

## **THE BUILDING USE STUDIES (BUS) OCCUPANT SURVEY: ORIGINS AND APPROACH Q&A**

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## 1 INTRODUCTION

As the use of the BUS occupant survey increases, we have had a growing number of requests for more details about the survey's origins, the approach and the technical details underpinning it. This answers some of those questions. It is aimed mainly at researchers, especially PhD students who may need to support their work with further referencing.

## 2 WHAT IS IT FOR?

Getting feedback from building users on a case-by-case basis, where a single building is a case study.

## 3 HOW DID IT START?

In 1985, as part of the groundbreaking *Office Environment Survey*<sup>1</sup>. The original questionnaire was created by a working group which included the primary authors Sheena Wilson and Alan Hedge, with Sherwood Burge, Jon Harris-Bass and Alastair Robertson<sup>2</sup>. Although effective in establishing the first dataset, which covered 4,300 office workers in 50 UK buildings, and pump-priming international interest in 'sick'<sup>3</sup> buildings, the 16-page questionnaire was unwieldy, impractical to administer and hard to analyse.

## 4 CONSOLIDATION

After the original large-sample study in 1985-87 the original questionnaire continued to be used for individual building studies and investigations.

In the period from 1987-1995:

- The BUS questionnaire was shortened from the original 16-pages, mainly by removing all but one of the questions on *Health* and cutting out questions considered to be redundant.

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<sup>1</sup> Principal references in the early stages are:

Wilson S. and Hedge A., *The Office Environment Survey*, Building Use Studies, London, 1987, ISBN 187009901X

Burge S., Hedge A., Wilson S, Harris Bass, J and Robertson, A, Sick Building Syndrome: A Study Of 4373 Office Workers  
*The Annals of Occupational Hygiene* Volume 31, Issue 4, p. 493-504.

Burge PS, Robertson AS, Hedge A , The development of a questionnaire suitable for the surveillance of office buildings to assess the building symptom index, a measure of the sick building syndrome , - , 1993 ; 1 : 731-736

Hedge, A., Burge, P.S., Wilson, A.S. and J. Harris-Bass (1989) Work-related illness in office workers: a proposed model of the sick building syndrome. *Environment International*, 15, 143-158.

Leinster P, Raw GJ, Thomson N, Leaman A, Whitehead C, Pickering CAC, Burge PS , A modular longitudinal approach to the investigation of sick building syndrome , *Indoor air* 90 , 1990 ; 1 : 287-292

Raw GJ, Whitehead C, Robertson AS, Burge PS, Kelly CA, Leinster P , A Questionnaire for studies of Sick Building Syndrome , - , 1995 ; :

Raw G J, Roys M S, Leaman A., Further findings from the Office Environment Survey: Productivity, *Proceedings of Indoor Air '90*, Toronto, v.1, p231-236

<sup>2</sup> Sherwood Burge and Alastair Robertson: Occupational Lung Disease Unit, East Birmingham Hospital; Alan Hedge: Applied Psychology Group, Aston University Birmingham; Sheena Wilson: Building Use Studies Limited London.; Jon Harris Bass: RMJM Limited, Architects and Engineers London.

<sup>3</sup> 'Sick' buildings was not the right choice of term. 'Building-related health' is better.

- In 1995 BUS was asked to create a more simplified version which could be used as one of the analysis tools in the Probe <sup>4</sup> series of post-occupancy studies. A two-page A4-size standard questionnaire was created. The Probe study went on to publish twenty building performance evaluation studies, plus further analysis on the implications. <sup>5</sup>
- In 1990 the *Health* section, cut out of the longer original BUS questionnaire, became the basis of the BRE's Healthy Buildings questionnaire and is maintained separately.
- The original large-sample study was carried out using *Statistical Package for the Social Sciences (SPSS)* as the analysis software, running on a mainframe. This was dropped in favour of migrating the system to microcomputers.
- Separate *Filemaker Pro* databases for each building study were created, each feeding into a database metafile.
- The layout environment of *Filemaker Pro* was originally used for creating report data Appendices which included some graphics like histograms. This was replaced in 1998 by custom-made workflow software.
- Fuller graphics requiring better resolution, e.g. scatterplots for publications, were produced separately using a succession of statistical graphics programs, including *Systat*, currently *Abel* <sup>6</sup>.

