Ethical issues in domestic building performance evaluation studies

Tim Sharpe

MEARU (Macintosh Environmental Architecture Research Unit), Mackintosh School ofArchitecture, Glasgow School of Art, Glasgow, UK

E-mail: t.sharpe@gsa.ac.uk

Abstract

Dwellings are occupied by people and it would seem reasonable to expect that the way they are designed and constructed protects people's health and wellbeing, and the effectiveness of this would be verified in practice. However, the construction sector is unusual in that is does not routinely evaluate the performance of its artefacts. Thus, when new forms of construction or technology are used, occupants are effectively the subjects of experiments, which raises ethical concerns. Building performance evaluation (BPE) is a critical tool that addresses this problem. This has mainly been conducted by academic organizations, but to be effective BPE needs to become more widely used by design and construction professionals. In these studies occupant behaviour is a key factor and, consequently, occupants are often the focus of studies. Domestic environments are particularly contentious due to the personal and sensitive data that may be collected. Some of the common ethical issues arising from BPE studies in housing are considered. It is argued that if BPE is to become more widely used by industry professionals and their clients, then a wider adoption of ethical policies is needed to protect the participants of such studies, and the practice of BPE itself.

Introduction

For much of the history of architecture, innovation was a trial-and-error process. The pace of change was gradual and construction knowledge was based on craft and routine. Building design gradually

adapted to local environments and available materials. Due to limited resourcesand technologies, any evolution of practice could be based on trial and error. If they were found successful over time, then they became 'tried and tested'. Toward the second half of the 20th century, the needs of society became drivers for increasing innovation. However, trial-and-error approaches resulted in unintended consequences of well-intentioned interventions, such as increased problems of dampness and mould growth (Stewart, 2005). Investigation of these led to the development of the concept of building performance evaluation (BPE) (Markus, 1972) as a mechanism to evaluate the actual in-use performance of a building, incorporating both forms of testing and evaluation of the building as constructed, along with post-occupancy evaluation of the building in use. Such studies began to identify performance gaps between expected and actual performance and impacts of design decisions. An overview of the development and focus of BPE is described by Tweed and Zapata-Lancaster (2017), and the international context for this, and the implications of BPE for the professional, is set out by Preiser, Davis, Salama, and Hardy (2014). This century, the legal and moral imperatives to reduce energy demand and CO2 emissions have led to substantial improvements in building regulations in the UK (DEFRA, 2006) and internationally (Casals, 2006; Laustsen, 2008), with particular emphasis placed on housing as a major source of CO2 emissions. This has led to significant changes in the way that buildings are constructed and how they perform, but more radical changes have been resisted. For example, although the mandated Code for Sustainable Homes in the UK (DCLC, 2007) led to some forms of innovation, pressure from the industry led to it being dropped, as have targets for zero-carbon homes (Walker, Karvonen, & Guy, 2016). Internationally there has also been a slow adoption of other standards. In addition, Williams et al.(2016) have identified the gap between international energy standards and the actual delivery of low-energy homes.

The preferred model for the majority of housing would appear to be 'business as usual' as any variation represents an unquantified risk. Due to a longstanding reliance on the 'tried-and-tested' model, the constructionindustry in general, and designers in particular, have no inherent

capacity or mechanisms to evaluate or adapt to innovation. The construction industry (particularly the housebuilders) have not embraced innovation in a systematic manner. Successive reviews have identified that construction spends little on research. In 1998, the Egan Report stated:

> Companies do little systematic research on what the end-user actually wants, nor do they seek to raise customers' aspirations and educate them to become more discerning [and …] it invests little in research and development [R&D] and in capital. In-house R & D has fallen by 80% since 1981. (Egan, 1998)

Eighteen years later, the Farmer review of the UK construction labour markets (Farmer, 2016) highlighted that the construction industry spends less than 0.1% on R&D, and this situation would appear to be similar in other industrialized nations (Barlow, 2012; Hernández, 2013).

This in turn raises a question about the value of design activity as a predictor of performance, as opposed to a demonstration of compliance. In most industries the process of design requires a conceptualization that, particularlyfor artefacts used by the public, includes the need to prototype, test and evaluate the product. The knowledge generated by these processes is used to improve design knowledge and to inform increasing sophisticated modelling and analysis tools, e.g. the aerospace industry builds sophisticated computer models of aircraft designs which can be simulated in detail before prototyping and test flights (Stevens, Lewis, & Johnson,2015). In most industries clear protocols exist before products are used by the public.This is not the case in buildings: whilst procedures may exist for testing individual components in buildings (e.g. British Board of Agrément, British Standards Institute, International Association for Testing Materials, National Association of Testing Authorities), evaluation of the complete building is rarely undertaken. As a result, very little is known about the effectiveness of contemporary building performance and consequently methods for predicting performance are not robust. For example, in UK housing the Standard Assessment Procedure (SAP) calculation is used to demonstrate compliance, and is often erroneously thought of as a predictor, whereas it is a comparative tool for limited aspects of energy use in the home (Kelly,

Crawford-Brown, & Pollitt, 2012). What this means in practice is there is no routine modelling of how the building is expected to perform or work. What does this mean for design? The constraints of funding, procurement timescales and legislation are such that it may be said that contemporary architects are 'styling regulations'. The connections between design, construction and performance have also been undermined by changes in contractual arrangements such as design and build in which the contractor takes over design responsibility, and may novate architects to produce design information. Consequently, architects have found themselves moved from leaders of the construction process to subordinates. Given the policy drivers for changes in legislation, there is developing concern about the causes of performance gaps and how to address these practically. Whilst still far from mainstream, the concept of BPE has attracted increasing attention. Given that most new buildings have some form of innovation due to changing standards (e.g. improved thermal performance, increased standards of airtightness), evolving technologies (e.g. low-carbon heating systems, renewables, mechanical ventilation with heat recovery – MVHR), and changes in construction practices and procurement (e.g. design and build, offsite construction), this introduces increasing uncertainty about outcomes, and this is one reason why the industry resists change. It is therefore vital to evaluate the actual performance outcomes against anticipated performance, to learn from failures and to build on successes. Some of this attention has been driven by government agencies concerned that their targets, such as progress toward carbon reduction, are being undermined (Zero Carbon Hub, 2014), and client and design organizations increasingly concerned about their risks and liabilities of underperformance (Eaton, 2014; Loulakis & McLaughlin, 2014).

