

Post Occupancy Evaluation and
Building Performance Evaluation
Primer

Introduction to POE/BPE

Helping clients' get the best out of their projects is the main reason for evaluating a building. Beginning by looking at a client's motives for embarking on a project – their desired Project Outcomes – evaluations can get to the core of the client's and occupants' needs and fine tune the way the building delivers these.

Evaluations also help designers to close the performance gap, that of designed energy and organisational performance and the actual measured performance of these areas. The more designers, clients and other members of project teams learn about how their buildings perform in use, the better their next buildings are likely to meet the complex needs of the clients and occupants – completing a virtuous circle of learning.

The definitions of Post Occupancy Evaluation (POE) and Building Performance Evaluation (BPE) vary slightly across the construction industry and the RIBA does not intend to add to this confusion by making its own definitions but to rather provide guidance on POE/BPE activities as a whole.

POE/BPE services will ideally be agreed as part of the project team's appointment during Stage 1. In some instances an independent POE/BPE will be more appropriate, and while this may be commissioned at any point it should ideally take place at least 1 year after Handover, as should POE/BPE that is commissioned as part of the project team appointment.

Based on feedback from clients and contractors (RIBA Client Roundtable discussions, 2015) there is an expectation that evaluation information will be shared – at least with the client of the next project – and ideally made public so the rest of the industry can learn from these experiences.

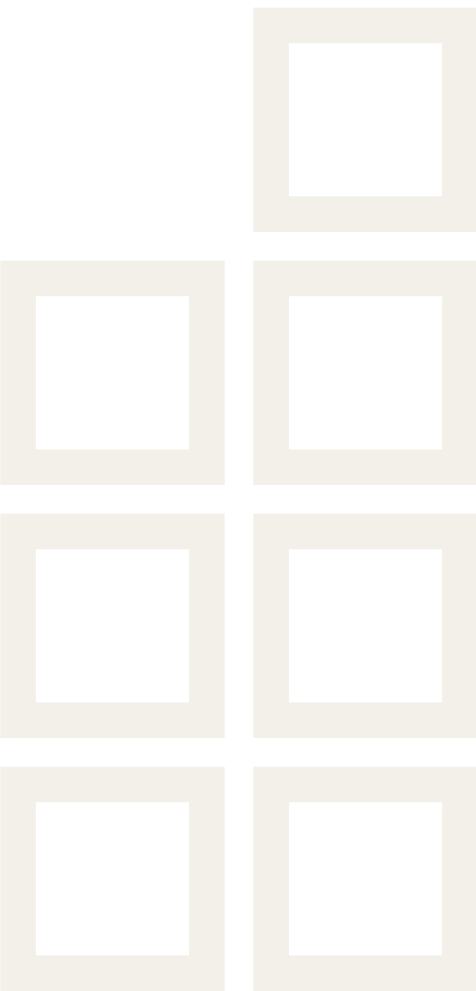
The RIBA will soon publish a more interactive toolkit to briefing and evaluation of projects that will be compatible with this guidance. It will focus on clients desired personal/organisational performance outcomes and how architects can better embed these into the briefing, design and handover processes.

Professional indemnity insurance

The RIBA Insurance Agency has confirmed that architects with an RIBA Insurance Agency professional indemnity insurance policy are covered to undertake Post Occupancy Evaluation/Building Performance Evaluation services, but recommend that practices that are going to offer these services inform the RIBA Insurance Agency of their intention to do so.

It should be noted that some contracts may require insurance to be maintained for 6 or 12 years (10 in Scotland) from the date of completion of services rather than practical completion.

