Barriers to "green operation" of commercial officebuildings: Perspectives of Australian facilities managers

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Abstract

Purpose – The built environment is a major source of carbon emissions. However, 80 per cent of the damage arises through the operational phase of a building's life. Office buildings are the most significant building type in terms of emission-reduction potential. Yet, little research has been undertaken to examine the barriers faced by building operators in transitioning to a green operation of the office buildings in their care. This study aims to identify those barriers.

Design/methodology/approach – Building facilities managers with between 7 and 25 years' experience in operating primarily Melbourne high-rise office buildings were interviewed. The sample was taken from LinkedIn connections, with ten agreeing to participate in semi-structured interviews – out of the 17 invitations sent out. Interview comments were recorded, coded and categorised to identify the barriers sought by this study.

Findings – Seven categories of barriers to effecting green operation of office buildings were extracted. These were financial, owner-related, tenant-related, technological, regulatory, architectural and stakeholder interest conflicts. Difficulties identifying green operation strategies that improved cost performance or return on investment of buildings was the major barrier.

Practical implications – Government, policymakers and facilities managers themselves have been struggling with how to catalyse a green transition in the operation of office buildings. By identifying the barriers standing in the way, this study provides a concrete point of departure from which remedial strategies and policies may be formulated and put into effect.

Originality/value – The uptake of green operation of office buildings has been extremely slow. Though barriers have been hypothesised in earlier works, this is the first study, to the best of the authors' knowledge, that categorically identifies and tabulates the barriers that stand in the way of improving the green operational performance of office buildings, drawing on the direct knowledge of facilities experts.

Keywords Green building, Energy efficiency, Sustainability assessment, Asset management, Building maintenance, Office buildings, Commercial properties

Introduction

An increasing worldwide demand for environmentally friendly buildings – known as green buildings (GB) – have elevated them to a national priority, irrespective of the socio-economic status of the country concerned (Gou and Xie, 2017; Darko and Chan, 2018). Although various initiatives and incentive schemes have been introduced to promote the adoption of green operation of buildings (Olubunmi *et al.*, 2016), the uptake of GB remains short of the required level needed to generate further incorporation of sustainable practices in the construction industry (Chew *et al.*, 2017; Zuo *et al.*, 2017).

In Australia, the advent of the 2000 Summer Olympic Games in Sydney received global recognition as the "Green Games" and fermented the national drive towards the GB movement (GBCA, 2010). In crossing that threshold, the sustainable building agenda has developed increasing traction across the nation (Xia *et al.*, 2013; Martek *et al.*, 2019). As a signatory to the Paris Climate Agreement, Australia has committed to achieve net zero emissions, nationally, by 2050 (ClimateWorks, 2016). The Australian building industry, as the major source of emissions, is an integral element in the programme towards reducing emissions (Berry and Marker, 2015; Wong *et al.*, 2018).

According to the functional classification of buildings in Australia, commercial buildings are those primarily engaged or occupied in commercial-related work and trade. Office buildings – or simply termed offices – are a category of commercial buildings used for the provision of public administration, professional or financial services (ABS, 2012). Office buildings make up a major part of the building stock in Australia, with their floor area in major Australian cities exceeding more than 23 million m^2 in 2012 (Zuo *et al.*, 2016). Australia's commercial office market has experienced dramatic changes in recent years because of strong interests from domestic, as well as foreign, investors, triggering a new wave of construction around the country. As a result, over five years, Australia's total office stock increased around 5 per cent to over 25 million m^2 by 2018 (PRP, 2018). In response to the requirements of sustainable development, the office building sector has attempted to embrace sustainability initiatives with an increasing number of green office buildings being developed (Zuo *et al.*, 2016).

Indeed, in terms of transition to sustainability, the office buildings sector in Australia is unique (Wilkinson, 2014). That is, it is the only sector of the Australian building industry in which sustainability transition and green operation have been actively attempted and pursued in recent years (van der Heijden, 2014; Martek *et al.*, 2019). Besides, the office building market in Australia is responsible for around 27 per cent of total emissions in the buildings industry and, therefore, of particular importance in terms of green transition (Marquez *et al.*, 2012). Moreover, office buildings in Australia have the highest opportunity for transition to green buildings and reduction of emissions (Higgins *et al.*, 2014; Wilkinson, 2014, GBCA, 2015).

More than 85 per cent of the office space already exists, not necessarily sustainably constructed, with a slim chance for green design considerations (Marquez *et al.*, 2012). Greener buildings must be thus pursued through green, efficient post-occupancy facility green operation and maintenance (Chew *et al.*, 2017). Facilities managers, therefore, play a key role in the reduction of buildings' negative impacts on the environment and, hence, advancing the green transition agenda across the building industry through greener operation of buildings (Elmualim *et al.*, 2010). They have the power to influence how a building is operated and affect the technological and behavioural changes needed to deliver green targets (Price *et al.*, 2011; Perera *et al.*, 2016). As the interface between owners, senior management, contractors, tenants and the building's equipment and infrastructure, facilities managers have the potential to influence organisational behaviour towards advancing the green agenda (Curtis *et al.*, 2017; Rameezdeen *et al.*, 2019). Facilities managers are in a position to offer the best "picture" of the barriers faced by other stakeholders in moving towards green office buildings, a point argued by Nielsen *et al.* (2016).