Whilst issues of design and building performance tend to be predicated on the technical issues and risks, one aspect that is rarely considered are the ethical issues implicit in the production of housing. There are two broad issues. First, what are the implications and responsibilities of producing housing that is in some way an experiment? What are the ethical responsibilities of

built-environment professionals to those occupants who are effectively the subjects of these experiments? Second, whilst BPE presents a solution to this, what ethical challenges arise when BPE studies are undertaken? In this case occupants become participants in a study, and in many cases the subjects of the investigation. This paper considers the ethical issues that arise in the context of building performance and BPE studies. Up to now, this has mainly been the remit of research and academic organizations, but if such activity is to become mainstream and undertaken by construction professionals, in particular those with responsibilities for design, it needs to be based on robust ethical principles.

The study of ethics is vast, with a substantial history and literature (Fieser & Dowden, 2011). Contemporary philosophy divides theories into broad questions about where ethical principles are derived and their meaning (metaethics); the development and application of ethical principles to define standards that regulate conduct (normative ethics), and an exploration of the specific application of ethical principles to particular contexts (applied ethics). In the latter, some subject areas are well defined, such as medical ethics, which provide an approach to value sets for professionals. However, as discussed by Fox in a series of papers in Ethics and the Built Environment (2012), there is much ambiguity in the application of ethics in architectural design, and whilst there are a number of normative ethical principles concerning what the profession 'ought to do', e.g. responding to climate change, there is lack of clarity on specific responsibilities and actions to guide the design profession (i.e. what the profession 'must do'). In terms of the ethical responsibilities of the profession and the industry as a whole, a critical question is whether it is ethical to expect people to live in buildings where the actual performance is not accurately predicted or understood? What are the likely risks to the occupants, clients and the public, and what might be the consequences? Applied ethics generally translate into codes of conduct to prescribe professional ethical behaviour. However, codes of practice for architects in the UK, which include The Royal Institute of British Architects' (RIBA) 'Code of Professional Conduct' (2013a) and the Architects Registration Board's (ARB) 'The Architects Code: Standards of Professional Conduct and Practice'

(2017) are largely silent on the issue of ethics. Internationally, equivalent bodies tend to follow similar lines – the American Institute of Architects (AIA) (2017) and Royal Australian Institute of Architects (RAIA) (2006) both have a code of ethics and professional conduct. Whilst these state in broad terms obligations to the public, a review of professional codes by Sadri (2017), which included the AIA, Architects Council of Europe and International Union of Architects, identified that these are primarily directed toward protecting the profession and tend to ignore wider responsibilities. The main thrust of the codes tends to be toward maintaining professional standards and abiding with current legislation. As Till points out:

> One of the most commonly made mistakes is to confuse professional propriety with an ethical position, as if acting in accordance with the codes of professional conduct will ensure ethical behaviour…. (Till, 2009)

Some aspects of the professional codes that might impact on building performance are extremely vague, e.g. to be 'aware of the environmental impact of their work'. An absence of clear ethical standards in relation to building performance has been discussed previously. Hill et al. identified gaps between the ethical responsibilities and professional guidance of built environment professions (Hill, Lorenz, Dent, & Lützkendorf, 2013). Hartenberger, Lorenz, and Lützkendorf (2013) pointed out that there is no equivalent to the medical concept of non-maleficence and they called for the development of an equivalent of the Hippocratic oath. In the specific context of performance gaps there have been other calls for the development of ethical standards described by Bordass and Leaman (2013) as a 'new professionalism'. One key recommendation of The Edge Commission's Report on the Future of Professionalism was for construction professions to develop standards for 'Ethics and the public interest, and a shared code of conduct' (Morrell, 2015).

In areas where there is clear physical risk to occupants, it may be argued that building regulations are aimed at providing protection to occupants and that design that complies with legislation and the various standards that underpin these protects building occupants from harm. Whilst in some areas this may appear to be quite explicit, e.g. fire protection or structural design,

other issues which may have impacts on the occupants, such as energy consumption, thermal comfort and health, are rather less well defined. For example, UK building regulations for ventilation are predicated on moisture control rather than indoor air quality. A regulatory approach also takes a piecemeal approach, with some aspects of regulation confounding others. There are other shortcomings to a compliance-only approach. First, it is increasingly clear that compliance with building standards is inconsistent, perhaps most disastrously demonstrated by the Grenfell Tower fire in London, June 2017. The interim report from the inquiry by Dame Judith Hackett concluded:

> it has become clear that the whole system of regulation, covering what is written down and the way in which it is enacted in practice, is not fit for purpose, leaving room for those who want to take shortcuts to do so. (Hackett, 2017)

The second shortcoming is where the ethical responsibility lies when, whilst complying with regulations or standards, the building still results in performance gaps. These may give rise to secondary issues which are often referred to as unintended consequences – or to use a medical analogy, 'side-effects'. A current example of this include effects on indoor air quality arising from energy-reduction strategies such as air tightness without related improvements to ventilation provision (Sharpe, Farren, Howieson, Tuohy, &McQuillan, 2015), or cases where no regulation is in place, e.g. source control of pollutants, or requirements for overheating.

A common response from architects is that the design complied with the regulations (or more accurately: the guidance to regulations), and that shortfalls occur in later stages during construction. Unfortunately, regulatory compliance is largely achieved at design stages, withless reliance on onsite testing. The changes in forms of contract (e.g. design and build) have further reduced the authority of architects over construction processes.

BPE is now included in the RIBA plan of work (RIBA, 2013b), but it has not been widely embraced (Stevenson, 2017). Common objections are that it constitutes additional work not covered by the fee and/or there is no additional money to pay for such activity. There may be some

justification for this given that construction has evolved without any intrinsic mechanisms for research and evaluation, so the introduction of what appears to be a new service does represent an additional cost. In addition, the majority of architects now work in private practice with a great deal of competition. Concerns about effects on liability, indemnity and reputation of 'failure' (even though the failures might be due to others) leads to a tacit, but commonly held, view that BPE presents a threat ('what if we find out it doesn't work?'). As pointed out by Morrell (2015, p. 5) in the Edge report:

> However, the standing and perceived value of the professions is being challenged, with detractors seeing in their conduct and practice a tendency towards protectionism, resistance to change, the reinforcement of silos and the preservation of hierarchies.
>
> There is also a risk that the institutions lose control of the very things that are claimed to differentiate their members from those lacking a professional designation: quality control and oversight of educational standards; a transparent and enforced code of ethics; a defined duty to serve the public interest; the development and dissemination of a relevant body of knowledge; and a demonstration of leadership on some of the great issues that reach across the whole of the built environment.