RIBA Insurance Agency is a joint venture between the RIBA and Arthur J. Gallagher (UK) Limited: www.architectspi.com



List of thematic areas and activities for POE/BPE

1 Project Delivery

- 1.1 Discuss Clients Experience
- 1.2 Discuss Project Team Experience

2 Project Outcomes

- 2.1 Review Strategic Brief
- 2.2 Review Business Case
- 2.3 Review Sustainability Aspirations

3 Building Use/Occupant Behaviour

- 3.1 Analyse Building Layout
- 3.2 Examine Building Fabric And Detailing
- 3.3 Analyse Occupants Use of Building And Systems
- 3.4 Analyse Occupation Patterns

4 Occupant Feedback

- 4.1 Conduct Questionnaires/Surveys
- 4.2 Conduct Semi Structured Interviews

5 Energy Use

- 5.1 Analyse Utility Invoices And Meter Readings
- 5.2 Analyse Metering Strategy
- 5.3 Conduct Equipment Survey
- 5.4 Analyse Embodied Carbon
- 5.5 Analyse Measurement And Verification Strategy

6 System Behaviour (FM's Experiences)

- 6.1 Analyse Health And Safety Strategy
- 6.2 Analyse Ventilation Strategy
- 6.3 Analyse Heating And Cooling Strategy
- 6.4 Analyse Lighting Strategy
- 6.5 Analyse Control Strategy
- 6.6 Analyse Maintenance Strategy

7 Environmental Performance

- 7.1 Measure Light Levels
- 7.2 Measure Thermal Comfort
- 7.3 Measure Indoor Air Quality
- 7.4 Measure Acoustics
- 7.5 Measure Air Tightness
- 7.6 Measure Heat Loss (Thermal Imaging)

8 Comparisons

- 8.1 Intended Building Use Against Actual
- 8.2 Design Performance Predictions Against Actual
- 8.3 Benchmark Against Published Datasets

9 Report

- 9.1 Client, FMs, Users
- 9.2 Project Team
- 9.3 Open Dissemination to Industry

Activity guidance

The schedule of activities is not an exhaustive list and some activities may overlap and some can be undertaken at the same time.

The process of creating spaces to meet specific needs necessitates the use of building services systems. Understanding the performance of these systems can directly impact the design of buildings. Many of the activities listed in the schedule will require specialist knowledge of Building Services or Mechanical and Electrical Engineering particularly System Behaviour, Energy Use and Environmental Performance.

There is a complex relationship of causality between the different thematic areas and the results of each area can be affected by those of at least one other. The results of early parts of the POE/BPE may indicate underlying issues that can be further investigated and resolved. The following diagram shows the lines of causality for each thematic area:

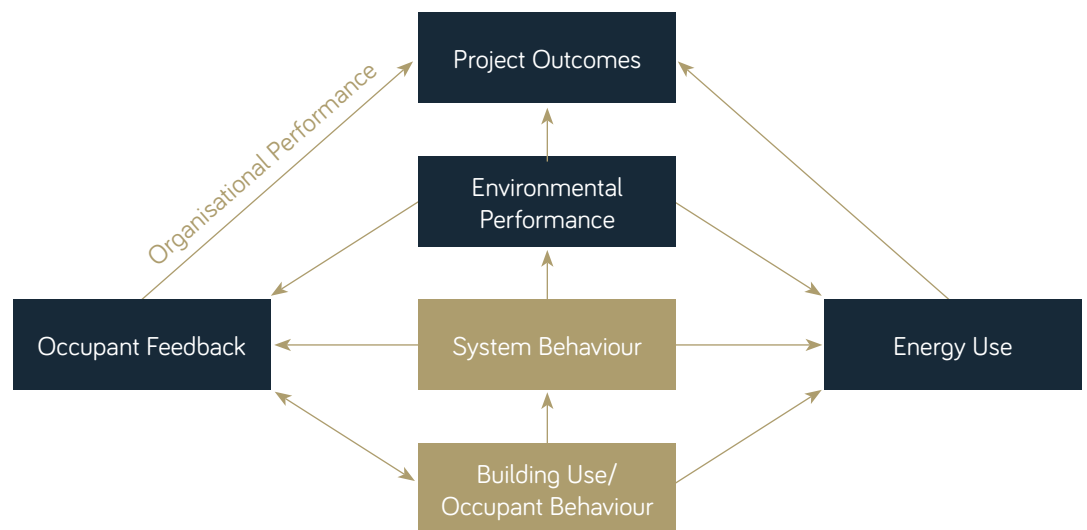


Diagram of causality showing Essential POE/BPE thematic areas (navy boxes) and Deep POE/BPE thematic areas (gold boxes). Some specific activities which come under Deep POE/BPE may be essential to a POE/BPE study to test the resolution of a specific Project Outcome. (Source: adapted from Feilden Clegg Bradley Studios)

Further guidance on the activities that sit within the thematic areas is set out in the attached schedule. It explains the causality of thematic areas in more detail and point out which to find relevant regulations, standards and guides that more thoroughly explain how to undertake the various activities.