Several challenges however hamper green transition across the Australian office buildings market (Xia *et al.*, 2013; Zuo *et al.*, 2016). And, in spite of such significance attached to the office building market, a review run on the related literature reveals several gaps. First, only few studies have addressed the issue of barriers to office building green transition in Australia. Second, literally no attention has been paid to exploring the barriers from the perspective of stakeholders.

This study thus aims at providing a picture of barriers to green operation of office buildings in Australia, through the lens of facilities managers. This is deemed an effective approach, given that addressing the barriers of green operation based on facilities managers' perception of the barriers can create relatively more rapid advances in the sustainability sphere (Elmualim *et al.*, 2010; Nielsen *et al.*, 2016; Curtis *et al.*, 2017).

The findings of the study will raise awareness and offer new insight into the nature of barriers to improving the green performance of office buildings. In practical terms, the findings will provide a sound basis for formulating recommendations on how these barriers are to be addressed and overcome.

Background

Australian green transition and office buildings

Australia's per capita greenhouse gas (GHG) emissions are estimated to be the highest among the Organisation for Economic Cooperation and Development (OECD) countries, as well as among the highest in the world (Olanipekun *et al.*, 2017). And as a result, Australia aims to reduce emissions to under 28 per cent of 2005 levels by 2030 (ClimateWorks, 2016). With Australia's strong rate of population growth, this means at least a 50 per cent reduction in emissions per

capita, exceeding even the targets set by the USA, Japan, the EU, Canada and South Korea (Australian Government, 2015). The Australian building industry, as a major source of emissions, is therefore an integral element in this green move towards reducing emissions (Berry and Marker, 2015; Wong *et al.*, 2018). This has led to an increase in mandatory, as well as voluntary, building codes and standards to improve the environmental performance of buildings (van der Heijden, 2015). As for mandatory documents, the National Construction Code (NCC) forms the regulatory basis for minimum building requirements in Australia, in which volume 1 concerns the construction of commercial buildings – requirements for the thermal performance of the envelope and the energy efficiency of fixed components, such as water and lighting in buildings (Jackson, 2016; Foong *et al.*, 2017; Wong *et al.*, 2018). Compliance with the minimum standards set out in the NCC is mandatory, where Section J aims at reducing the built environment sourced GHG emissions (Hampton and Clay, 2016). For compliance with NCC requirements, an energy star rating scheme – Nationwide House Energy Rating Scheme – is used by applying a simulation software (Daniel *et al.*, 2017; Hatvani-Kovacs *et al.*, 2018).

Several voluntary tools also exist to provide certification across a range of sustainability

dimensions (Yang and Yang, 2015; Gou and Xie, 2017; Li *et al.*, 2017). These tools (hereinafter referred to as "green" rating tools) act as complimentary to the mandatory ones (Xia *et al.*, 2013; van der Heijden, 2016), impute "green building" status and determine the extent to which a building can outperform the resource consumption thresholds outlined by building codes (van der Heijden, 2018). Of these, the National Australian Built Environment Rating System (NABERS) and Green Star are regarded as the two major rating tools in Australia, as argued by Mitchell (2010).

The Green Building Council of Australia (GBCA) launched Green Star in 2003 (van der Heijden, 2018). It is a design rating tool, the system is voluntary and it relies on existing regulations, but interest in it has been on the rise (Xia *et al.*, 2013). To its credit, it has sought to be adaptive, seeking to assess a range of factors, including management, environment quality, energy and transport, as well as tailoring its instrument according to building usage – office, rental, educational, health and multi-unit residential (Iyer-Raniga *et al.*, 2014). As of March 2018, it had over 1,700 certified buildings (GBCA, 2018). Green Star's area of impact has nevertheless been limited to office buildings located in the CBDs of Australia's major cities (van der Heijden, 2014; Zuo *et al.*, 2016; Martek *et al.*, 2019).

NABERS, a performance-rating tool, was launched in 1998 in NSW, and in 2005 it became a nationwide voluntary instrument to gain insight into the resource consumption of existing buildings (Iyer-Raniga *et al.*, 2014). According to the Building Energy Efficiency Disclosure Act, 2010, a NABERS energy certificate is needed for office buildings beyond a certain size (NABERS, 2018), yet no specified

level of certification is mandatory. NABERS is classified in four rating categories: energy, water, waste and indoor environment. For office buildings, NABERS concerns three types of performance measurements, including whole building, tenancy or base building (Zaid *et al.*, 2017).

