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Learning from built projects – sources of post occupancy feedback used by architects in Victoria, Australia

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ABSTRACT

How do architects know whether their design was successful and if the building performs as intended? This is important to improve the standard of the built fabric, to show the value in good design, for the architect to learn whether the spaces achieved the desired aims, and to check sustainability performance. This research investigates the types of feedback received and studied by architects in Victoria to learn from their own built works. A literature search identified possible informal and formal feedback methods and emerging feedback methods. A general pilot study was conducted by interviewing six senior architects in practice regarding their practices' feedback sources and methods of disseminating that knowledge. Additional feedback sources identified included the defects liability period, practice specific commissioning procedures, photography visits, and architectural services interviews. Knowledge dissemination methods included feedback reported directly to design teams, management & staff meetings, staff email, formal presentations, practice intranet software and updates to practice quality assurance procedures. Concerns raised by practitioners included procurement methods that actively discourage post occupancy analysis (POA), client unwillingness to pay for POA, and impacts on building performance of client or builder cost-based decisions.

1. Introduction: how do architects learn from built projects?

How do architects know whether their building design was successful? Does it satisfy the aesthetic, functional and environmental goals that were set at the beginning of the project? How does it compare to other similar buildings?

In disciplines such as commercial business and management many organisations follow a Continuous Improvement philosophy. If a Continuous Improvement mindset were applied to architecture, do architects receive sufficient feedback from built projects to enable improvement?

Continuous Improvement is a term from enterprise management theory which is an umbrella term covering an array of business improvement techniques (Zangwill and Kantor 1998, 29). In commercial business and management systems, procedures, product designs, components and work practices are examined and changed on a continuous basis, to improve efficiency and therefore profitability and to learn from any adverse events that arise so that they may be prevented or avoided in the future (Aartsengel and Kurtoglu 2013). This research asks how architects pursue similar aims in their design practices.

In order to clarify the scope of this project and develop meaningful results, this research investigated the types of feedback received and studied by architects to learn from their own previous built works. The research questions included:

- How do Victorian architects get post-build feedback on their projects?
- What mechanisms are available that they may not be using?
- Do they have formalised practices for acquiring and passing on this knowledge?
- Are there barriers to collection and dissemination of information?

While these questions could be broadly described as post-occupancy evaluation (POE), over time this term has come to mean more formal studies, mostly concerned with user requirements and energy performance. Due to differences in understanding of the definition and scope of POE by practitioners (Hay et al. 2017, 121), and in order to obtain comprehensive answers to these questions, this research used the term '*post build feedback*'. This term was deliberately intended to encompass all types of post-occupancy feedback and avoid raising pre-conceptions about any specific feedback method. Consequently, this study was designed to understand the whole spectrum of feedback available to and used by architects.

This paper is structured into two main sections: a literature review investigating types and sources of post-occupancy feedback available, as presented in the literature, and the results of a pilot study consisting of semi-structured interviews of senior architects in practice in Victoria, Australia. The pilot study was intended to test questions and understandings so that they could be refined for a larger scale statistical survey in the future.

The literature review describes why it is important for architects to receive feedback on built projects after they have been used, what types of post-occupancy feedback are currently available to architects and the context of the research project in the profession.

The second part of this paper describes the methodology of the semi-structured interviews, analyses the results, and presents some unexpected findings of the study.

2. Post-occupancy feedback methods in the literature

Building designers need post-occupancy feedback for a number of reasons. This is important to improve the standard of the built fabric, for the architect to learn whether the spaces achieved the desired aims, to check sustainability performance and to show the value in good design.

The Australian construction industry has been characterised as inefficient, following old-fashioned practices, slow to incorporate sustainability improvements and overly dependent on 'wet trades' (Hartley 2009; Hay et al. 2017; Graham and Warren-Myers 2019). Often, buildings do not perform as intended, in terms of energy use, carbon emissions, occupant comfort and satisfaction (Hay et al. 2017), for example, where high-tech systems require high levels of monitoring and operation beyond the capabilities or interest of occupiers (Cohen et al. 2001, 85). By high-lighting causes of these issues, post-build feedback can be used to improve the standard of the built fabric.

Buildings are largely customised products of which all projects are prototypes and which are occupied by different user groups with unique organisational cultures. Although design firms may focus on a building type and therefore have projects with repeated parameters &/or clients, the building process is not like mass production manufacturing, where many standardised units are produced with little change to models over time. In mass production performance is easily predicted, and the effect of changes easily measured. Feedback is more difficult in the building industry: 'buildings are more like ships than cars' (Bordass, Leaman, and Ruyssevelt 2001, 150), not only because the product is much more complicated but also due to the many designers in the process (Zimmerman and Martin 2001). Therefore, in order to learn the effect of changes in designs, information on buildings in use must be acquired and fed back to designers, constructors and owners (Andreu and Oreszczyn 2004; James, Kirti, and Andrew 2013).

Also, an architect may intend for a space to have a certain character, or be used a certain way, but will not know if it fulfils these expectations unless they receive feedback at some time after occupancy. Other expectations included in briefs, such as degree of control vs automation, and ongoing information requirements will need to be compared to actual results (Andreu and Oreszczyn 2004, 326).