If architectural design is to evolve, the development of knowledge, thorough evidence-based design, is a critical factor. Duffy (2008) identified the imperative for the design professions to better connect to research, and cited building-use studies as examples of this.

This provides a strong case for wider use of BPE. However, a further question arises: what ethical issues may arise when undertaking BPE? Whilst some aspects of BPE may clearly be physical tests of construction (e.g. air tightness or U-value testing), a systematic evaluation of a building in use inevitably involves the study of the behaviour and interactions of the occupants. Indeed, an understanding of the impacts of occupant interaction with the building and outcomes in terms of comfort, health and satisfaction are critical elements (Monahan& Gemmell, 2011) and methods to evaluate these continue to evolve (Lowe, Chiu, & Oreszczyn, 2017). BPE studies may provide insight into two aspects of occupancy: first, the effects of occupant behaviour on building performance; and

second, the effects of building performance on occupants. The former examines how occupant behaviour and interaction changes energy use and environmental conditions (Delzendeh, Wu, Lee, & Zhou 2017); the latter examines what effects environmental conditions and satisfaction might have on building occupants (Mavrogianni, Davies, Wilkinson, & Pathan, 2010; Wargocki, 2013).

Given the role of building users in BPE studies, a number of ethical issues may arise, and these are outlined below. In a general sense and compared with other disciplines that undertake research, the risks to participants are not great. Nevertheless, a number of principles need to be observed when conducting research in order to protect the rights of participants.

Outline of the ethical principles

In the past few years, the number of BPE studies has increased. An important driver to this in the UK was the Innovate UK (formerly the Technology Strategy Board) BPE programme conducted between 2010 and 2015. This was an £8 million programme of support to enable designers and clients to undertake BPE studies of both domestic and non-domestic buildings. This conducted domestic studies across 53 projects and 350 dwellings and non-domestic studies on 48 projects and 56 buildings, on sites across the UK (Palmer, Terry, & Armitage, 2016; Seguro, 2015). The author was one of a number of expert evaluators for the programme and was also directly involved in seven domestic and two non-domestic projects and has participated in a large number of other BPE studies and three knowledge-transfer partnerships with architects developing capacity in BPE. Whilst much of this work has been made available through published reports and available data (see buildingdataexchange. org.uk), a great deal of tacit knowledge has been gathered through participation in these projects and discussion with contributors. In undertaking these projects and reviewing

outcomes, several ethical issues emerge, and the following is a discussion of key issues of relevance to construction industry participants.

The discussion below focuses on BPE studies undertaken in domestic projects, for the following reasons. First, the home environment is one where individuals are entitled to privacy and safety, but an evaluation will necessarily impinge on this. Second, the relatively small nature of domestic BPE projects means that engagements with individuals is necessary and differs from non-domestic environments in which the occupants will be much larger cohorts, e.g. office workers. Third, user interactions in domestic environments can have much greater impacts on performance, and also problems of performance may have much greater impacts on individuals. Nevertheless, many of the ethical issues raised will be relevant to other building

typologies.

Ethical policies

The first question is whether a BPE study is at all conditioned by ethical constraints. For studies undertaken by higher education institutes, ethical compliance is a fundamental prerequisite to the conduct of research. However, studies may be undertaken by a range of groups and organizations that may not have a mandatory ethical policy. Projects in the Innovate UK BPE programme were led by different types of organizations, including landlords, developers and design teams. Funding was conditional on following a method stipulated in the BPE, Domestic Buildings, Guidance for Project Execution (Technology Strategy Board, 2010). Although this method contained technical guidance for the conduct of the research and the reporting mechanisms, an ethical policy was not mandatory. Applicants were 'strongly advised to obtain the consent of individuals taking part in any surveys or interviews, especially if they could be identified and associated with specific results'.

This does suggest an incomplete regard for ethical issues that might arise through BPE studies, and given an argument for wider use of BPE, a greater understanding of such issues is

needed. All universities now have ethical policies to govern the conduct of research. It is suggested these could provide a viable model for BPE studies. The wording of these varies between institutions but generally includes the following elements: non-maleficence; guidance on research conduct including honesty and integrity; lack of coercion; informed consent, including a right to withdraw; a requirement for confidentiality; equality and diversity; and data protection. A description of these key tenets along with a discussion of the aspects that may impact on BPE studies are presented below.

Non-maleficence

Generally referred to as 'do no harm', the term is more commonly associated with clinical activity in which participation in research could result in harm to occupants. It is generally accepted that the risks of this occurring in BPE studies are low, and that it is possible there may be beneficial effects for occupants, e.g. reduced energy consumption and improved comfort. Consequently, most ethical policies would adopt a 'light touch' assessment of applications which would gather information from occupants. This would perhaps assume that no highly sensitive data would be collected from participants, and that the object of the study is the performance of the building. These elements may need further explication and are discussed below.

Some aspects of harm may need to be considered. For example, could monitoring that revealed particular patterns of behaviour, such as overcrowding (Scottish Government, 2015) or lack of room use (the 'bedroom tax') (Robson, 2015), be used to disadvantage occupants?
Could monitored data be used to identify patterns of lifestyle or occupancy that could be exploited?
Would showing when houses are empty present a security risk?

For these reasons, the nature of these data, how they will be collected, stored and used, who will have access to them, and what their responsibilities are need to be clearly identified at study design stages. Some of the issues will be addressed through other aspects of ethical policies, e.g. data protection and anonymization (discussed below), but the study design should consider

wider implications of data use at early stages, in particular by project participants with other contractual relationships with occupants, such as landlords.