NABERS and the Green Star have both led the way towards green movement in the office buildings sector in Australia (Martek *et al.*, 2019). However, it is the NABERS rating scheme which is at the forefront of changes associated with improved operational performance of existing office buildings; in comparison, Green Star is basically a design tool (Mitchell, 2010). Moreover, NABERS has a relatively high participation rate (van der Heijden, 2018); close to 81 per cent office space in Australia is rated with NABERS (NABERS, 2018). With these facts in mind, NABERS implementation provides the best context for exploring the issues associated with green operation across the office buildings sector in Australia (Mitchell, 2010; Gabe, 2016).

Facilities managers and the green transition

Facilities management entails the responsibility for: "the safe operation and maintenance of a corporation or organization's real estate as well as its systems". (Levitt, 2013, p. 7) Operations and maintenance activities contribute significantly to costs accrued during the building's whole life cycle – such costs being five to seven times higher than the building's initial construction cost (Hosseini *et al.*, 2018). Buildings, at a global scale, are responsible for 30-40 per cent of GHG emissions and close to 48 per cent of energy and natural resources consumption (Baynes *et al.*, 2018). For Australia, buildings account for almost 20 per cent of the nation's annual energy consumption and produce 23 per cent of the GHG (Robati *et al.*, 2018); the most substantial part of the climate-change impacts are estimated to be caused by buildings during their operating phase (Junnila, 2004; Nielsen *et al.*, 2016). According to Ramesh *et al.* (2010, p. 1594):

Operating energy has major share (80–90 per cent) in life cycle energy use of buildings followed by embodied energy (10–20 per cent), whereas demolition and other process energy has negligible or little share.

The energy and emission during operation of buildings, termed as operational energy/ emissions, are determined by building occupants and their patterns in using buildings (Ibn- Mohammed *et al.*, 2013). The energy and emission levels depend on the way heating, cooling and appliances are used or if there are any changes during the life cycle of a building – renovation, shift to renewable energy sources, maintenance activities (Ramesh *et al.*, 2010; Martek *et al.*, 2019). The way office buildings use and direct technological and behavioural changes are strongly affected by facilities managers (Price *et al.*, 2011). Facilities managers hence have a pivotal role in reducing building energy consumption and emissions and thereby

curbing negative environmental impacts (Junnila, 2004; Perera *et al.*, 2016). Indeed, facilities managers are central to the green transition agenda in office buildings (Elmualim *et al.*, 2010). Their frequent audits of buildings is an effective strategy to reduce emissions (Gabe, 2016). As asserted by Curtis *et al.* (2017, p. 99) facilities managers "are seen as potentially playing a critical role in the translation and implementation of government and industry sustainability agendas".

There is also a variety of motivations for facilities managers to sustainably operate their buildings (Elmualim *et al.*, 2012). In terms of duties of facilities mangers in daily operation and maintenance, they are expected to create the highest return on value for owners and other stakeholders (Curtis *et al.*, 2017). And joining the green buildings movement is seen as an avenue to this purpose (Elmualim *et al.*, 2010). That is, green buildings have lower operating costs, higher market value and rental income, decreased rental vacancy and better health and safety records of occupants (Ries *et al.*, 2006; Burroughs, 2011; Warren-Myers, 2012).

Besides, the necessity of complying with environmental legislation, implementation of sustainable practices and the need for enhancing corporate image and organisational ethos are also recognised as motivators of facilities managers to join the green movement (Elmualim *et al.*, 2012). This is because of the rising tide of sustainability legislation, public scrutiny on environmental matters, as well as the needed business case for genuinely embracing sustainability (Martek *et al.*, 2018; Martek *et al.*, 2019).

Barriers affecting the green transition

As shown by Foong *et al.* (2017) and later by Martek *et al.* (2019), barriers to sustainability transition within the Australian building industry arise from three generic sources: *socio- spatial embedding, multi-scalarity* and *power issues*. Firstly, *socio-spatial embedding* speaks to the synthesis of locally embedded contexts of events, objects and actions that are affected by wider socio-political, institutional and cultural factors. Examples are political systems, cultures, institutions and existing networks, as well as actors affected by new regulations, policies or working styles. Secondly, *multi-scalarity* denotes problems associated with the existence of different scales, such as those used to measure standards and performance (as occurs with rating tools), and the interpretative and benchmarking confusions caused when moving between measures. Finally, *power issues* pertains to stakeholder interests and the dynamics of who gets to set the agenda and who gains or loses as a consequence of decisions made and actions undertaken (Martek *et al.*, 2019).