Requirements are now embodied in legislation and regulation in Australia for higher standards of Environmentally Sustainable Design (ESD) for all buildings (e.g. BASIX in NSW and Green Star requirements in Victoria). As these assessments are required pre-build, there is also greater demand for tools to assess post-build performance against these predictions. It is understood by architects that sustainability of our designs is a given, as evidenced by the dropping of the category of sustainability from the 2012 NSW Australian Institute of Architects awards (Borg 2011). Concomitant with rising awareness of sustainability is the understanding that more durable buildings are less environmentally costly.

> However, there is a wider paradigm shift in how we think about the duration of the relationship between the designed and the designer. … … … -the performance of the built environment post occupancy should also be implied in everything that an architect does. (Borg 2011, 87)

In addition, results from post occupancy analyses are seen by some architects as important for supporting the argument to clients and wider society that investment in design adds value (Hay et al. 2017).

Therefore, architects need feedback on their own built projects and completed projects in general, and the following section discusses feedback processes that are currently available as shown in the literature.

2.1. Informal post-occupancy feedback

Evidence indicates that architects will visit most of their buildings once in use and will receive informal feedback from clients (Woodroffe and Tucker 2007; Kelly et al. 2011; Othman and Elsaay 2018). Other types of informal feedback that are available include:

- panel assessments from award juries – limited to positive comments as juries are forbidden from making negative comments (Australian Institute of Architects 2015),
- the AIA 25 Year Award – not timely (awarded 25 years after occupancy) and inconsistent because they have been awarded based upon a number of different jury rationales (Goad 2011),
- journal review articles – while prepared by experts, have a number of deficiencies including representing a limited viewpoint, do not include analytical measures of performance, do not include user feedback, and, of necessity, represent a limited number of projects,
- newspaper articles – are written by journalists with a news or editorial agenda in mind and are subject to similar problems to journal review articles,
- site visits, conversation and observation with clients (Woodroffe and Tucker 2007).

2.2. Formal post-occupancy feedback

Categories of formal feedback which may be available to architects for a particular building include:

2.2.1. Sustainability assessment and reporting methodologies
There are a number of sustainability rating schemes that may be used by architects or their clients to verify the performance of their completed building or benchmark it against buildings of a similar type. All schemes include ratings of energy use, water use, waste and indoor environment quality, although the latter two may be included in more comprehensive categories. Areas rated by sustainability rating schemes available to architects in Australia are listed in Table 1.

Table 1. Areas assessed by different sustainability rating schemes.

Scheme	NABERS	Green Star	BREEAM	LEED
Organisation	Australian Government	Green Building Council of Australia	Building Research Establishment Ltd UK	United States Green Building Council
Phase used	Design & As Built	Design & As Built	New Construction, Refurbishment or In Use	Design & As Built
Rated areas	Energy	Energy	Energy	Energy & atmosphere
		Emissions	Pollution	
	Water	Water	Water	Water efficiency
		Materials	Materials	Materials & Resources
	Waste		Waste	
	Indoor environment	Indoor environment quality	Health and well being	Indoor environment quality
		Land use & ecology	Land use	Sustainable sites
		Innovation	Innovation	
		Transport	Transport	Location & transportation
		Management	Management	
				Regional priority

NABERS (National Australian Built Environment Rating System) (Baird 2011; NABERS 2014) – used as an assessment tool during the design phase to improve predicted energy performance and used for publicly available as-built ratings (NABERS 2017) and to compare to design predictions and analyse discrepancies.

Green Star (GBCA 2017), a rating system administered by the Green Building Council of Australia, is used mainly as a marketing tool, but is also used to compare design predictions and analyse discrepancies.

BREEAM (Building Research Establishment Environmental Assessment Method), was established in the UK in 1990 and is the rating system most used worldwide (Building Research Establishment Ltd 2017) and can be used at New Construction, Refurbishment or In Use lifecycle stages.

LEED (Leadership in Energy and Environmental Design) (LEED 2017) is the equivalent programme from the United States Green Building Council. The system is intended to be used during design and then may be confirmed with as-built assessments.

WELL Building and Passivhaus are other voluntary certifications that can be performed both during design and post-build. WELL certification includes qualitative measures, such as Feature 87: Beauty and Mindful Design which includes human delight and celebration of culture (International Well Building Institute 2019).

2.2.2. Post occupancy evaluation

Post Occupancy Evaluation (POE) is defined as 'the process of evaluating buildings in a systematic and rigorous manner' after they have been completed and used for a significant time (Preiser, Rabinowitz, and White 1988, 360). POEs may include analysis of space planning, functional fit, resource consumption, internal environmental quality, maintenance and occupancy costs, user comfort, satisfaction and outcomes (Zimmerman and Martin 2001; Göçer, Hua, and Göçer 2015; Hay et al. 2017). POEs may be conducted using methods such as user questionnaires, interviews, data from energy bills, instrumental measurement of comfort factors, building in use observation and data from patient records (Preiser, Rabinowitz, and White 1988, 360). Early POEs were generally undertaken by academics and produced an excess of data. Also, due to different metrics and methods, studies were not comparable. Clients also felt POE was too academic and too late to be of benefit to the particular project studied (Bordass and Leaman 2005). POEs were mainly used in office building contexts where they concentrated heavily on user surveys (Cooper 2001) which are vulnerable to worker dissatisfaction with other workplace issues (Cohen et al. 2001; Candido et al. 2016).