Research conduct and integrity

Ethical policies for research conduct integrity cover several aspects. At a basic level they require that the research methodology is robust, honest and truthful. Whilst it may seem self-evident that a research study should aim to produce scientifically valid results, there can be situations where this is compromised. This includes the design of appropriate research methodologies for the domestic BPE studies, and there is increasing literature on this subject (Baborska-Narozny & Stevenson, 2014; Gupta & Kapsali, 2016; Sharpe, 2013) but there are particular challenges in undertaking BPE in domestic environments. Access may be restricted and remote data collection is challenging, which can lead to situations where insufficient or poor-quality data are collected. Data collection, particularly remote sensing, is a challenging and rapidly evolving field. Common problems experienced in the BPE programme included sensor failure, drift, contamination, lack of resolution on sub-metered data, and loss of data (failure of logging devices, service providers going out of business etc.) and poor practices in sensor placement. This also applies to data handling and interpretation. There was evidence of (often very well-intentioned) data 'cleaning', e.g. to remove outliers or spikes. Errors can also occur in data interpretation – in one project it was discovered that data being made available on an online portal were being incorrectly calibrated. Some research that has attempted to use publicly available data from the BPE programme in meta-studies has identified limitations in the quantity and quality of recorded information (Sharpe, Mawditt, Gupta, McGill, & Gregg, 2016).

Other aspects of BPE processes also need care in the interpretation of results. Two examples from the BPE programme include co-heating tests (Jack, Loveday, Allinson, & Lomas, 2018) and thermography (Balaras& Argiriou, 2002). In the case of co-heating tests, a subsequent analysis of the

data indicated that the results were largely dependent on the method of analysis used (Butler & Dengel, 2013). With thermography, the cost of these devices has dropped rapidly in recent years, with much wider availability and, consequently, more widespread use by untrained personnel. It is therefore important that accepted standards for research conduct are adopted by BPE projects. Good study design can anticipate likely issues in relation to methods and equipment and be cognizant of the limitations of the data obtained through fieldwork. A more difficult area concerns the end use, interpretation and communication of the data. In the BPE programme it was apparent that some study participants, primarily developers and contractors, but in some cases landlords and designers, were uncomfortable with the findings of the studies, which revealed poor performance, possibly over concerns about possible risks of litigation. As a consequence, some studies were redacted in some areas and in other cases not published at all. Although reporting of data was a condition of funding, it is clear that some studies have not made full disclosure of information. This is an important and challenging for BPE, especially if it going to be more widely adopted. Concerns over the risks and liabilities that may be revealed by BPE studies are often major barriers to the adoption of BPE. Designers are concerned about professional liability and reputational risk; contractors and developers are concerned about the costs incurred in rectifying issues; and client organizations are concerned about costs of remedial measures and complaints by tenants. In discussions with potential clients for BPE, some of these issues are frequently raised. In one case, a major housing association was apprehensive that use of BPE (which might reveal construction problems) would inflate tender prices as contractors would have to 'get it right'.

The difficult choice was whether it was better for studies to proceed with limited dissemination than not to take place at all. Feedback loops into the practice are important, but if BPE is to be effective, at a minimum wider reporting is needed and an aspiration may be for peer-reviewed publication, which is the norm in other professions such as medicine and law and forms the basis for new knowledge in the discipline. A failure to identify and report performance leads to the replication of poor practice. If not identified and disseminated at an early stage, this can

contribute to widespread failure. An example of this is the adoption of mechanical ventilation with heat recovery (MVHR) systems. Whilst this technology can provide good levels of ventilation at the same time as reducing energy loss, various studies have identified problems with performance (Balvers et al., 2012; Lowe & Johnstone, 1997), but a failure to communicate or act on this has led to many thousands suboptimal systems being installed (Sharpe &Charles, 2015).

From the perspective of an ethical approach to the design of BPE studies, ownership, use and reporting should be clear from the outset, but some difficult issues will remain. A key issue is who the study is for, who instructs it and who owns the content. Studies are rarely commissioned by the building occupant (with the possible exception of single home owners in dispute with a builder or architect) and are more normally a third party organization. The question is therefore who owns the data, and what will they do with it? For example, an architect had been commissioned by a developer to undertake a study of a house after complaints by the occupant. The study found numerous incidences of poor workmanship, but the client only wanted the report to identify incidences of regulatory non-compliance. The lack of an ethical policy and agreement places the architect in a difficult position – the study is undertaken on behalf of the occupant and with their consent and participation (in terms of access), but the contractual obligation is to deliver the information that was commissioned.

A further ethical issue also arises in terms of those responsible for delivering the project undertaking BPE on their own work. The dilemma is whether designers can be both the subject and the researcher – can they be sufficiently objective and what measures may be needed to reduce reporting bias and ensure accurate dissemination? It may be argued that evaluating their own work is a conflict of interest for architects, which in a competitive environment may lead to problems being under-reported or misrepresented. It also applies to forms of development where there is little or no architect involvement such as the majority of housing produced by volume housebuilders.

There is therefore an argument that a more robust model would be for BPE to be undertaken by independent researchers, who may be able to adopt greater rigour and to share data more consistently. However, a counter argument is that if properly conducted studies are undertaken, there are clear benefits for designers to see at first hand the impacts of these, and this provides a direct loop back into design. There are also advantages to both occupants and clients if the BPE processes enable defects to be identified and rectified, ideally within a defects liability period. Furthermore, the architectural profession has lost too many areas of expertise to other disciplines and this has led, in part at least, to the fragmentation of the design process, and perhaps the marginalization of architects (Raisbeck & Day, 2016). Given that BPE is now part of the RIBA plan of work, the adoption of a requirement for an ethical policy for BPE would protect the intent as BPE becomes mainstream.

The object of the study is also important. For BPE studies, ostensibly the focus is on the performance of the building, and clearly some aspects of BPE will undertake physical testing of the building itself. However, it is quite clear that the performance of the building is predicated on the 'performance' of the occupants and it is very difficult to disaggregate users from performance (Janda, 2011). Measured data on environmental conditions can describe 'what'. Building a picture of occupants' interactions can help to explain 'why' and developing an understanding of occupants' engagement with and use of a building is critical to developing a full understanding of performance (Gill, Tierney, Pegg, & Allan, 2010). However, it is also clear that the occupants are being assessed – e.g. in the Gill study, occupants are described as 'frugal' or 'profligate'. Some care is needed here both from the perspective of the participants and also the focus of investigation – e.g. some studies describe 'misuse' of heating systems, when the reality is that control interfaces are difficult to understand and use (Stevenson, Carmona-Andreu, & Hancock, 2013). This is an important distinction, particularly from the perspective of the occupants, who may not be wholly aware of the focus on their activities and the reporting of this, and this would need to inform the basis of informed consent. For some people with busy lives, families and other pressures, energy saving is

not their principal focus. A robust method and clear reporting are needed to identify wider responsibilities, e.g. for the production of buildings which are difficult to use, or for which no user guidance is provided.