In respect of commercial buildings, the major barriers to green operation, as identified in the literature, are of the socio-spatial kind. Chief among these is the age of buildings – with 85 per cent of Australian office space being over 10 years old (Marquez *et al.*, 2012). In 2002, carbon dioxide (CO_2) emissions were reported at

3.75 million tonnes, with 59 per cent coming from Melbourne office buildings (Wilkinson, 2014). An obvious solution would be to replace older stock with newer, greener office buildings. Of course, however, construction generates significant GHG emissions, consumes energy and generates large amounts of waste in their own right (Banihashemi *et al.*, 2018). Consequently, the benefit of constructing a 5-star NABERS-rated building over that of merely upgrading an existing building to a 4.5- star rating would only materialise some 290 years into the future (Marquez *et al.*, 2012) – far beyond the current life of buildings. Clearly, operational performance enhancement of existing buildings is of top priority (Ibn-Mohammed *et al.*, 2013; Wilkinson, 2014; Paradis, 2016).

Gabe (2016) conducted a study of 3,500 audits of 800 office buildings that had participated in the NABERS rating scheme. A direct correlation was found between the extent of NABERS involvement in Australian office buildings with energy efficiency performance. Thus, a lack of prescience of the potential of green building performance, especially in the early days of the "green building" movement, has been a further barrier (Warren-Myers, 2012; Higgins *et al.*, 2014; Olanipekun *et al.*, 2017).

Other barriers include difficulty in raising capital, lower rental returns of smaller and older office buildings, cost issues, the lack of incentives through a misalignment of government initiatives and a lack of on-site facilities managers (Love *et al.*, 2012; Curtis *et al.*, 2017). Low income and high debt levels of owners, supply constraints, regulatory barriers, inaccurate price signals and a lack of skilled employees were also reported as major barriers to green transition of office buildings in Australia (Marquez *et al.*, 2012; Higgins *et al.*, 2014; Martek *et al.*, 2019).

With respect to multi-scalarity, the key barrier within this class is the highly diverse

ownership profiles, which include corporations, foreign investors, private families and not- for-profit organisations (Department of the Environment and Energy, 2017). Added to this, van der Heijden (2014), van der Heijden (2018) and Warren-Myers *et al.* (2018) argue that green transition has failed to gain significant traction in market segments other than the narrow top-end luxury office building niche.

Finally, the major power issue is simply that owners do not see rewards in enhancing energy efficiency, particularly given the enduring bullish Australian property market. It has been a leaser's market, with supply limited and rents rising (Gabe, 2016; Martek *et al.*, 2019). (The market may well have plateaued by the time of publication).

Previous studies and gap A

review of the literature reveals that various streams of research are available pertaining to the barriers facing the green transition of office buildings in Australia. Several studies have attempted to identify the barriers to making the building

industry in Australia greener. Of these, some researchers such as Foong *et al.* (2017), Martek *et al.* (2019) targeted interpreting these barriers, regardless of the type of buildings, and hence have paid little attention to office buildings and their peculiarities. Recent studies of this category are those by Warren- Myers *et al.* (2018) in which the lack of engagement of occupants was highlighted as the main barrier, or van der Heijden (2016) and van der Heijden (2018), who unearthed the deficiencies of governing the green transition in Australia.

Another group of studies focused on office buildings, yet have targeted categories of barriers, and hence have missed the big picture. Of these, Marquez *et al.* (2012) focused on the attributes of office buildings – age of the existing stock – as a barrier. Exploring the impacts of government incentives in removing the barriers to retrofitting, namely, making office buildings greener, was studied by Higgins *et al.* (2014). Similarly, Wilkinson and Remoy (2017) explored barriers, however, limited their investigation to projects that entailed office building to residential conversion. Recently, Rameezdeen *et al.* (2019) explored the role of green lease arrangements in reducing a building's negative impacts on the environment.

Another group of studies, however, attempted to explore the barriers to greening office buildings from a broad view. These studies have used various methods in exploring the bārriers. Zuo *et al.* (2016) provided a picture of challenges and barriers to obtaining the Green Star certificate for office buildings based on analysing the scoring sheets of certified buildings. Based largely on the perception of clients, Love *et al.* (2012) conducted a case study and argued that the lack of incentives can be seen as the main barrier. Kato *et al.* (2009), Armitage *et al.* (2011) and later Jailani *et al.* (2015) relied on perceptions by occupants of office buildings to identify any challenges and issues. Zhang *et al.* (2012) used a survey questionnaire of contractors, architects, project managers and engineers involved in office building constructions and concluded that the major barriers were caused by uncertain governmental policies.

As discussed, in exploring the barriers to green transition of buildings, particularly during the operational phase, facilities managers are central and capable of providing the best picture (Elmualim *et al.*, 2010; Nielsen *et al.*, 2016). Nevertheless, as the review of the literature demonstrates, incorporating the perspective of facilities managers in investigating the barriers to green transition of office buildings in Australia is missing – an area in need of further research. This corroborates the existence of a gap, justifying conducting the present study.