Since then there have been a number of initiatives to make POEs more useful and comprehensive including the British Probe process (late 1990s) (Cohen et al. 2001), Soft Landings (late 2000s) (Way

and Bordass 2005) and the Australian BOSSA system (2010s) (Candido et al. 2016). Many post occupancy studies have been published in the architectural, sustainability and facilities management literature, and summarised in papers such as (Zimmerman and Martin 2001; Meir et al. 2009; Laursen, Danielsen, and Rosenberg 2014; Li, Froese, and Brager 2018). However, when considering their use by architects to review their own completed work, this body of work exhibits a number of deficiencies:

- The focus has been on examining particular aspects of performance rather than providing comprehensive feedback on individual buildings, as described in a systematic review article prepared in 2018, (Li, Froese, and Brager 2018, 191).
- They tend to be focussed on energy performance and comfort and consequently neglect qualitative aspects (Brown 2018). This may in part be due to the difficulty in objectively assessing qualitative aspects of designs and the lack of research in this area.
- With the exception of a very few, they do not aim to distil guidelines for design from the data (Li, Froese, and Brager 2018; Vischer 2009). Guidelines could be rules of thumb, strategies, lists of considerations, methods or processes.
- Questionnaires provide data of client and user perceptions but do not provide information as to what caused those perceptions. Questionnaire results tend to provide generalised feedback that does not provide architects with the information they require (Kelly et al. 2011).
- POE results (that are not proprietary to a particular organisation) tend to be published in academic journals (Li, Froese, and Brager 2018) and journal formats do not support the publishing of spatial information (Hamilton 2007).
- Lack of uniformity in the data has prevented meta-analysis (i.e. comparison of results across the literature) to derive conclusions regarding design features (Göçer, Hua, and Göçer 2015; Candido et al. 2016; Hay et al. 2017).
- POEs are still largely prepared by academics and published in academic journals, therefore, not readily available, analysed, compiled nor formatted in a way to explicitly provide guidelines for design (Martin 2014; Li, Froese, and Brager 2018).

  … members of the design community tend to be nervous about reading and understanding original research. They are unsure of their ability to understand academic language, much less to critically interpret the implications of research on their projects. They are hesitant to draw conclusions, yet they frequently overestimate the reliability of findings. (Hamilton 2007, 29)

  There are times when researchers may not fully understand the constraints under which the design community operates, and thus they may limit the practical application of their research. (Hamilton 2007, 29)

In addition to the above shortcomings of POEs as feedback mechanisms, other barriers to post occupancy analysis are related to operating practices in the construction industry, including:

- There is an industry culture that sees a building as completed at handover (Cooper 2001, 162; Hay et al. 2017).
- No part of the project budget is allocated for post occupancy studies. Clients were unwilling to pay for POEs as they saw the main benefits going to the design team and/or their next client and there was no POE in the standard conditions of engagement for designers (Bordass 2004). Andreu and Oreszczyn, in their 2004 survey found that although architects felt the cost or time was worth spending, post-build analysis would be clear overhead (Andreu and Oreszczyn 2004, 325) and contractors do not see the benefit of this (Hay et al. 2017).
- Builders fear uncovering problems for which they may be held responsible, ranging from having more (probably unpaid) work to do, to being subject to a lawsuit. (Bordass 2004)
- Architects in the profession have concerns that conducting Post Occupancy Evaluations may lead to issues with professional liability or practice reputations, and insurers have expressed worries

regarding a possible increase in Professional Indemnity related claims (Hay et al. 2017), for example, if a POE reveals a significant deficiency in the energy performance of a design.

2.2.3. New and developing feedback technologies

In addition to feedback types described above, there are some new and emerging techniques in the post-occupancy evaluation sector. Some examples are:

The Green Building Assessment Tool (GBAT) is a software application that has been developed by researchers to take information from Building Information Modelling (BIM) project models, analyse it with the BREEAM green materials database and provide documents for BREEAM certification. These could be used as part of a BREEAM In Use certification which would provide feedback on whether the design goals were met. The GBAT is rudimentary at present and requires considerable manipulation of data before input (Ilhan and Yaman 2016).

An effort is underway to use Geographic Information System (GIS) spatial mapping and BIM tools to provide spatial information regarding building performance, in order to provide feedback to compare to spatial analyses modelled during the design phase (Göçer, Hua, and Göçer 2015). The researchers created a database in a GIS system which integrates environmental data from the Building Management System (BMS) and in-situ measurements, spatial data from the BIM building model and user-related data from facilities management and POEs, and presents that data in spatial maps of the building (Göçer, Hua, and Göçer 2015).