## 5 THE APPROACH

- Questions were modularised into sections, which could be easily inserted or removed.
- Only essential questions were included. Our motto was: "*Need to know, not nice to have.*"
- Respondents would only be asked about things to which they actually knew the answers. There would be no speculative questions, especially asking about things people may like to have.
- Everything would be in plain English.
- Rating scales would be balanced with comments boxes so that there was equal weight given to quantitative and qualitative responses.
- The primary function of the questionnaire was to elicit factual responses in as short a time as possible and with minimal disruption to the respondents. In practice, this meant 5 to 15 minutes to fill in.
- The questionnaire should be easy to translate. There are 17 language versions.
- Data curation and analysis should be considerably speeded and simplified, thereby making it an affordable service to others.
- A 'double-entry' approach to coding was introduced so that software, input errors or output errors could be more easily trapped.

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<sup>4</sup> Probe is short for Post-Occupancy Studies of Buildings and their Engineering (later changed to Environment). The Probe project, which started in 1995, was a joint venture between the UK government (Department of Environment, Transport and the Regions), a publisher and a research team. It undertook post-occupancy surveys of well-regarded new commercial and public buildings, typically 2–3 years after completion.

<sup>5</sup> A full reference list with downloads for Probe is at [www.usablebuildings.co.uk](http://www.usablebuildings.co.uk) (follow the Probe menu item).

Further details of the BUS method may be found in, for example:

Leaman A., Bordass W., Cohen R., Standeven M., Probe Strategic Review Report 3: Occupant Surveys, Building Use Studies, William Bordass Associates, ESD, August 1999

Leaman A., Probe 10: Occupancy Survey Analysis, Building Services, The CIBSE Journal, 1997, May, pps. 21-25

<sup>6</sup> [www.gigawiz.com](http://www.gigawiz.com)

This approach is the basis of the survey today. Its essence is real-world research <sup>7</sup>:

- solving problems not just gaining knowledge,
- field- not laboratory-based,
- predicting effects and outcomes not just finding causes.
- Strict time and cost constraints.

The aim is to produce robust<sup>8</sup> results believable to skilled sceptics so that action can be taken where necessary. In other words, it is practical and affordable.

## 6 BENCHMARKING

As the number of buildings studied grew<sup>9</sup>, it became possible to create benchmarks based on national sub-samples. The first of these was for the UK, followed by Australia and New Zealand and subsequently others. It is normal practice for the *most recent 50 qualifying buildings* to be used for the benchmarking. Further details may be found in *The BUS Methodology Guide for Licensees*.

## 7 LICENSING

Licensing was introduced in 1998. It was a response to:

- Researchers using the questionnaire, but not the analysis system, so their results were not being fed back into the benchmark database.
- This also meant that these studies were not benefitting from benchmarking and curation by BUS, and the questionnaire they used may not have been up-to-date.
- In a more extreme case, both the questionnaire and the proprietorial names (in fact both the *BUS* and *Probe* names) were being used commercially without permission.

Licensing helped overcome these problems. It also helped establish enduring relationships with licensees.

## 8 PUBLICATIONS BASED ON BUS DATA

There have been many such, an estimated minimum of 300. They include:

- Most of the publications by Adrian Leaman, and many of those co-authored by Adrian Leaman and Bill Bordass. For an up-to-date list of citations please refer to Google Scholar. <sup>10</sup>
- Two books by George Baird. <sup>11</sup>
- Articles and reports on building performance by Roderic Bunn.

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<sup>7</sup> A term coined by Colin Robson, *Real-World Research*, Oxford: Blackwell, 1993, Second edition 2002.

<sup>8</sup> Robust is used in the statistical sense, meaning that results are not unduly influenced by extreme cases or 'outliers'.

<sup>9</sup> Studies progressed at the rate of 2 to 3 a month up to 2005. Currently (2011) it is 2 to 3 a week.

<sup>10</sup> [http://scholar.google.co.uk/scholar?q=adrian+leaman&hl=en&btnG=Search&as\\_sdt=1%2C5&as\\_sdt=on](http://scholar.google.co.uk/scholar?q=adrian+leaman&hl=en&btnG=Search&as_sdt=1%2C5&as_sdt=on)

Leaman A., [Productivity in buildings: The "killer" variables](#) Six versions.