The number of buildings in the study will also affect the study design and the ethical implications. For bigger studies that evaluate broad data from a larger number of homes, better statistical power is generated, but at the cost of detailed analysis of the home context. As numbers decrease, so does the ability to produced statistically relevant data, but this may be balanced by more detailed information about the building, e.g. as a mixed-methods case study (Johnson, Onwuegbuzie, & Turner, 2007) which enables a detailed examination of the building (and its occupants) as well as its related contextual conditions. In this case, it is clear that detailed information will be gathered from the building in question, and also anonymization will not be possible.

Coercion

A further ethical dimension is that of coercion. Put simply, potential participants must not be pressured to participate in a study. The use of incentives is generally accepted – these commonly include payment of expenses (to cover, for example, additional electricity used by equipment), or small payments or tokens (e.g. shopping vouchers) for participation in a study, proportionate with the task involved and therefore might vary depending on the length and complexity.

Issues that arise in domestic BPE include expectations from a landlord or employer of participation – occupants may feel that their tenancy or relationship with the landlord is under threat if they do not participate. This can be an element in the use of gatekeepers (third parties who, by virtue of their personal or work relationship to a respondent, can provide access to the respondent), e.g. a housing association. Use of gatekeepers is a very valuable tool to enable access to participants and can also provide reassurance to participants that the study is bona fide, but care

is needed in communications to uphold other aspects of ethical policies such as informed consent and a right to withdraw.

A related dimension is the nature of the relationship between researchers and study participants. In small studies it is frequently the case that researchers can become well-known to occupants and this can provide greater access, sharing of information and valuable insights. It is not uncommon for researchers to be given a high degree of trust, e.g. being allowed into the house unaccompanied. However, care is needed to avoid entering quasi-relationships which may imply expectations, e.g. repairs, and may make withdrawal difficult for participants, or place a burden of responsibility on the researcher.

In a small number of properties, the monitoring equipment was installed before letting (where the building was tested as part of an earlier study) or occupancy (when tenancies changed during the period of the study). Due to the nature of the investment, some projects considered making participation a condition of tenancy. Whilst it may be argued that the participants did not have to agree to the tenancy, this would clearly disadvantage them and could therefore be seen as coercion.

Informed consent

Informed consent is the key principle of ethics in human research and is defined as consent by a participant in a research activity. The participant must be capable of consent and participation should be voluntary. Consent is reliant on appropriate information being given to the participant by the researcher on the nature of the activity undertaken including what information may be gathered, and what it will be used for. This final element is critical and requires that participants understand the purpose and nature of the study, what participation in the study requires, and what the outcomes might be. Furthermore, participants should have a right to withdraw their consent at any time without penalty.

BPE studies will frequently involve the participation of children, e.g. family houses, or others with special needs such as the elderly or occupants with impaired mental capacity. There are well-established principles for third-party consent through the use of gatekeepers, such as parents or carers. More difficult issues include the nature and detail of the information provided and care is need to balance the need for clear understanding, against participant bias and also Hawthorne effects (Jones, 1992). For example, would telling participants that a study was evaluating how frequently they opened their windows affect their window-opening habits? Sufficient information needs be provided to enable an informed decision to be made without affecting thearea of study.

Informed consent also requires that the nature of participation and its possible impacts is made clear. This can include, for example, the frequency of visits, who will be visiting, what equipment may be installed and what it does, and how long the visits and the study will be. Particular issues that arose in the BPE programme were sensors being unplugged because participants were concerned about energy consumption, or not realizing they were still in operation. Another frequently occurring issue was 'survey fatigue' (Porter, Whitcomb, & Weitzer, 2004). In the longer term (two-year) studies, there were regular visits for interviews or to download data, and in some case the frequency was increased due to problems with equipment, and this became problematic for participants who subsequently withdrew. Requests for more detailed or onerous information such as occupant diaries, were not always completed.

A less clear element of informed consent, but one that is increasingly contentious, is the nature and use of the data and the findings of the study. In post-occupancy evaluation, detailed data may be collected from both the sensing and monitoring and also the occupants themselves, which can be used to build a detailed picture of how the building is performing and the effects that occupancy can have on this. Some of these data will be very sensitive (e.g. environmental conditions in individual rooms such as bedrooms), which can provide an intimate picture of how the house is being used. Anonymization may be possible with large data sets, but this is much more difficult with

highly granular data in small numbers of homes, and doing so may undermine the contextual insights that may be gained from the project. Ethical questions that may arise are (1) whether occupants are fully aware of the detail that may be gathered as part of this process; and (2) whether it is clear how and where this information may be disseminated.

Participation in a study may also raise expectations, e.g. of improvements or remedial measures which may not be forthcoming. It is common for participants to request information about the findings of the data, and the study should have a policy for this fact. In one project, although this was not an initial objective, summarized feedback was provided and this became a useful benchmark to evaluate changes in building use and subsequent performance, but some clients have raised concerns that identifying problems may then mandate repairs. The identification of potentially harmful issues may present dilemmas. In several projects, observations of poor ventilation led to specific feedback to occupants to try to improve conditions, but if direct communication with occupants about the findings was not a requirement of the study, this would present researchers with an ethical quandary. A consideration here is whether confidentiality agreements allow the ethical responsibility be passed on, e.g. if the researchers pass on information about possible harm to the client organization, are they relieved of their ethical responsibility and is the client then bound to act on it?

The right to withdraw is also an important concept. For some studies this could present major difficulties, particularly where the numbers are small, and was experienced by a number of projects. In most studies it was generally accepted that the implications of withdrawal were that occupants would not participate in the study any more, but what was less common was an expectation about data that had been collected previously.

For most BPE studies informed consent is achieved through the use of an information sheet and a consent form. The information sheet is important and should provide – in an easy-to-understand form – what the purpose of the study is, what their participation will involve, what

information is being collected and what it will be used for. In some cases, third-party consent may be achieved, e.g. parents of children or carers. Consent may be required from gatekeeper organizations from whom permission is needed to conduct the research. This is a critical document as it forms the basis of the agreement between the study and the participants.