The Architecture Engineering and Construction (AEC) industries are currently grappling with the need for information exchange between BIM models, building energy performance simulation (BEPS) modelling software, and BMS. A number of papers have suggested different frameworks and methods for translating this information for example, (Oti et al. 2016; Gerrish et al. 2017; Pinheiro et al. 2018). Industry standards are needed regarding form and structure of this data, because at present it requires specialist IT knowledge and many steps to extract and compare data between systems (Andriamamonjy, Saelens, and Klein 2019; Wang, Pan, and Luo 2019).

However, all these new feedback initiatives are in their infancy, and not available to architects as yet. Obstacles to development include the same AEC industry structural and cultural issues listed as barriers to POE above, being industry culture, project budgets and professional liability worries. The other major obstacle is the lack of interoperability between data stored in the BIM, BEPS, GIS and BMS computer applications. (Andriamamonjy, Saelens, and Klein 2019; Wang, Pan, and Luo 2019).

In the future crowd-sourcing of building energy consumption information may provide more comprehensive data regarding actual energy consumption of the building stock, and an ability for users to benchmark their own building, as predicted in a study by Robertson, Mumovic & Hong (Robertson, Mumovic, and Hong 2015). The particular crowd sourced databases used for that study were (a) the UK Display Energy Certificates (DECs) database (DECs are records of the actual energy usage of public buildings, on a simple scale from A to G, and since 2015 all public buildings over 250 m^2 must display DECs prominently) with over 45,000 records and (b) Carbon Buzz, a UK joint initiative of higher education, CIBSE (Chartered Institute of Building Services Engineers), RIBA (Royal Institute of British Architects) and large building portfolio owners, an on-line energy use comparison platform where professionals can upload actual energy use and compare against design estimates and comparable buildings, listing 486 projects (Robertson, Mumovic, and Hong 2015).

All of these emerging feedback methods utilise the processing power of computer systems to analyse and present post occupancy data. In the future, these technologies could enable seamless transfer of data to enable comparison of actual outcomes to predictions made during the design phases.

Figure 1 below shows the various methods of feedback described by the literature review above, and their timing in relation to the construction cycle.
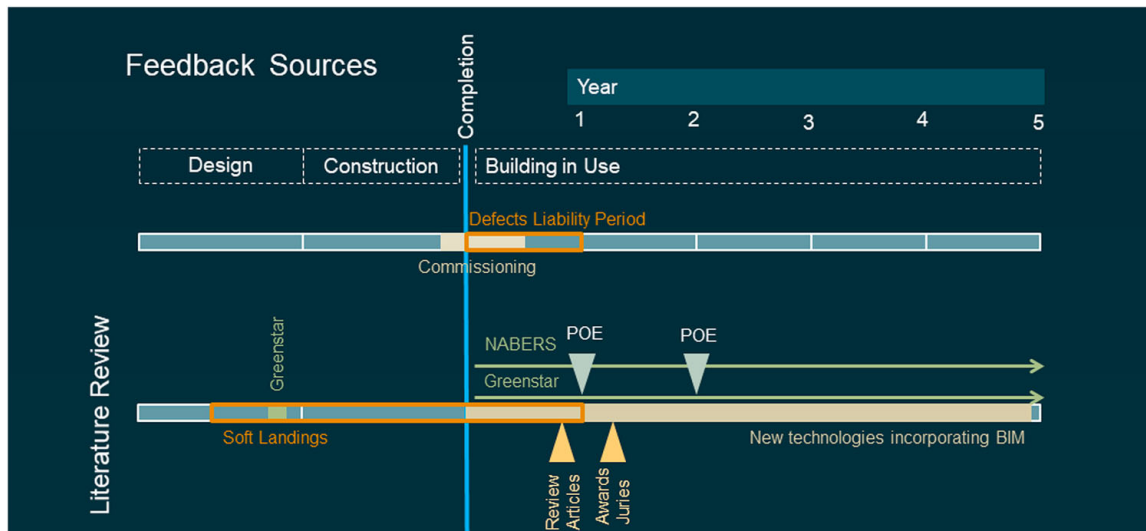
Figure 1. Sources of feedback and their timing in relation to the construction cycle.

2.3. Existing research on post-occupancy feedback in architectural practices

In 2007 a survey was conducted of leading ESD architectural practices, 9 in Australia and 1 in Britain, to investigate implementation and use of POEs (Woodroffe and Tucker 2007). This study used POE as a general term for any kind of post-occupancy information. They surveyed 3 small, 2 medium and 3 large practices. However, in the paper they did not define their size criteria. This study is now over 10 years old, targeted only leading ESD practices and was only concerned with project sustainability outcomes. It found that the smaller practices did not perform formal POEs, the medium-sized practices performed their POEs in-house, and the large practices generally used consultants (Woodroffe and Tucker 2007). Informal feedback methods reported included conversations with clients (including during the defects liability period), observation of the building in use, structured reviews with clients of design process and outcomes, and ongoing client relationships.

Kelly et al conducted semi-structured interviews in 2011 with 7 UK architects (Kelly et al. 2011). The aim of the interviews was to understand architects use of feedback and their values and views on feedback in order to improve feedback usefulness when designing for adaptability of buildings. Formal feedback was not utilised by the practices unless required by and paid for by the client. All practices used informal feedback methods including discussion with clients (Kelly et al. 2011).