Bibliography

Arup *BUS methodology* www.busmethodology.org [accessed 03.08.15]

ASHRAE *Standards 62.1 & 62.2 The Standards For Ventilation And Indoor Air Quality* (2013)

ASHRAE *Standard 55-2013: Thermal Environmental Conditions for Human Occupancy* (2013)

ATTMA *Technical Standards Measuring Air Permeability of Building Envelopes TSL1 (Dwellings) & TSL2 (Non-dwellings)* (2010)

Ostime N. *RIBA Job Book – ninth edition* RIBA Publishing (2013)

Bordass W., Leaman A., Eley J. *A Guide to Feedback and Post-occupancy Evaluation Usable Buildings Trust* (2006)

BSI *BS 8206-2:2008 Lighting for buildings. Code of practice for daylighting* (2008)

BSI *BS ISO 50015:2014 Energy management systems. Measurement and verification of energy performance of organizations. General principles and guidance* (2014)

BSI *BS ISO 55000:2014 Asset Management: Overview, Principles and Terminology* (2014)

BSI *BS EN 50491-11:2015 General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS). Smart Metering. Application Specifications. Simple External Consumer Display* (June 2015)

BSI *PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services* (2011)

BSI *BS 8206-2:2008 Lighting for buildings. Code of practice for daylighting* (2008)

BSI *BS EN 12464-1:2011 Light and lighting. Lighting of work places. Indoor work places* (2011)

BSI *BS EN 15193:2007 Energy performance of buildings. Energy requirements for lighting* (2007)

BSI *BS EN ISO 16000-1:2006 Indoor air. General aspects of sampling strategy* (2005)

BSI *BS EN 15251:2007 Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics* (2008)

BSI *BS EN ISO 16283-1:2014 Acoustics. Field measurement of sound insulation in buildings and of building elements. Airborne sound insulation* (2014)

BSI *BS EN 13829:2001 Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method* (2001)

BSI *BS EN 13187:1999 Thermal performance of buildings. Qualitative detection of thermal irregularities in building envelopes. Infrared method* (1999)

BSI *BS EN ISO 6781-3 Performance of buildings. Detection of heat, air and moisture irregularities in buildings by infrared methods. Part 3. Qualifications of Equipment Operators, Data Analysts and Report Writers (in development)*

BSRIA *Soft Landings: www.bsria.co.uk/services/design/soft-landings* [accessed 03.08.15]

BSRIA *BG 3/2008: Maintenance for Building Services* (2008)

BSRIA *BG1/2007 Handover, O&M Manuals, and Project Feedback. A toolkit for designers and contractors* (2007)

BSRIA *BG10/2011 Embodied Carbon: the inventory of carbon and energy – ICE* (2011)

BRE *IP1/15 Bridging the performance gap: Understanding predicted and actual energy use of buildings* (2015)

BRE *BREEAM In-Use* (2015)

Cabinet Office *Government Soft Landings www.bimtaskgroup.org/gsl* [accessed 03.08.15]

Caplehorn P. *Health and Safety: RIBA Plan of Work 2013 Guide* RIBA Publishing (2016)

CIBSE *Guide B: Heating, Ventilating, Air Conditioning and Refrigeration* (2001 collated 2004)

CIBSE *TM26 Hygienic Maintenance of Office Ventilation Ductwork* (2000 reprint 2011)