Confidentiality and anonymity

It is an accepted precept that the individual identity of the participant should be anonymized and any personal information provided in the course of the study be kept confidential, or where this is not possible the participant should be aware of this and what information will be made available. Anonymity includes protecting the privacy and dignity of the participants.

In normal social surveys where information is collected by interview of survey, data can be quite easily anonymized, and for larger groups of houses where high level data are collected this is relatively simple. However, in smaller developments in which perhaps one or two houses were being investigated, although names and addresses can be removed, it may be possible to identify which houses were included, particularly to the study participants. In single-house studies anonymization is clearly not possible. In reviewing the BPE project reports it was apparent that there was an inconsistent approach to this. There was no reporting of personal data (with the exception of single houses where this was unavoidable, but for which the occupants had necessarily consented). Most had adopted a coding for building types, but others did include data on flat numbers, for example. Issues of privacy and confidentially also arise in some recorded data, e.g. photographs. It is generally accepted that photographs of participants, except where explicitly agreed, would not be acceptable, but there is less clarity about photographs taken in the home, particularly where these showed personal items, or of the houses themselves which could be used to identify the locus of the study (and by implication the data associated with it).

Data protection

The value of large data sets in research, in particular to develop statistical power, is understood, and in the modern digital world the concept and availability of 'Big Data' (Mayer-Schönberger & Cukier, 2014) has developed rapidly. Indeed, the current challenge is the paucity of large data sets for building performance. However, as the recent Facebook/Cambridge Analytica scandal has shown (Cadwalladr, 2017), the gathering, use and dissemination of personal data is a contentious issue. Ethical policies for research generally require researchers to manage data in a manner that does not compromise the personal dignity of the participant or right to privacy through all the collection, storage, analysis and disposal stages of the research.

Until now, most ethical policies would require researchers to comply with statutory data-protection legislation, such as the Data Protection Act (UK Government, 1998). However, there have been increasing concerns about access and use of personal data and in response to this new legislation has come into force in May 2018 which will affect how data are gathered, processed, stored and disseminated and will affect ethical policies. The European Union's General Data Protection Regulation (GDPR) (Albrecht, 2016) was approved by the European Parliament in April 2016. As a regulation, it is directly applicable without the need for domestic legislation and it become live in all member states in May 2018. It effectively repeals the Data Protection Act 1998 (DPA) and introduces new legislation regulating the processing of personal data. The GDPR, in many respects, extends the DPA's current position. Whilst the main driver for the legislation is aimed at the increasing harvesting and processing of digital data by large corporations, its implementation will impact on ethical processes insofar as they relate to the collection, storage and, ultimately, deletion of data. It will affect all organizations collecting data, irrespective of whether they have ethical policies. It is attracting attention due to the punitive nature of fines for transgression, i.e. up to the greater amount of 2% of annual global turnover or €10 million and higher fines up to €20 million for more serious breaches.

In the GDPR ‘personal data’ means any information relating to an identified or identifiable natural person (‘data subject’); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. The identifiable definition is emphasized here. In the case of BPE studies, whilst it is normal to remove personal information, as noted above, robust anonymization may be difficult.

However, it is entirely reasonable for researchers to have access to and to process personal data and both the DPA and GDPR provide a ‘legitimate interest’ basis on which to gather and process such information and a justification of this is a requirement of an ethical review. However, from the perspective of BPE studies, having the requirements and constraints of the GDPR embedded in an ethical policy protects both the participants and the organization conducting the study. The GDPR requires a clear consent protocol and is therefore a strong argument for the development of an ethical standard for BPE studies.

Conclusions

Buildings are occupied by people and it would seem reasonable to expect that the way they are designed and constructed protects their health and wellbeing, and to expect that those actors responsible for designing and the construction of these buildings would routinely assess their performance in use. Unfortunately, this is generally not the case. When such studies are undertaken, the evidence suggests that the regulatory systems and professional standards in place to achieve satisfactory performance may not be entirely fit for purpose. Business as usual does not easily fit with the need for innovation.

If building design professionals want to situate themselves as stewards of the built environment, this entails a responsibility for the performance of the buildings they create. The

construction industry, in particular the design professions and their professional bodies, needs to adopt a more rigorous ethical approach to protect the needs of building users. This means adopting a research-driven approach to the generation and synthesis of new knowledge, and the generation of evidence- based design. This is viewed by some as a threat to commercial practice and the status quo. Although professionals believe they are protecting their reputation by avoiding BPE, in fact the opposite is true. A profession that does not routinely protect the needs of its users faces a far more serious existential threat. Given the increasing marginalization of architecture, the need to demonstrate the value of design as a benefit to building users has never been more pressing. To observers from other industries it would seem extraordinary and shocking to see a prevailing culture that knowingly avoids finding problems and improving performance. However, the increasing awareness of performance gaps and the likely risks and liabilities of these are beginning to outweigh inherent barriers, particularly for some client groups such as housing associations and private rented-sector (PRS) clients who have a contractual relationship with building occupants and are also liable for maintenance and repairs. For these groups, outcomes from BPE studies may be a bitter pill, but ultimately good medicine.

There are costs associated with undertaking robust BPE studies. These will include the studies themselves, but also remediation of defects and, over time, of improving standards of design, construction and maintenance. At present, as the construction industry has no inherent capacity (either financial or intellectual) for research activity, this represents 'additional' costs. However, it can be argued that these costs are small when compared with those for rectifying defects, avoiding risks and liabilities, and are a very small proportion of the actual construction costs and an even smaller proportion of the running costs.

Irrespective of this, an ethical approach makes the need for BPE and its benefits self-evident. In adopting a 'do no harm' principle, it is clear that that it is better for construction professionals and client organizations to undertake BPE, rather than not. However, if BPE is to become a sound

practice (and given that it may be undertaken by this industry), then BPE processes need to be predicated on an ethical and robust practice. An ethical approach would underpin BPE studies, protect the rigour and substance of such studies, as well as protect the interests of study participants. This paper calls for the development of a shared ethical code of conduct that may be adopted by BPE studies. This may sit with technical guidance on project execution, but it is argued that an ethical policy protects the participants as well as the outcomes.