In late 2016, Hay et al. interviewed 10 architectural practitioners in the UK to investigate reasons for the low up-take of POE and explore their experiences and their views of the future of POE (Hay et al. 2017). Informal feedback methods were not discussed. Participants were deliberately selected who were already active in POE. The researchers found that while these practitioners valued POE, they experienced barriers to delivery, mainly caused by structural issues in the construction industry. These included speculative clients, design and build contracts, reduction of the architect's authority in the construction process, insurance and liability issues, short-termism in the industry and lack of regulatory incentives. The practitioners also expressed a wish to extend POE to broader occupant issues, such as impact of school design on learning and impact of healthcare buildings on patient comfort & stress (Hay et al. 2017).

A survey of 38 architectural design firms in Egypt in 2016 (Othman and Elsaay 2016) found that only 34.2% conducted post-build assessment and their methods included observations, walk throughs, site visits, telephone interviews, in person interviews, emailed surveys and paper-circulated surveys (Othman and Elsaay 2018).

Gaps have been identified in the research represented by the above 4 studies including a lack of recent studies in Australia, and needs to survey a more comprehensive sample of practices, to determine whether architects examine a more comprehensive range of factors, to determine other

feedback sources used and to determine whether circumstances have changed since the 2007 Australian study. This study aimed to examine the situation in Australia to investigate what information was available to and used by architects and which building outcomes architects examined.

3. Pilot study rationale, results & analysis

3.1. Interview methodology

Interviews were used as the method to obtain the maximum information most efficiently. Semi-structured interviews were used with qualitative, open-ended questions which were not intended to be reduced to quantified data (Fellows and Liu 2015, 27). but do describe the range of information available, the practitioners' attitudes and how the contingencies of the business of architecture impact upon this aspect of design. In other words, they provide richness and depth to the data (Groat and Wang 2002, 257)

For this study the researcher endeavoured to ensure questions were unambiguous and free from implied judgements The term 'post-build feedback' was coined to be broad and to avoid any preconceptions regarding POE that might affect responses. The order of questions moved from the general to the particular, so that answers to the general questions were not influenced by previous questions of the particular (Labaw 1981, 121).

Table 2 lists the semi-structured questions that were asked:

3.2. Participant selection

Architects were selected who are senior in the profession, who might have an interest in the subject area and from a range of practice sizes. Of the 11 practitioners who were approached, 6 agreed to be interviewed. The range of building types covered in this study was predefined by the participants/ practices who were available for interviews.

3.3. Results and analysis

Responses were generally tabulated and analysed at face value. However, where interviewees raised issues outside the scope of the questions, these comments were subjected to a limited thematic analysis (Braun and Clarke 2006).

3.3.1. Practice information and building types
Practices were categorised by size, in accordance with prior studies: Small, employing 0–20 architects, medium, employing 21–50 architects and large, employing more than 50 architects (Martin 2014). It should be noted that the small practices ranged in size from 2.5 to 20 architects.

The practitioners identified their firms' top 3 building type areas of expertise as indicated in Table 3.

An unexpected result of the interviewee selection was the weighting of the building types represented in the sample towards the education category, and thus may not be representative of the Victorian population of architectural practices. Practices with major areas of expertise in houses or multi-residential or retail may use different feedback methods.

3.3.2. Learning through built projects
Post-occupancy feedback methods identified by both the literature review and the interviewees included:

- site visits (observation of the building in use)
- conversation with clients (including telephone calls),

Table 2. Learning from built projects interview questions.

Practice information

1. Number of architectural staff Small 0–20, medium 21–50 Large >50
2. Area of Practice: Building Typology of Designs – indicate top 3 areas of expertise:

Learning through built projects

3. What are your sources to get information on how your building actually performs?
4. Does your firm perform assessment of built projects after they are occupied? Yes/No
5. How do you analyse built projects and what is the analysis focused on? E.g.
6. Does the location of the project have an impact on the information received?
7. How are lessons from these assessments incorporated into later projects?

Rating schemes

8. When NABERS/Greenstar/Or similar assessment of projects is commissioned post-occupancy, do you receive access to this data?
9. How are lessons from these assessments incorporated into later projects?

Post occupancy evaluation Post Occupancy Evaluation (POE) is a term used by academics to describe studies of completed buildings, including analysis of thermal performance, occupant satisfaction, operational efficiency, durability of materials, etc.

10. Do you think Post Occupancy Evaluation (POE) is useful?
11. Why?
12. Was POE covered in your university studies?
    a. Described in depth
    b. Mentioned
    c. Not discussed
13. Have any of your firm's completed buildings been subject to POE?
14. Was the information useful?

- structured reviews with clients of design process and outcomes,
- ongoing client relationships
- energy assessment rating schemes
- formal in-house assessments or POEs by staff of the architectural practice
- formal POEs funded by building owners

Additional post-occupancy feedback methods identified by the interviewed architects included:

- Independent commissioning agents employed by the Project Manager
- Education Design Strategist facilitating client settling in processes up to 3 months (an employee of the practice who works with the educational users during the design phase, commissioning and for follow up after occupation),
- Issues or defects in the building raised during the 12 month defect period or indeed, at any time after that. Despite extensive searching, no literature was found that listed the defects liability

Table 3. Areas of expertise of interviewed practitioners' firms.

