change will have a profound impact on built environment performance over the next 50 years. More severe flooding and overheating will lead to more obsolete buildings and premature mortality across the UK and Europe. The research team explored the issues surrounding adaptation of the built environment to climate change, and developed a new model of built asset management that integrates adaptation decision making into the building life cycle. The model is being used by facilities managers and surveyors to produce long term asset management plans, and by central and local government policy makers to inform and develop adaptation strategies.

2. Underpinning research

The research is drawn from two EPSRC (IDCOP - Innovation in the Design, Construction and Operation of Buildings for People, ref GR/T04878/01, value £1,773,507; and the CREW - Community Resilience to Extreme Weather, ref EP/F035861/1, value £551,593) and two industry (RBS - Royal Bank of Scotland, value £195,000) projects undertaken by the Sustainable Built Environment Research Group (SBERG), University of Greenwich.

Professor Keith Jones was co-investigator on the EPSRC IDCOP project (2004-2009), involving three UK universities and 16 industrial partners. It aimed to identify the innovation required to ensure that buildings continued to support the needs of businesses and citizens over the next 50 years. Professor Jones identified the existing built asset management model's inability to objectively integrate economic, environmental and social performance into the maintenance and refurbishment decision-making process and reconcile short-term adaptation plans with long-term drivers for change (e.g. corporate social responsibility, climate change etc.). The project's key research outputs were:

- a new theoretical built asset management model that linked maintenance and refurbishment actions to the performance of buildings-in-use;
- identification of the barriers to implementing adaptation solutions in the built asset management process.

The new management model was tested in a parallel RBS-funded research project which developed practical toolkits to assess building performance in use [3.6]. The barriers associated with implementing adaptation solutions were examined through an RBS-funded International PhD Scholarship, won by Jones. This project identified the adaptation decision-making process from a business perspective [3.5]. Both the performance-based management model and business decision model formed the theoretical basis of a subsequent EPSRC project (Jones was the PI) investigating Community Resilience to Extreme Weather Events (CREW).

The multi-disciplinary CREW consortium project (2008-2011), involving 14 UK universities, examined how existing communities could better prepare for and recover from future extreme weather events. Jones and Dr Ali (full-time member of SBERG since 2009) were responsible for developing an adaptation framework that could be integrated into the built asset management process [3.4]. The framework involved translating vulnerability, resilience and adaptive capacity of buildings and communities (Ali and Jones, 2013) to extreme weather events into a series of performance metrics. The metrics were tested through a field study of social housing [3.3] whilst

the wider policy implications were explored through joint workshops with Greater London Authority, Confederation of Small Businesses, local Councils, local community groups and insurance industry representatives. Public and private sector facilities managers explored the business drivers. SBERG's outputs from the CREW project included: six international conference papers; three international refereed journal papers; one book chapter; six business dissemination workshops; a risk assessment framework, and a policy drivers framework. The CREW project's combined outputs are summarised in the CREW Final Report [3.1], published by EPSRC through the Adaptation and Resilience to Climate Change Coordination Network (ARCC).

The research identified clear weaknesses in existing built asset management theory, and identified the business challenges to be addressed if adaptation was to be integrated into maintenance and refurbishment planning. It provided solutions since used by policy makers and professionals to improve the resilience of buildings, their surroundings and communities, to current and future climate change.

3. References to the research (REF1 submitted staff in **bold**, **REF2 Output)

3.1 **Jones, K.** & Ali, F. (2013). Community Resilience to Extreme Weather Events through Improved Local Decision Making. In Hallet, S. (Ed.). *Community Resilience to Extreme Weather the CREW project Final Report* (Chapter 3). Available online at http://www.arcc-cn.org.uk/wp-content/pdfs/CREW_Final_Report.pdf. Accessed on 11 November 2013.

3.2 Ali, F. M. M., & **Jones, K**. (2013). Negotiating community resilience in the city in a time of political change and deficit reduction. *International Journal of Disaster Resilience in the Built Environment*, *4*(1), 9–22. http://dx.doi.org/10.1108/17595901311298973

3.3 **Jones, K.**, Brydson, H., Ali, F., & Cooper, J. (2013). Assessing vulnerability, resilience and adaptive capacity of a UK Social Landlord. *International Journal of Disaster Resilience in the Built Environment*, *4*(3), 287–296. http://dx.doi.org/10.1108/IJDRBE-03-2013-0004

3.4 **Jones, K. (2012). Preparing for Extreme Weather Events: A Risk Assessment Approach. In C. Booth, F. N. Hammond, J. Lamond, & D. G. Proverbs (Eds.), *Solutions for Climate Change Challenges in the Built Environment* (pp. 269–282). Chicester: Wiley-Blackwell. ISBN 9 781405 195072.

3.5 Desai, A., & **Jones, K.** (2010). Examination of existing facilities management approaches to climate change and future directions. In M. E. A. da Graca (Ed.), (pp. 585–596). Presented at the Proceedings of the CIB W International Conference in Facilities CIB W070 International Conference Facilities Management: FM in the Experience Economy, Sao Paulo, University of Sao Paulo, 13-15 September 2010. Available at: http://www.irbnet.de/daten/iconda/CIB21402.pdf .

3.6 **Jones, K.**, & Sharp, M. (2007). A new performance-based process model for built asset maintenance. *Facilities*, *25*(13/14), 525–535. http://dx.doi.org/10.1108/02632770710822616

4. Details of the impact

Impact on Policy Makers

The business decision-making model developed from the IDCOP and CREW projects has directly informed local and national government policy frameworks.