Research methods

The primary aim of this study is to identify the key barriers that face facilities managers, explain how these barriers affect their ability to join the green transition and to uncover potential remedial solutions to address and overcome the identified

barriers. All these items are formulated based on the viewpoints, perceptions and experience of facilities managers acting as the key stakeholders in effecting the green transition. In view of these objectives, a qualitative research approach was adopted. Qualitative research methods are particularly useful when seeking to develop new insights through the gathering of perceptions, experiences and opinions of those engaged in the immediate context of the study. Conducting interviews is the most effective method for elucidating perceptions, experiences and practices of experts in their natural context (Creswell, 2014). Consequently, this study relies on the collection of data through a series of interviews with facilities management professionals.

Sampling

To define the interviewees', the "life history homogeneity" approach is taken (Robinson, 2014). That is, the sample has to comprise only facilities managers with previous experience in sustainability – green – operation of office buildings. The number of interviewees is considered between 3 and 16 as a reasonable estimation for defining the sample size. This estimation is to define the number of invitations to be sent, in view of the estimated sample size (Robinson, 2014). Subsequent to defining the sample requirements and estimated number of cases to be approached and invited, researchers have to define the sampling method. To recruit the participants, researchers used websites of leading companies and groups dedicated to facilities management and green buildings in social professional networks, such as LinkedIn, as a common acceptable method recommended for finding interviewees (Robinson, 2014).

A preliminary list of 24 of potential interviewees meeting the criteria was prepared and approached. Of these, 17 experts responded favourably, out of which 10 were ultimately interviewed. Following the convenience sampling approach, and given the interest expressed, these invitees were deemed reflective of individuals who were quite open and the most interested in the topic.

The adequacy of the sample size of 10 is tenable because saturation could occur with any number greater than six, based on the nature of the study (Bazeley, 2013). The actual number of interviewees in qualitative studies is deemed immaterial, where the target population is limited to a small group with particular expertise, in need of careful selection (Fernando *et al.*, 2017).

Interviews and analysis

Several alternative options for participation were made available. These included the option to answer questions via a face-face interview, phone interview or video conference. Seven of the participants opted to answer the research questions via an online video conferencing. Another two participants were interviewed over the phone, and one interview was carried out in person. All these interviews were

audio-recorded upon participants' consent. The main concern was to ensure that the research questions were open-ended and non- assumptive. The interviews started only after the interviewer ensured that the interpretation of the interviewee was in consistency with the definition of sustainability as considered for the present study. The interviews lasted 50-80 min and were recorded after receiving the interviewees' permissions. The interviewer (member of the research team) posed one general question to the interviewees and encouraged them to generate responses, views and opinions. The general question was, "What are the main problems and challenges you have faced in sustainable operation of office buildings that you manage?" Interviewees were encouraged to give examples and elaborate on each item.

All the recorded interviews were converted to transcripts. The transcripts were then analysed, coded and compared against the findings of previous studies to extract meanings and identify the key themes that emerged from the passages of transcripts, in meetings among research team members. These meetings served two primary purposes:

(1) examining commonalities across the interview transcripts to pool together elements of data and identify key themes that emerged; and

(2) exploring relationships to identify how different themes related to each other.

As the outcome of these meetings, several major themes emerged, reflecting the barriers, a description of which follows.

From interviews to findings

Interviewees

The findings of this study are dependent on the quality of the data provided by the interviewees. As illustrated in Table I, the property portfolio of participants primarily consisted of high-rise office buildings within Melbourne's CBD. However, most of these buildings were mixed-use developments, with retail outlets located on lower floors. A large stadium complex within the outskirts of Melbourne's city fringe was also noted as an asset within the portfolio of one participant. Therefore, the criteria "demographic heterogeneity" (Robinson, 2014) among selected cases was met, that is, cases with different demographic attributes were included to make findings generalisable. Moreover, the years of experience brought by the interviewees is significant: a maximum of 25 years and a minimum of 7 years, with an average of the ten interviewees at over 12 years (see Table I). As such, the data provided by such a sample can be deemed robust.

Key barriers

Participants collectively identified seven major barriers hampering their efforts to join the green transition (see Table II). An account of discussions and justifications

provided by the interviewees with regard to each of the above categories of barriers is presented next.

Table I. Interviewees' profiles

No.	Job title	Experience (years)	Project type	Project location
1	Facility manager	23	Commercial office and retail	Melbourne, CBD
2	Facility manager	12	Commercial office and retail	Melbourne, CBD
4	Senior facilities manager	7	Commercial office and retail	Melbourne, CBD
5	Operations manager	25	Commercial office and retail	Melbourne, CBD
6	Property manager	9	Commercial office and retail	Melbourne, CBD
7	Facilities manager	10	Commercial office	Melbourne, SE Suburbs
8	Property manager	12	Commercial office	Melbourne, SE Suburbs
9	Facility manager	16	Stadium complex	Melbourne City Fringe
10	Facility manager	8	Commercial office and retail	Melbourne City Fringe

Table II. Key barriers to implementation of new energy-efficiency measures in commercial buildings