Practice	A	B	C	D	E	F
Size	Medium	Large	Small	Small	Small	Large
1	Tertiary education	Workplace-office	Law Courts	Education	Education	Education
2	Institutional	Health	Masterplans	Commercial	Government specialist e.g. CSIRO	Commercial
3	Commercial	Education	Residential	Institutional	VCAT expert witness	Infrastructure

Note: Institutional was described by practitioner A as council, police, library, etc. and by practitioner D as art galleries, libraries, etc. Infrastructure was described by practitioner F as being rail and airport buildings.

process as a source of feedback to architects. It is possibly a useful source of feedback because the procedures are already in place. However, practitioner A stated that approximately 75% of defects found relate to mechanical services,

- Photography visits 6–9 months post-occupancy,
- Architectural Service Interviews at 12 months (a kind of client satisfaction/lessons learned interview),
- Green Star reports from ongoing monitoring,
- Reports from clients providing data from continuous monitoring instruments and
- Independent consultant POE reports

Unlike the literature review, the practitioners did not mention journal review articles and AIA awards as sources of feedback.

Figure 2 below compares the various methods of feedback described by the literature review and interview survey, and their timing in relation to the construction cycle.

Interestingly, 3 of the practices (C, D & E) reported finding the defects liability period insufficient and wanting longer periods of contact with the client to ensure the building is performing as expected. One large practice is offering a new in-house analysis service, with assessments every 6 months, as an alternative to requesting independent consultant POEs. The content, timing and extent of these assessments are agreed with the client beforehand. Three practices D, E & F stated that being involved with clients over a number of projects allowed repeated follow-up visits to the site and opportunity to observe and receive feedback from clients and users. Practice E, which specialises in Environmentally Sustainable Design (ESD) and design of complex institutional buildings also continues their weekly or fortnightly meetings with the client until all parties to the project are satisfied, which can take more than a year.

Only the large practices had projects with externally contracted formal post occupancy assessments. This may be related to the size of the projects or the size of the clients and budgets. Also, according to respondents D and F, the Victorian School Building Authority has in early 2017 funded
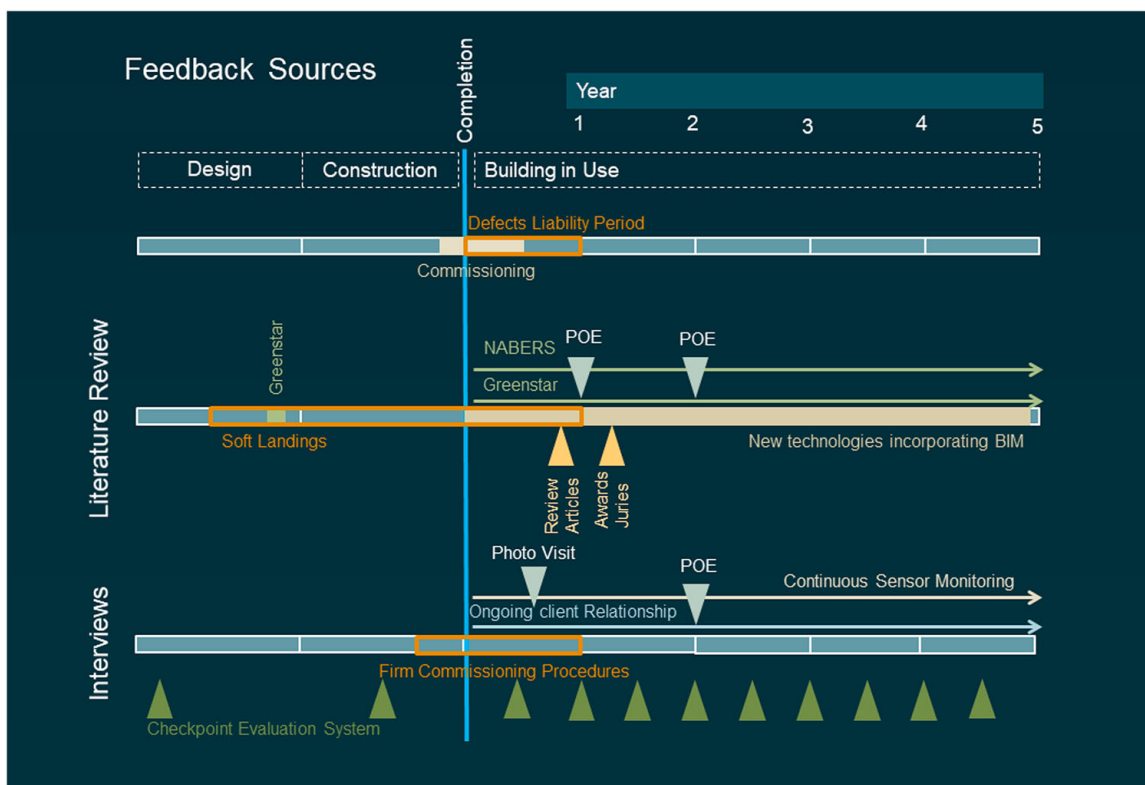

Figure 2. Sources of post-occupancy feedback and their timing in relation to the construction cycle.

a requirement for independent POE analysis on all completed school projects. This aligns with the literature review, where it was suggested that clients with large building programmes are more likely to contract for independent POEs.