Locally, members of SBERG worked closely with Croydon Council's Sustainability Team and Lewisham Council's Emergency Planning Team to help them develop their community resilience plans. The team briefed council officials and organised scenario-based cross-departmental

workshops with their adaptation-relevant teams on 15/7/10 (Lewisham) and 08/12/10 (Croydon). These centred on the impacts of climate change on extreme weather events that might affect their communities, and provided technical input into development of their flood risk and overheating adaptation plans. Local, regional and national policy makers were also involved [5.1—5.3].

Regionally, SBERG worked with the Greater London Authority (GLA) to understand the adaptation challenges London faces. The community resilience factors identified by the CREW project helped inform the Mayor's Climate Change Adaptation Strategy through a series of meetings with the Mayor's Strategy Manager for Climate Change Adaptation and his direct involvement with the CREW project. As part of this process, Professor Jones was invited to be a member of the GLA team which presented the lessons learnt from developing the Mayor's Strategy to an international policy-making forum at the 2011 Resilient Cities Conference, Bonn. Approximately 80 people, representing cities from around the world, attended a workshop where London's approach to adaptation planning was held as exemplary [5.4-5.6].

At the national level, Jones briefed the Cabinet Office (29/10/2011) and DEFRA/EA/DCLG (26/05/2010) civil servants on the CREW project findings as they affect policy thinking [5.7].

Impact on the built environment industry and its clients

The performance-based approach to built asset management and the adaptation framework developed through the IDCOP, CREW and RBS projects formed the basis of two TSB *Design for Future Climate Change* projects and seven training/awareness-raising workshops/assemblies for industry.

In TSB project 'PN 400258' (2011-2013), SBERG worked with Octavia Housing (a Registered Social Landlord) and Pellings (a Chartered Surveying Practice) to apply the adaptation framework to assessing the resilience of 3,989 homes, located in London, to extreme weather events. The project used the framework to evaluate the vulnerability, resilience and adaptive capacity of Octavia's housing stock and identified pluvial flooding (25.6% of Octavia's stock is at potential risk from flooding) and overheating (55.7% of Octavia's stock is at potential risk from overheating) as the highest risk categories, both today and into the future. This was at odds with Octavia's expectations and contingency planning which was primarily designed around recovering from fluvial flooding. The adaptation framework was also used to identify and evaluate 29 adaptation solutions, of which eight (ranging from technical interventions to working with tenants to raise awareness and prepare personal flood protection plans) have been adopted. Octavia have also reviewed their contingency plans and developed a built asset management strategy that integrates adaptation of their existing stock to future climate change. This represents a fundamental change in approach to adaptation which is normally reactive rather than pro-active. SBERGs involvement with Octavia is on-going [5.8].

In TSB project 'EM/1520160' (2011-2012), members of SBERG joined the client's team (the University of Greenwich) to examine the adaptation needs to climate change of a new 15,267m^2 educational building. SBERG helped develop a range of future performance scenarios against which adaptation solutions were assessed. Twenty five adaptation solutions were developed by the building's design team (Heneghan Peng, Hoare Lea, Fanshawe and Alan Baxter Associates) of which seven (ranging from technical changes to the original design, to future changes in service equipment) were adopted by the client and included in a future refurbishment strategy. This again represents a fundamental change in approach to climate change adaptation where the future performance of the building is proactively considered at the design stage and future solutions integrated into long-term built asset management strategies. The integration of climate change adaptation into the initial design stage of a building was presented to an international audience of

Facilities Managers and Built Environment Professionals at the EFMC2013 Conference in Prague [5.9].

Finally, the SBERG team worked closely with the London Climate Change Partnership, Climate South East, London Confederation of Small Businesses and the London Knowledge Transfer Network to ensure that the CREW project's outputs raised awareness/understanding and stimulated debate of climate change resilience and adaptation amongst London businesses. Five industry-focused workshops (28/09/10 – LTN/Willis RE; 08/03/2011 & 10/11/11 LCCP/Climate SE; 05/04/2011 & 13/07/10 – FLASH) attracting over 250 delegates, and three Assemblies (03/04/2009, 02/07/10 & 25/11/11) attracting over 280 delegates, ensured that the adaptation framework reached a wide, non-academic audience [5.5, 5.6]. The framework is also the subject of a book chapter aimed at industry [5.10].

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

5.1 Travel & Transport Planning Officer, Croydon Council

5.2 Email from the Chair of the Emergency Planning Society & Emergency Planning Officer, Lewisham Council.

5.3 Croydon Climate Change Adaptation Action Plan

(http://www.croydon.gov.uk/contents/departments/environment/pdf/ccaaplan.pdf)

5.4 Mayor's Climate Change Adaptation Plan

(http://www.london.gov.uk/sites/default/files/Adaptation-oct11.pdf)

5.5 Partnership Manager, London Climate Change Partnership

5.6 Technical Director UKCIP

5.7 Email from the Department of Communities and Local Government.

5.8 Asset Management Director, Octavia Housing

5.9 TSB Design for Future Climate Final Report - University of Greenwich Stockwell Street. - Available on request.

5.10 Jones, K. G. (2011) 'Preparing for Extreme Weather Events: A Risk Assessment Approach' in Booth, C., Hammond, F., Lamond, J., & Proverbs, D. (eds.) *Solutions to Climate Change Challenges in the Built Environment*. Wiley-Blackwell. ISBN 9 781405 195072.