No.	Category	Primary concerns
1	Finance related	Access to capital Lack of government grants and incentives
2	Property owner/ landlord related	Landlord priorities Landlord education
3	Tenancy-related	Tenant and staff education Tenant and staff priorities Limitations posed by leasing agreements
4	Building technology related	The effect of building age and condition upon the time and costs associated with upgrade works The availability of space suitable for the installation of new plant and/or equipment The inability to alter existing conditions, such as access to public transport or onsite parking arrangements The limitations or availability of BAS The number and location of metering systems
5	Perceived split benefits (landlords and tenants)	A lack of balance between the costs benefit to building owners and the advantages experienced by tenants
6	Regulatory considerations	Occupational health and safety implications of new measures Building compliance issues (e.g. minimum lighting levels)
7	Architectural or atmospheric implications	The need to consider the direct impact of new measures upon building ambience and staff/visitor satisfaction

Financial barriers.

Eight interviewees, out of ten, repeatedly emphasised the role of financial barriers. That is, as the costs associated with upgrade and improvement works generally come out of the capital expenditure (CAPEX) budget, any improvements or upgrades come directly out of the company's "bottom line" and impact the amount of funds available for other ventures. As such, a company must factor in the opportunity cost with respect to other priorities that might be served by the capital budget. CAPEX budgets are generally renewed every five years. Thus, it is a challenge for facilities managers to make a case for implementing measures where the pay-back period lies in excess of five years: two years or less is the standard expected pay-back time horizon.

Moreover, budgets are set at specific intervals, and by the time budget renewals come around, it is likely that there will be a significant number of immediate concerns vying for capital upgrades before any longer term "greening" measures would be considered. Compounding this, the availability of government grants and incentives that would assist building owners with the upfront costs associated with green improvement works are also lacking. As one participant put it on the matter of water supply:

Given the low cost of water usage, there is a very long payback period associated with major water saving initiatives.

You can bring in all sorts of possibilities and sums but they (the landlord) will never get a payback from it. Water savings only happen because the owners want to do water savings. It is never because it is something they can see saving them money in the long-term.

Similarly, regarding solar panel installation:

Until the government starts to give building owners an enticement to put them on they will not look into it for the upgrades. It is unfortunate because there is a lot of roof space to utilise and you would get some good benefit out of the panels and drain a bit more power. It would be a missed opportunity if they don't want to do it, but it is a bit restricted as to what the building owners want to spend.

Property owner/landlord barriers.

Out of ten interviewees, seven constantly argued that property owners and landlords were primarily driven by the perceived financial benefits of their investment. An exception are large-sized corporations that are conscious of their "green image" and as such tend to be more likely to invest in sustainable features to be perceived as "doing good" in the public eye. This is evidenced in the relative

greater concern for energy saving by landlords over, say, water and waste improvements, as this is the more glamorous green cause. Small private property owners, landlords and smaller companies, operating smaller buildings with smaller rental spaces, have less need to market their "social conscience" with even less interest in joining the green transition. Recently, however, there has been a shift:

The big shift you are starting to see now are these "WeWork" type of tenants come in. So, they are catering for your small tenants but taking a large amount of space and they push the "green" on. So, a lot of your start-ups are going into places like a "WeWork" rather than taking their own leases.

Respondents suggested that there needs to be an increase in landlord education as to the financial advantages of improving the sustainable performance of their buildings. Of particular interest must be the issue of the interplay between "public image" and building sustainability.

Tenancy-related barriers. Tenancy-related barriers pertaining to the priorities of tenants, their staff, staff compliance and their education were emphasised strongly by six interviewees (see Table II). Currently, larger tenants such as banking corporations or government agencies generally do not enter into a lease agreement where a NABERS rating is less than 4.5 stars. In contract, smaller tenants have lower expectations (though expectations do appear to be increasing over time). One major barrier facing facilities managers is in maintaining positive

relationships with tenants whilst negotiating and implementing new measures. When it comes to compliance issues, it is not generally the tenant but the staff operating under the tenant who fails to follow proper operating procedures. For instance, respondents reported that it is not uncommon for staff to value their own comfort over that of energy conservation. Therefore, individuals may change the temperature settings in their workspace beyond stipulated operational parameters. "Green leases agreements", which stipulate conditions governing acceptable standards for building operations, can be particularly useful in changing behaviour. However, uptake of green leases has been slow in Australia, and in their absence, building landlords remain powerless to enforce green practices among tenants.

Building-technology barriers. There was consensus among the interviewees that one of the challenges faced by facilities managers pertains to the technology used in buildings. Particularly, six interviewees emphasised this matter. A participant offered an example of a building, which was constructed approximately 30 years ago and which still had all its original services in place. The metering systems within this building were extremely restricted – at the time of the construction, there were no energy-monitoring requirements:

There is no segregation between base building power consumption and tenancy power consumption. Everything basically goes off one meter board. There are no

meters on any floor so the only place where you have meters is at the main switchboard."