The architecture practices sources for information on how the building actually performs were different between practices and appeared to be related to the size of practice and the area of expertise. The largest practices contracted for or conducted their own POEs or conducted formal reviews with the client, the medium sized practices incorporated extended commissioning periods or client contact, whereas the smallest practices were limited to site and photography visits unless the client supported instrument monitoring or user feedback.

It was observed that the practices focused on acquiring feedback relevant to their particular specialty. For example, practice E mainly focuses on ESD and are installing automated sensors in buildings designed for innovation uses, to collect comfort data and data regarding use of spaces, which they will analyse to determine how the building performs compared to modelling during design. Practice D (education specialists) also pursue ESD projects and obtain energy performance data from those clients.

For the largest practice (B), who specialise in workplace design, the focus of the analysis is determined in conjunction with the client. The building needs to support the business objectives of the client. Analysis techniques include user surveys, interviews and social network mapping, a research methodology that studies the ways individuals interact and the influence they have on one another which emerged in the discipline of sociology and is now used in anthropology, biology, and many other disciplines (Freeman 2004).

Other practices pursue some of the following activities during a post-occupancy site visit:

- Observe performance of materials and specified items
- Ask the client how spaces are working
- Sit down and observe people in spaces
- Talk to users
- Obtain energy performance data from client

All but practises A and F stated that location did have an impact on the information received about a project. Generally, those buildings that were farther away received fewer visits due to time and cost constraints.

All practices incorporated lessons learned from this post-build feedback in later projects although they used a selection of different methods including:

- through the practice Quality Assurance system,
- direct staff emails
- management and staff meetings
- presentations at staff and management meetings
- formal presentations with invited guests
- Directors that receive feedback from clients report it directly to design teams,
- practice intranet databases,
- practice internal social networking software (such as Yammer) and
- modification of practice pro-forma Specifications

Figure 3 below is a graphic describing these methods in the context of the project cycle.

Only Practice F described creating a database or design guide where these lessons are accumulated, although practice B does have a document management file system for academic papers found to be relevant to their work. All of the practices rely on directors or associates to communicate lessons learned to design teams, often with formal meetings specifically for this purpose. Practitioner
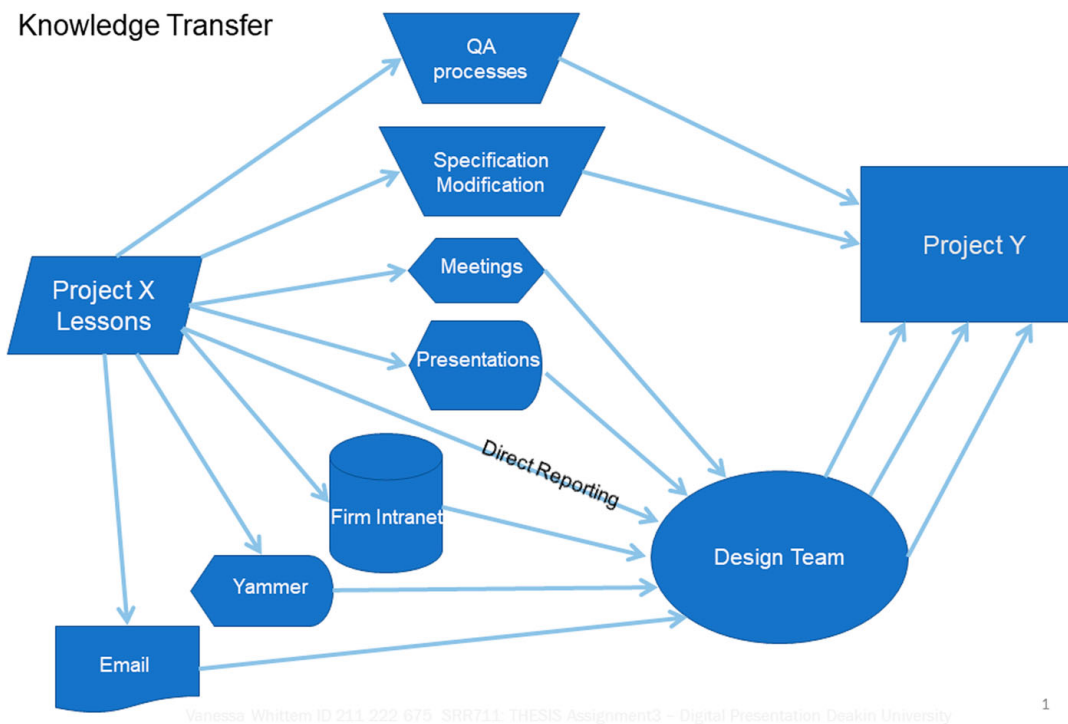
Figure 3. Methods of dissemination of lessons learned from one project to the next.