- CIBSE *Commissioning Code A: Air Distribution Systems* (1996 confirmed 2006)
- CIBSE Society of Light and Lighting *SLL Lighting Guides*
- CIBSE *Commissioning Code L: Lighting* (2003)
- CIBSE *Guide H: Building control systems* (2009)
- CIBSE *KS04 Understanding Controls* (2005)
- CIBSE *Commissioning Code C: Automatic Controls* (2001)
- CIBSE *TM39 Building Energy Metering* (2009)
- CIBSE *TM31 Building Log Book Toolkit* (2006)
- CIBSE *Guide M: Maintenance Engineering and Management* (2014)
- CIBSE *KS02: Managing Your Building Services* (2005)
- CIBSE *TM22 Energy Assessment and Reporting Methodology – 2nd edition* (2006)
- CIBSE *Guide A: Environmental Design* (2015)
- CIBSE *TM52 The Limits of Thermal Comfort: Avoiding Overheating in European Buildings* (2013)
- CIBSE *KS17 Indoor Air Quality and Ventilation* (2011)
- CIBSE *TM23 Testing Buildings for Air Leakage* (2000)
- CIBSE RIBA *Carbonbuzz* www.carbonbuzz.org [accessed 06.08.15]
- Department for Communities and Local Government *Energy Performance Certificates guidance* (2013)
- Education Funding Agency *BB101: Ventilation of School Buildings* (2014)
- International Organization for Standardization *ISO 16000 indoor air – series*
- HSE *Construction Design and Management (CDM) Regulations 2015* (2015)
- Institute for Sustainability *Guide to Building Performance Evaluation*: <http://bpeguide.instituteforsustainability.org.uk> [accessed 03.08.15]
- ISO *14001:2015 Environmental Management Systems* (2015)
- Jones C., Hammond G. *ICE Inventory of Carbon & Energy database* Circular Ecology Circular Ecology and University of Bath
- Lewis, A., Torrington, J., Barnes, S., Darton, R., Holder, J., McKee, K., Netten, A., Orrell, A. *EVOLVE Tool – Evaluation of Older People’s Living Environments* (2010)
- Mallory-Hill S., Preiser W., Watson C. *Enhancing Building Performance* John Wiley & Sons (2011)
- NHBC *NF 35: How occupants behave and interact with their homes – The impact on energy use, comfort, control and satisfaction* (2011)
- Satchwell H., Fletcher P. *Briefing: A practical guide to the RIBA Plan of Work 2013* RIBA Publishing (2015)
- Willars N. *RIBA Plan of Work Guide: Project Leadership* RIBA Publishing (2015)
- Innovate UK (formerly TSB) Tools and Methods for BPE: <https://connect.innovateuk.org/web/building-performance-evaluation/tools-and-methods>

The RIBA does not assume responsibility for the content in the publications listed in this bibliography.

RIBA schedule of activities for POE/BPE

No.	Evaluation activities	Essential activities	Comments	Standards and guides
1	Review Of Project Delivery		Usually a Stage 6 activity but useful if not already undertaken.	
1.1	Discuss Clients Experience		Conduct interviews and/or focus groups. Check if the client is managing knowledge gained for future use.	RIBA Job Book Ninth Edition (2013)
1.2	Discuss Project Team Experience		Conduct in house appraisals and/or focus groups. Ensure project knowledge is managed for future use. Gather information and support from the Project Team.	RIBA Job Book
2	Project Outcomes	✓	The overall outcomes a client wishes to achieve, as defined by the client in a Strategic Brief in RIBA Plan of Work Stage 0: Strategic Definition.	
2.1	Review Strategic Brief	✓	The Strategic Brief will encompass the client's vision and primary aims of the project that support delivery of the Project Outcomes. Issues of comfort and productivity can be tested under Occupant Feedback and issues of use can be tested under Building Use/Occupant Behaviour.	Briefing: A practical guide to the RIBA Plan of Work 2013 (2015), RIBA Plan of Work Guide: Project Leadership (2015)
2.2	Review Business Case	✓	Discuss with the client how the project meets the business needs, risks and opportunities, and social, environmental and economic benefits as defined in the Business Case.	Briefing, Project Leadership
2.3	Review Sustainability Aspirations	✓	These may be set in Stage 1 of the RIBA Plan of Work and may be tested under Energy Performance and further tested under Environmental Performance, which may need additional expertise.	Briefing, Guide to Using the RIBA Plan of Work 2013 (2013)
3	Building Use/ Occupant Behaviour		Conduct A forensic walkthrough and inspection of the building, reviewing building documentation, aftercare plans and observing how occupants use the building to meet their needs, which can help the building to be run more efficiently.	
3.1	Analyse Building Layout	✓	Note any changes of use, extensions and equipment.	
3.2	Examine Building Fabric and Detailing	✓	Check for any inconsistencies in documentation following walkthrough. The building services may be checked with facility manager during a walkthrough in System Behaviour activities.	