Leaman A., and Bordass W., [Assessing building performance in use 4: the Probe occupant surveys and their implications](#), Building Research and Information Volume 29, Number 2, 1 March 2001, pp. 129-143(15)

Cohen R.; Standeven M.; Bordass B.; Leaman A., [Assessing building performance in use 1: the Probe process](#) Building Research and Information, Volume 29, Number 2, 1 March 2001, pp. 85-102(18)

<sup>11</sup> Professor George Baird has written two books with the BUS Method as the primary data collection technique.

*Sustainable Buildings in Practice – What the users think.* (Routledge, Abingdon, 2010)

*The Architectural Expression of Environmental Control Systems* (Spon Press, London, 2001)

- Over 300 postgraduates have licensed the system, so most will have written it up in their theses and dissertations. <sup>12</sup>
- Articles in the professional press by commercial practices including Arup, Buro Happold, Fielden Clegg Bradley, Hoare Lee and more.
- Many references to BUS data may also be found in presentations available in the *Events* section of [www.usablebuildings.co.uk](http://www.usablebuildings.co.uk).

## 9 HAS THE BUS METHOD BEEN VALIDATED STATISTICALLY?

Not in the sense of a controlled experiment which tests whether the same results are obtained in repeated iterations of the method. However, it has been used in so many buildings worldwide (over 1000 by 2018) and subject to much critical scrutiny, that any flaws are bound to have emerged over that period of time. Roderic Bunn's longitudinal studies <sup>13</sup> have confirmed the consistency of buildings' 'fingerprints' over time with different respondents showing consistent results.

In general we think:

- The results seem unbiased when response rates of over 70% are obtained.
- Recall of summer and winter comfort conditions seems to work well (but not if more seasons are added because people find it harder to distinguish).
- The *perceived productivity* question is often regarded as dubious because it is a 'subjective' estimate. We acknowledge this, but no-one has yet come up with a better method.

BRE and BUS staff examined health questionnaires in a wider context <sup>14</sup>.

## 10 IS THE QUESTIONNAIRE UPDATED?

We try to stick to the standard questionnaire sets for backwards compatibility reasons. For example, a building surveyed in 1997, revisited in 2007, would need to use the same questions to get full compatibility between surveys. We also allow researchers to add their own questions (within reason, using BUS protocols) but these are not included in the benchmarking.

Since the 1995 update these changes have been made:

- A new question in the *Noise* section on *Unwanted Interruptions*.
- A new question on personal *Safety* in and around the building.
- A new section on *Journey to Work*.
- Translations are added on demand.

## 11 IS THERE AN INTERNET VERSION?

Yes, but we are not keen on this method as response rates are much lower (30% and below as opposed to 70% and higher), which introduces the likelihood of bias. It is also much better if the researcher is actually present in the study building, so that they can see things for themselves. There is more about this in *The BUS Methodology Guide for Licensees*.

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<sup>12</sup> Two examples are Zack Gill (University of Bristol) and Kate Fewson (CAT/UCL).

Gill ZM., Tierney MJ., Pegg IM., and Allan, N. (2010). Low-energy dwellings: the contribution of behaviours to actual performance. *Building Research and Information* 38(5), 1-18., p.491-508

<http://www.bsria.co.uk/news/journeys-to-work>

<sup>13</sup> Bunn R., EngD thesis, UCL, 2018.

<sup>14</sup> Raw GJ., Roys MS., Whitehead C., Tong D., Questionnaire design for sick building syndrome: An empirical comparison of options, *Environment International* Volume 22, Issue 1, 1996, Pages 61-72

**12 IS THERE A DOMESTIC VERSION?**

Yes, introduced in 2010 after five years of development work <sup>15</sup>. This has modules in common with the non-domestic version. At the time of writing (2011) the benchmarking is still rudimentary and for the UK only. This is because it takes 3-5 years to accumulate enough studies to populate the benchmarks database properly.

**13 NEXT STEPS**

In 2008 the intellectual property of the BUS Method was transferred to Arup who will take forward the development of the method and its commercial arm, especially into larger, global markets ([busmethodology.org.uk](http://busmethodology.org.uk)). Usable Buildings will continue servicing academic projects along former lines. This arrangement balances commercial and public interest uses of the method, within the broader context of the *New Professionalism* and *Soft Landings*.

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<sup>15</sup> Undertaken by Fionn Stevenson, David Hendrickson and Zack Gill.