The ethical challenges of BPE are not extreme and can be resolved, but they do require consideration and planning. Some of the dilemmas raised in recent studies may be addressed by its wider adoption. For example, at present as BPE tends to be limited to small studies with selected buildings in which anonymization and aggregation of data is difficult and statistical power is low. However, with much larger data sets, more statistically reliable data may be obtained and better characterization may be obtained with reliable anonymization. All organizations collecting personal data will need to comply with legislation (e.g. in the European Union the GDPR) and this may be a good opportunity to integrate an ethical policy into BPE processes and outcomes.

References

Albrecht, J. P. (2016). How the GDPR Will Change the World. Eur. Data Prot. L. Rev., 2, 287.

ARB (2017) The Architects Code: Standards of Professional Conduct and Practice http://www.arb.org.uk/architect-information/architects-code-standards-of-conduct-andpractice/ accessed 2/2/18

Arcipowska, A., Anagnostopoulos, F., Mariottini, F., and Kunkel, S. (2014). Energy performance certificates across the EU-a mapping of national approaches. Buildings Performace Institute Europe (BPIE). Brussels.

Balaras, C. A., and Argiriou, A. A. (2002). Infrared thermography for building diagnostics. Energy and Buildings, 34(2), 171-183.

Balvers, J., Bogers, R., Jongeneel, R., van Kamp, I., Boerstra, A., and van Dijken, F. (2012). Mechanical ventilation in recently built Dutch homes: technical shortcomings, possibilities for improvement, perceived indoor environment and health effects. Architectural Science Review, 55(1), 4-14. Barlow, T. (2012). The built environment sector in Australia RandD investment study: 1992-2010. http://sbenrc.com.au/app/uploads/2013/11/BUILT_ENVIRONMENT_RD_2012_latest_report.pdf , accessed 5/4/18

Baborska-Narozny, M., Stevenson, F. (2014, July). Performance evaluation of residential architecture–scope and methods applied in two case studies based in North England. In the5th International Conference on Applied Human Factors and Ergonomics AHFE (pp. 109-115).

Bordass, B., Leaman, A. (2013). A new professionalism: remedy or fantasy?. Building Research & Information, 41(1), 1-7.

Butler, D., Dengel, A. (2013). Review of Co-heating Test Methodologies: Primary Research.

NHBC Foundation. https://www.nhbcfoundation.org/publication/review-of-co-heatingtest-methodologies/ Published 10.12.13, Accessed 2/2/18

Cadwalladr, C. (2017). The great British Brexit robbery: how our democracy was hijacked. The Guardian, 07 May 2017. Retrieved 3/4/18

Casals, X. G. (2006). Analysis of building energy regulation and certification in Europe: Their role, limitations and differences. Energy and buildings, 38(5), 381-392.

UK Parliament (1968) Clean Air Act 1968 http://www.legislation.gov.uk/ukpga/1968/62/contents. Retrieved 31/1/18

DEFRA (2006) Climate Change: The UK Programme 2006, Department of Environment, Food and Rural Affairs, London Department for Communities and Local Government, (2007). Building a Greener Future: policy statement. London: Communities and Local Government Publications.

Delzendeh, E., Wu, S., Lee, A., Zhou, Y. (2017). The impact of occupants' behaviours on building energy analysis: A research review. Renewable and Sustainable Energy Reviews, 80, 1061-1071.

Duffy, F. (2008). Forum Linking theory back to practice. Building Research & Information, 36(6), 655-658.

Eaton, C (2014) GHA Monitoring Programme 2011-13: Technical Report, Good Homes Alliance May 2014 http://goodhomes.org.uk/wp-content/uploads/2017/08/01-GHAMonitoring- Report-Phase-2-Summary-and-Recommendations.pdf accessed 19/4/18

Egan, J. (1998). The Egan report: Rethinking construction, report of the construction industry taskforce to the Deputy Prime Minister. London: HSMO

Fieser, J., Dowden, B. (2011). Internet encyclopaedia of philosophy. http://www.iep.utm.edu/ethics/ accessed 24/4/18

Farmer, M (2016) The Farmer Review of the UK Construction Labour Model, available at

http://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2016/10/Farmer- Review.pdf accessed 2/2/18

Fox, W. (Ed.). (2012). Ethics and the built environment. Routledge.

Gill, Z. M., Tierney, M. J., Pegg, I. M., Allan, N. (2010). Low-energy dwellings: the contribution of behaviours to actual performance. Building Research & Information, 38(5), 491-508.

Gupta, R., Kapsali, M. (2016). Evaluating the 'as-built'performance of an eco-housing development in the UK. Building Services Engineering Research and Technology, 37(2), 220-242.

Hartenberger, U., Lorenz, D., Lützkendorf, T. (2013). A shared built environment professional identity through education and training. Building Research & Information, 41(1), 60-76.

Hackett, J (2007) 'Building a Safer Future - Independent Review of Building Regulations and Fire Safety': Interim Report December 2007 accessed at https://tinyurl.com/y7lo3x3t accessed 2/2/18

Hill, S., Lorenz, D., Dent, P., Lützkendorf, T. (2013). Professionalism and ethics in a changing economy. Building Research & Information, 41(1), 8-27. Thanet District Council https://www.thanet.gov.uk/your-services/housing/multiple-occupancyhomes/offences/

Jack, R., Loveday, D., Allinson, D., Lomas, K. (2017). First evidence for the reliability of building co-heating tests. Building Research & Information, 46(4), 383-401. Janda, K. B. (2011). Buildings don't use energy: People do. Architectural Science Review,

54(1), pp. 15 22.

Johnson, R. B., Onwuegbuzie, A. J., Turner, L. A. (2007). Toward a definition of mixed methods research. Journal of Mixed Methods Research, 1(2), 112–133. doi:10.1177/1558689806298224

Jones, S. (1992). Was there a Hawthorne effect? American Journal ofSociology, 98(3): 451-468

Kelly, S. Crawford-Brown, D, Pollitt, M (2012) Building performance evaluation and certification in the UK: Is SAP fit for purpose?, Renewable and Sustainable Energy Reviews, 16(9), 6861-6878.

Laustsen, J. (2008). Energy efficiency requirements in building codes, energy efficiency policies for new buildings. International Energy Agency (IEA), 2(8), 477-488.