No.	Evaluation activities	Essential activities	Comments	Standards and guides
3.3	Analyse Occupants' Use of Building And Systems	✓	Observe how occupants understand systems and how, why and when they change their environment. Check how spaces are used and if there are improvised alterations.	NHBC NF 35,
3.4	Analyse Occupation Patterns		Observe and conduct surveys of when spaces are used and whether they over or underused.	
4	Occupant Feedback	✓		
4.1	Conduct Questionnaires/ Surveys	✓ dependant on project size	This activity can provide an understanding of user satisfaction. Concerns on comfort from occupants can be tested in Environmental Performance. Difficulties of building use may be tested in System Behaviour.	Such as the BUS methodology, RIBA Plan of Work Guide: Project Leadership (2015)
4.2	Conduct Semi-Structured Interviews and Facilitated Discussions	✓	Interview key occupants, after or during a walkthrough to allow occupant to demonstrate understanding of and concerns with System Behaviour.	e.g. EVOLVE Toolkit (Housing LIN)
5	Energy Use	✓		
5.1	Analyse Utility Invoices And Meter Readings	✓	Check energy use against design prediction. Reconcile energy consumption across building during the buildings daily use.	CIBSE TM22 Energy Analysis tool, DCLG EPC guidance, BRE IP1/15
5.2	Analyse Metering Strategy	✓ dependant on project size	Visual inspection against M&E drawings to identify energy usage by building uses. Check the meters are correctly commissioned. M&E expertise may be required.	CIBSE TM39, BS EN 50491-11:2015
5.3	Conduct Equipment Survey	✓	Check electrical equipment against designs noting any extra load.	
5.4	Analyse Embodied Carbon	✓	A full life cycle analysis of embodied carbon will help to understand the impact of the building, its components and products.	PAS 2050:2011, University of Bath Inventory of Carbon & Energy, BSRIA BG 10/2011
5.5	Analyse Measurement And Verification Strategy		If a continuous M&V strategy is necessary (e.g. for finance or organisational purposes), check this is appropriate.	BS ISO 50015:2014