Another issue highlighted pertained to outdated services, which were costly to run:

The building still has the original chillers and other (service) equipment. We are talking about very big machinery that is very high on start-up and operational measures as opposed to what you get with the new assets.

Discussions on technological barriers dwelt on the limited availability of Building Automation Systems (BAS), as well as lack of effective metering systems. For example, when it comes to building automation and temperature control, BAS systems control HVAC according to zones. Attached to every zone is a temperature sensor. When the temperature reaches a set point, the HVAC will cut out until the temperature self-restores to the set point. Sensor location is thus critical, and in large zones, it may not provide an accurate reading of average temperature within that zone. As such, BAS systems are only as useful as their design and limitations allow them to be.

One interviewee said that they aimed to increase their NABERS rating by one star over the coming year. There was, however, only one metre for the entire building, and as NABERS ratings are derived from actual energy consumption, there was no way to isolate the issues without adequate metering. The alternative

was to literally enter wall and ceiling spaces to inspect equipment. This costly exercise created major disruptions to tenants and was time-consuming, and it did not guarantee accuracy, as items may have been overlooked. *Perceived split benefits (landlords and tenants).* As another category of barriers, six interviewees repeatedly point out that landlords should pay for the costs associated with upgrades, improvement and green transition. Yet, it is the tenants who receive the benefits. Landlords do not directly profit from green operation of buildings, at least in the short term.

Overall, landlords are generally reluctant to approve any investment without solid evidence of a quick financial payback.

Regulatory considerations. Regulatory considerations include occupational health and safety (OHS) legislation and compliance of building illumination (Lux) levels. Five interviewees clearly emphasised the role of regulatory considerations as major barriers, and other interviewees agreed upon. One interviewee pointed out that regulatory goals sometimes worked in opposition to one another. For example, for OHS reasons, stairwell lighting must remain active for at least 15 min after any movement is detected. This is because of the remote possibility of an individual collapsing whilst using the stairwell. Another example mentioned was in regard to the minimum lux levels of lighting. Whilst one can replace florescent lighting with

more energy-efficient LEDs, light levels must comply with minimum Australian Standards.

Architectural and aesthetic implications. There is a need to consider the aesthetic implications of upgrade, given the impact of building appeal and tenant satisfaction, as pointed out by four interviewees and approved by others. A simple example was changes to lighting, particularly in lobby areas, where in attempting to capture the feeling of a "grand entrance", there is a tendency to shy away from the use of LED lighting in design:

There needs to be an alignment between architects and consultants. Although this is improving, there is often still a gap in objectives particularly when it comes to lobby areas.

Discussions

Taking the three categories of barriers – socio-spatial embedding, multi-scalarity and power issue – as the major barriers that affect the Australian building industry context (Foong *et al.*, 2017; Martek *et al.*, 2019), the findings bring to light that, as perceived by facilities managers, barriers of socio-spatial embedding nature cause multi-scalarity barriers that eventually result in the manifestation of barriers in the form of power issue, namely, resistance and lack of commitment from key stakeholders.

The relative importance of barriers can be evaluated by the number of interviewees who tend to emphasise each barrier (Bazeley, 2013; Chileshe *et al.*, 2016). Barriers with the highest impact therefore manifest in relation to: access to capital along with compensatory financial returns; building insufficiencies in accommodating relevant technologies; regulatory obstructions and the disruptive impacts on buildings and occupants arising from refits; and, significantly, a dearth of education needed to motivate and advise, both land-owners and tenants, of the best ways to overcome impediments in moving towards "greening" their buildings.

That is, business considerations of property owners, namely, some power issue, act as major barriers faced by facilities managers in shifting to a green operation of office buildings in Australia, a point acknowledged by Rameezdeen *et al.* (2019). This is in spite of increased environmental concerns or social drivers such as perceived benefits from "going green", as argued by Chileshe *et al.* (2018). If there is to be a road map to green operation of office buildings, it must be predicated on a credible business case for property owners, in which both upgrade costs and business disruption risks have been acknowledged and accounted for. In essence, any shift to new practices needs to be justified in terms of return on investment (ROI), as a principle for construction-related businesses observed in previous studies (Elmualim *et al.*, 2010; Elmualim *et al.*, 2012). However, the financial

constraints impeding green operations are already recognised (Zuo *et al.*, 2016). For this to happen, however, socio-spatial embedding barriers need to be tackled. That is, policy incentives based merely on greening existing buildings through cost-compensation incentives alone are not adequate. Indeed, existing research studies show that the level of uptake of such programmes have been lower than expected (Curtis *et al.*, 2017; Martek *et al.*, 2019).