Lowe, R., Chiu, L. F., Oreszczyn, T. (2017). Socio-technical case study method in building

performance evaluation. Building Research & Information. doi:10.1080/09613218.2017.1361275

Lowe, J. and Johnstone, D. (1997) A Field Trial Of Mechanical Ventilation With Heat Recovery In Local Authority, Low-Rise Housing. Final Report. November 1997. Leeds Metropolitan University accessed at https://www.leedsbeckett.ac.uk/as/cebe/projects/derwentside.pdf 29/4/18

Loulakis, M. C., McLaughlin, L. P. (2014). Tort Liability Expands for Project Architects in California. Civil Engineering Magazine Archive, 84(8), 88-88.

Mavrogianni, A., Davies, M., Wilkinson, P., Pathan, A. (2010). London housing and climate change: impact on comfort and health-preliminary results of a summer overheating study. Open House International, 35(2), 49.

Markus, T. A. (Ed.). (1972). Building performance. New York: John Wiley & Sons. Monahan, S., Gemmell, A. (2011). How occupants behave and interact with their homes. The Impact on Energy Use, Comfort, Control and Satisfaction. HIS-BRE Press on behalf of the NHBC Foundation, Milton Keynes.

Morrell, P. (2015). Collaboration for Change: The Edge Commission Report on the Future of Professionalism.| London: The Edge.

Palmer, J., Terry, N., Armitage, P. (2016). Building performance evaluation programme: Findings from non-domestic projects. London: Innovate UK.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_d

ata/file/497761/Non-Domestic_Building_performance_full_report_2016.pdf accessed 24/4/18

Porter, S. R., Whitcomb, M. E., Weitzer, W. H. (2004). Multiple surveys of students and survey

fatigue. New Directions for Institutional Research, 2004(121), 63-73.

Preiser, W. F., Davis, A. T., Salama, A. M., Hardy, A. (Eds.). (2014). Architecture beyond

criticism: Expert judgment and performance evaluation. Abingdon: Routledge.

Raisbeck P, Day K (2016) 'Architectural specialisation and the death of architectural practice'

in Fifty years later: pp. 805-814. In Revisiting the role of architectural science in design and practice: 50th International Conference of the Architectural Science Association 2016, ©2016, The Architectural Science Association and The University of Adelaide.

RIBA (2013) RIBA CODE OF PROFESSIONAL CONDUCT. https://www.architecture.com/knowledge-and-resources/resources-landing-page/code-ofprofessional-conduct accessed 2/2/18

RIBA (2013) RIBA Plan Of Work London: RIBA Publishing. ISBN: 9781859465196

Robson, P. (2015). The Bedroom Tax. Edinburgh Law Review, 19(1), 134-139.

Sadri, H. (2017) Profession vs Ethics. Journal of Contemporary Urban Affairs, [S.l.], v. 1, n. 2, p. 76-82, aug. 2017. ISSN 2475-6164. Available at: www.ijcua.com/index.php/ijcua/article/view/15 Date accessed: 06/04/2018.

Scottish Government (2015) Overcrowding Statutory Notices. Private Rented Housing (Scotland) Act 2011

Seguro, F. (2015). Building Performance Evaluation meta-analysis. Insights from social housing projects. http://www.nef.org.uk/themes/site_themes/agile_records/images/uploads/FINAL_-_Meta-Analysis_Report_v2.1.pdf accessed 24/4/18

Sharpe, T., Farren, P., Howieson, S., Tuohy, P., McQuillan, J. (2015). Occupant interactions and effectiveness of natural ventilation strategies in contemporary new housing in Scotland, UK. International journal of environmental research and public health, 12(7), 8480-8497.

Sharpe, T., Mawditt, I., Gupta, R., McGill, G., Gregg, M. (2016). Characteristics and

performance of MVHR systems A meta study of MVHR systems used in the Innovate UK Building Performance Evaluation Programme.

Sharpe, T (2013) Building performance evaluation. In: Innovations for Sustainable Building Design and Refurbishment in Scotland (edited by B. Dimitrijevic). Cham: Springer, pp. 127-146. ISBN 9783319024776

Sharpe, T. and Charles, A. (2015) Ventilation Provision and Outcomes In Mainstream Contemporary New-Building Flats In London, UK. In 1st North American Regional Conference Proceedings Healthy Buildings 2015 America, Boulder, USA, July 19-22 2015 accessed at https://www.isiaq.org/docs/Proceedings_HB2015-America.pdf 29/4/18

Stevenson, F., Carmona-Andreu, I., Hancock, M. (2013). The usability of control interfaces in low-carbon housing. Architectural Science Review, 56(1), 70-82.

Stevens, B. L., Lewis, F. L., Johnson, E. N. (2015). Aircraft control and simulation: dynamics, controls design, and autonomous systems. Feb 2016, Wiley-Blackwell, ISBN 978-1-118-87098-3

Stewart, J (2005) A review of UK housing policy: ideology and public health. Public Health , Volume 119 , Issue 6 , 525 - 534

Technology Strategy Board (2010) Building Performance Evaluation, Domestic Buildings, Guidance for Project Execution.

Till, J (2009) Architecture Depends. London: MIT Press. ISBN 9780262012539

Tweed, C., Zapata-Lancaster, G. (2017). Interdisciplinary perspectives on building thermal performance. Building Research & Information,. DOI: 10.1080/09613218.2018.1379815

UK Government (1998). Data Protection Act of 1998www.legislation.gov.uk/ukpga/1998/29/contents accessed /2/18

Mayer-Schönberger, V. and Cukier, K. (2014). Big Data: A Revolution That Will Transform How We Live, Work, and Think. John Murray (10 Oct. 2013) ISBN 1848547927

Walker, G., Karvonen, A., and Guy, S. (2016). Reflections on a policy denouement: the politics of mainstreaming zero-carbon housing. Transactions of the Institute of British Geographers, 41(1), 104-106.

Wargocki, P. (2013). The effects of ventilation in homes on health. International Journal of Ventilation, 12(2), 101-118.

Williams, J., Mitchell, R., Raicic, V., Vellei, M., Mustard, G., Wismayer, A., Parkin, A. (2016). Less is more: A review of low energy standards and the urgent need for an international universal zero energy standard. Journal of Building Engineering, 6, 65-74.

Zero Carbon Hub (2014). Design as Built Performance End of Term Report. London: ZCH.