A stated that their practice's Quality Assurance process and documents are updated from lessons learned.

3.3.3. Sustainability rating schemes

The majority of participants stated that when clients request a NABERS or Green Star or rating scheme building to be designed, the architects are generally provided with the information from post-build assessments. However, three architects said that if a client requested a NABERS assessment post-build, the practice would not know, unless the client volunteered to provide the information.

Four of the respondents stated that they believe that rating systems, particularly Green Star, place emphasis on some sustainability measures and ignore others (so that more fully sustainable buildings receive a lower rating), rating schemes are used mostly for advertising and are either a waste of resources or unnecessary. Further, one respondent cited a number of examples where attaining a Green Star rating had resulted in unnecessary expenditure for redundant systems in order to acquire points.

Lessons learned from rating scheme analyses were communicated using the same mechanisms as feedback from post-build assessments, described above.

3.3.4. Post occupancy evaluations

Four of the respondents felt that formal Post Occupancy Evaluations were useful. Those four felt it was a good opportunity for learning and improvement. Conversely, the other two respondents felt POEs should be used with caution. Both practitioners indicated that this was partly because a POE is an analysis at a particular point in time, not an ongoing analysis. With workplace design, the respondent from practice B felt that POEs measure some things that are easy, but not useful, for example, the number of labour hours to produce a given output. In fact, the respondent felt that measuring productivity is not appropriate for knowledge workers. The answer to this question is clearly dependent upon the content of those POEs with which respondents have been in contact, and also relates to the the building type and client objectives.

In answer to the question whether POE was covered in the interviewee's own education, 4 of the 6 said 'No'. The other two believed it would have been discussed but not understood in any depth. It should be remembered that these are senior architects, and when they attended university in the 1970s and 1980s POE was in its infancy. This question was included to determine if this might be a barrier to use of POEs similar to that documented in the UK, where, 'by the 1990s POE had all but disappeared from the curriculum of British schools of architecture' (Cooper 2001), and documented in Canada (Zimmerman and Martin 2001).

Four of the six practices had projects which had been subject to formal POEs. In this case, the three practitioners with more exposure to POEs felt the information was useful. The remaining practice had one building assessed, a university business school, and the practitioner felt the information was not very useful.

3.3.5. Related considerations raised by practitioners

Four of the practitioners indicated that project management or design and build procurement methods actively discourage post occupancy analysis because the designers are working for the building contractor and 'effectively removed from a direct contractual and professional relationship with the client'. One practitioner stated that the builder or project manager sees post occupancy analysis as 'potentially bringing to light defects', when all the contractor wants to do is finish with the project and take their profit. Two practitioners stated that being appointed as Superintendent of the project ensures they are able to control the commissioning process to ensure the building performs as designed. These responses indicate structural issues in the Australian construction industry that act as barriers to post-occupancy feedback in line with that documented in the UK (Bordass and Leaman 2005; Hay et al. 2017).

Regarding the lack of POEs performed in the industry, four of the respondents stated that the client will generally not pay for a POE. Practice B includes post occupancy analysis in their fee agreements for workplace projects. Respondent D added that some clients with large building programmes, such as the Victorian Department of Education or a university, will request POEs for their own purposes. Practice E includes a very small percentage in their fee proposal for post-occupancy services but spends far more time on it to ensure the building is performing correctly.

Finally, four of the participants raised the issue that post occupancy performance is not entirely in the hands of the designer. Quality of components or finishes are often downgraded by the builder or project manager to save costs, thereby reducing the durability and performance and therefore impacting the sustainability of the building.

4. Conclusions

Clearly this research has raised many questions that will need to be answered. None of the architects interviewed questioned the need for post-build feedback, however, the questionnaire omitted to discover the relative importance of feedback in the design process compared to other information. All practices gathered a number of types of post-build feedback, although the smaller practices collected and disseminated this on an informal basis whereas the larger practices had more formal internal systems for collecting, recording and disseminating the information.

Further research is needed to test the general conclusions derived from the pilot survey described here. For example: Are there other feedback methods in use that have not been revealed by this study? Is there a statistically significant relationship between feedback sources and particular building type expertise? Do extended relationships with a project result in better building performance? Which aspects of building performance do practitioners believe are most important to examine?

Further research is also needed to determine whether the perceptions of architects revealed by this study are supported by empirical evidence. For example, in the business of architecture, are fee levels for smaller jobs (performed by small firms) insufficient to allow time for post build analysis? Is client and public education needed to address this deficiency?

As the more formal types of post-build analysis appear to be not feasible economically for small practices, there may be a need for accessible and cheap analysis tools to be developed for their use.

The related considerations raised by practitioners indicated a number of concerns that will require further research including:

- Statistical evidence to determine whether certain procurement methods discourage post build analysis,
- Quantifying the effect on building sustainability, maintenance costs or longevity of cost-based decisions made by clients or builders to over-ride architect's specifications and
- Research to validate or disprove the perception that rating schemes require upgrading to more comprehensively or comparably assess building sustainability.

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