While earlier literature has identified cost-related barriers to sustainable transition (Elmualim *et al.*, 2012), the details of programmes that can influence uptake of building improvement for operating green is emphasised here from the perspective of the facilities manager. In particular, the issue of the interplay between "public image", "going green" and business consideration of property owners is clarified. Risk-averse managers are prone to following market-benchmark practices and will continue to do so as long as this does not disrupt their business model or market competitiveness. If owners are to become more receptive to implementing green operating measures, more work has to be done to calibrate and quantify the cost-benefit consequences of greening refurbishment and maintenance measures and to publicise these to the wider market (Martek *et al.*, 2019). Only at this point will it be rational for ROI-focussed owners to move away from traditional, well-entrenched approaches to facilities management and to consider green operational alternatives. In particular, mid-tier building owners have been identified as being susceptible to taking on any retrofit measures that demonstrably reduce cost of energy (GBCA, 2015). All these can be resolved through changing and modifying socio-spatial barriers.

The issues of lack of knowledge of the long-term benefits of green operations and, as a result, a lack of commitment and support for the green operation agenda has been identified in the literature (Elmualim *et al.*, 2010). Though this can be seen as a power issue, his study highlights the various barriers faced by facilities managers based on the size and typology of property owners (GBCA, 2015). Therefore, the power issue identified in previous studies is stemmed from multi-scalarity barriers. With multi-scalarity in mind, various sectors needs various solutions. Education can be an effective solution for smaller owners, given that such businesses are not concerned with their green image in the community. Moreover, shifting to innovative styles of office operation such as the WeWork style can be more effective for smaller tenants. Here, stress must be on staff education of tenants, particularly in relation to disposal of waste, which is an issue largely under tenants' control.

Additional perspectives offered here as well pertain to socio-spatial embedding barriers, one being the contradiction between green operation practices and various regulations, notably with regard to health and safety. Indeed, regulatory barriers

have been identified in previous research, including the study by Marquez *et al.* (2012), yet contradictions between health and safety requirements and implementing green operation was here strongly highlighted by facilities managers.

By the same token, rigid contract structures – a socio-spatial barrier – give rise to conflicting interests and incentives for various key stakeholders. This item, belonging to the power-issue category, as documented elsewhere in the literature (Janda *et al.*, 2016), was raised and confirmed here as a particularly strong barrier.

The clear message is that addressing the factors belonging to the category of socio- spatial group can resolve the issues in other categories. These barriers must be carefully identified and addressed if the green operation agenda is to be advanced, given that green leasing uptake is especially slow in Australia (Burroughs, 2011; Janda *et al.*, 2016).

Conclusion

To the best of the authors' knowledge, this study is the first in its kind that approaches the barriers to green operation of office buildings in Australia, doing so through an exploration of the professional experience of facilities managers. As an outcome of this unique source of data, new knowledge has emerged regarding the barriers affecting the Australian office buildings market transition to green operations of building facilities. Firstly, lack of capital and access to government grants prove to be the greatest barrier, given the primarily financial focus of building owners. Secondly, both owners and tenants lack appropriate information and education that would redirect their approach to facilities management. Thirdly, current regulatory regimes and leasing agreements are largely out of step with developments in sustainability and need to be brought into alignment. Fourthly, the heavy limitations of older buildings with old equipment and their inability to support sustainability diagnostics, coupled with the prohibitive difficulties of removing and upgrading them make it impractical to conduct effective green operations. Finally, even where benefits can be had by upgrading facilities to those that are more sustainable and energy-saving, there remains an inherent asymmetry in who pays and who benefits – currently refurbishment is borne by the landlord, but any energy saving would accrue to the tenants – and it is not clear that rentals following such refurbishment could be raised sufficiently to recoup costs.

Although previous research has noted that facilities managers are being left out of the design process, discussion surrounding the importance of their involvement has not ensued. Given this, the research contributes a deeper understanding as to the importance of their involvement during design.

These research outcomes are of significance to government agencies, policymakers, building owners, investors, tenants and the property and construction industries. Without identifying these barriers and determining how they may be alleviated or overcome in the future, these challenges continue to threaten the planned progression towards achieving emission goals. Whilst the outcomes of this study shed light on the issues faced by facilities managers within Australia, it is recommended that further studies draw upon perspectives from contexts different from Australia. Moreover, validating the findings through exposure to the scrutiny of key stakeholders in the market will add value to the findings of this study as another area for directing future research.

This study is not without its limitations. While the perspective of facilities managers on the green operations of commercial office buildings presents as both unique and insightful, it is a highly localised study, focussing on Melbourne. Transferability of findings is therefore limited to contexts where the circumstances found in Melbourne are consistent with other locales – Sydney may be one of these, but caution is needed. Moreover, the approach taken here is that of interviewing experts. While expert interviews and surveys are ubiquitous and well precedented in the area of construction management, they are burdened with the critique of subjectivity. Key stakeholders of office buildings are local, state and federal government agencies and industry associations, property owners, facilities managers, on-ground intermediaries (e.g. contractors) and tenants (GBCA, 2015). Future studies therefore must explore the barriers from a combined perspective of these key players in the market to devise plans for tackling the issues from a fully inclusive perspective.

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