RIBA schedule of activities for POE/BPE continued

No.	Evaluation activities	Essential activities	Comments	Standards and guides
6	System	✓ measure any areas of concern	Understanding how the building regulates its environment may help to understand the results of Building Use/Occupant Behaviour, Occupant Feedback and Energy Use. Discuss the FM's experiences of the operation of building services and maintenance.	
6.1	Analyse Health And Safety Strategy		Check the client/FM has the Health and Safety file, and that it is appropriate and properly understood.	CDM 2015, Health and Safety: RIBA Plan of Work 2013 Guide (2016)
6.2	Analyse Ventilation Strategy		Identify the ventilation control strategies (openable windows, louvres, types of windows, etc.) and establish the path of the air.	CIBSE Guide B, CIBSE TM26, CIBSE Commissioning Code A
6.3	Analyse Heating And Cooling Strategy		Identify the main heat generators, controls and zones.	CIBSE Guide B
6.4	Analyse Lighting Strategy		Identify lighting systems by space or zone, how they are controlled and determine any effects. Check for any changes from the original installation.	BS 8206-2:2008, CIBSE SLL Lighting Guides, CIBSE Commissioning Code L
6.5	Analyse Control Strategy		Identify how systems are managed to prevent opposing actions, identify where the sensors are and how they fit into the Control Strategy. Occupant Feedback may relate to control issues.	CIBSE Guide H, CIBSE KS04, CIBSE Commissioning Code C
6.6	Analyse Maintenance Strategy		Check that a whole life maintenance plan for systems and products is still appropriate for the current buildings use.	ISO 14001:2015, BS ISO 55000:2014, CIBSE TM31, CIBSE Guide M, CIBSE KS02, BSRIA BG 3/2008, BSRIA BG 1/2007, B&ES SFG 20/2012, CIBSE Commissioning Code M
7	Environmental Performance	✓ measure any areas of concern	Particular concerns of Environmental Performance may be highlighted by Occupant Feedback which may be tested individually. Measuring Environmental Performance over a short amount of time may be useful though a Deep POE/BPE service will cover all seasons. These activities all require significant experience and may require Building Services Engineering expertise or other specialist expertise.	
7.1	Measure Light Levels		Analyse the daylight and artificial lighting levels including glare.	BS 8206-2:2008, BS EN 12464-1:2011, BS EN 15193:2007
7.2	Measure Thermal Comfort		Measure the dry-bulb air temperature. Wet-bulb, radiant temperature, air velocity and humidity can also impact thermal comfort.	CIBSE Guide A, CIBSE TM52, BB101, EN 15251, ASHRAE Standard 55 (2013)

No.	Evaluation activities	Essential activities	Comments	Standards and guides
7.3	Measure Indoor Air Quality		CO2 is a useful indicator of air quality however volatile organic compounds (VOCs), particulates (PM2.5 and PM10), NO2, allergens, and O3 are all potential aspects that impact indoor air quality.	EN ISO 16000-1:2004 and ISO 16000 series, ASHRAE Standard 62 1&2 (2013) CIBSE KS17
7.4	Measure Acoustics		Measure the ambient noise, impact noise, and reverberation.	BS EN ISO 16283-1:2014
7.5	Measure Air Tightness		Establish how the building fabric is assisting, or hindering the building services. ATTMA certified professional required for all new build work.	ATTMA TSL1 & TSL2, BS EN:13829:2001, CIBSE TM 23
7.6	Measure Heat Loss		Undertake co-heating test and/or locate areas of heat loss with a thermal imaging camera - for BREEAM use a UKTA Level 2 Certificate holder.	BS EN 13187:1999, BS EN ISO 6781-3

8	Comparisons	✓	Comparisons can take place throughout the POE/BOE. Any discrepancies will need further investigation by undertaking later parts of the POE/BPE such as System Behaviour and Environmental Performance.	
8.1	Intended Building Use Against Actual	✓	Use change will likely alter designed Environmental Performance, Energy Use and Occupant Feedback.	
8.2	Design Performance Predictions Against Actual	✓	Identify where areas do not perform as designed and how can they might be improved.	BRE IP1/15
8.3	Benchmark Against Published Datasets	✓	Understand relative building performance by checking how well other comparable buildings have performed. As illustrated in the causality diagram there are many areas that can impact performance.	BREEAM In Use, CIBSE TM46, DCLG EPC guidance, proprietary datasets e.g. BUS methodology, Carbonbuzz, project teams other projects

9	Report	✓	Any results from the POE/BPE that identify underlying issues should be reported immediately and analysed to establish what might be done to improve these issues.	
9.1	Client, FMs, Occupants	✓	Supplementary guidance to various stakeholders may be necessary.	CIBSE TM22
9.2	Project Team	✓	Sharing the report whenever possible will help designers understand how their buildings perform and help them work towards closing their performance gap.	

For more research, guidance and case studies on POE/BPE visit the RIBA Design Quality and Performance online knowledge database: www.architecture.com/DQandP

Written by Joe Jack Williams of Feilden Clegg Bradley Studios, Ben Humphries of Architype and Alex Tait of the RIBA. The RIBA wishes to thank the authors and Flora Samuel of the University of Reading, Simon Bradbury of Plymouth University and Peter Godfrey of the RIBA Insurance Agency for giving us their knowledge, experience and time.

