OCCUPIERS AS THE CRITICAL STAKEHOLDER IN SUSTAINABLE BUILDINGS INTERNATIONAL CONFERENCE ON CONSTRUCTION INDUSTRY, ASSET AND FACILITIES MANAGEMENT

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ABSTRACT

There is an established body of knowledge about technical aspects of sustainable buildings however little research conducted into the post-occupancy relationship between sustainable buildings and occupiers based on the 'form vs function' argument (Reed & Bole 2009). There has been limited attention placed on the relationship between technological advances and how occupiers interact and behave with these buildings (Wener & Carmalt 2006). Therefore this is a preliminary study into differences (if any) between (a) the expectation of occupiers and (b) their actual experiences. The data was provided by a survey of occupiers/tenants of sustainable buildings in Melbourne, Australia in 2012. The findings demonstrated (a) occupants of sustainable buildings are primarily interested in their own personal comfort levels, (b) occupiers of 5 star sustainable buildings have the highest expectations of how their buildings operate however there also exists the largest gap between their expectations and actual experiences, and (c) the communication channels available to occupiers about the operation of their sustainable office building and how they address problems are very limited. There is an urgent need to ensure future efforts to incorporate sustainability into new and existing office buildings meet the needs of present and future occupiers without compromising short and long-term occupier satisfaction levels.

KEY WORDS: Sustainability, Occupier, Building Design, Perception, Obsolescence.

1. INTRODUCTION

Sustainability has received substantial interest in society and this has also gradually transferred into the built environment discipline (Reed et al. 2010). The interest by stakeholders in sustainability is a result of concern about climate change and global warming in the broader media. This trend was initially observed at built environment and property conferences, followed by an increased research in this emerging area. However the concept of sustainability has evolved over time and today means different things to different people (Lockwood et al. 2008). For example there are many types of sustainability and 50 different 'shades of green' which depends somewhat on the view of each stakeholder. Most organisations would argue they have incorporated some form of sustainability in their building design, construction or at least management (Edwards et al. 2006). Due to other pressures (e.g. the need to embrace corporate social responsibility) many individual and collective groups and organisations have gained an interest, without a deeper conceptual understanding, in sustainability due to its higher profile and the general interest factor. Whilst there is an established body of knowledge about the technical aspects of sustainable buildings, there has been little research conducted into the relationship between the architects (i.e. form) and occupiers (i.e. function) (Reed & Bole 2009). Since the social aspect is a major principle of sustainability (Hoffman et al. 2008) it is important to understand the occupiers' perceptions and their expectations of sustainable building design and advanced technology now incorporated in buildings (Brown et al 2009).

The initial attention regarding incorporating sustainability in the built environment was placed on the design and construction phases of new buildings, predominantly office buildings (Reed et al. 2012). Eventually this moved onto existing buildings when it was realised the implementation phase would take too long after considering the relatively long lifecycle of a building and the need for immediate action. Other areas of research into sustainability have been extended to include other land uses (e.g. retail, residential) as well as acknowledging the benefits of corporate social responsibility (Maver et al. 2003). In some countries monetary incentive schemes have also been introduced with limited success in order to expedite the uptake of sustainable attributes in a building.

New sustainable office buildings incorporate modern and sophisticated designs and use advanced up-to-date technology for operational practices that substantially reduces or eliminates its negative impact on the environment and its occupants (Kohler 1999). However there is usually limited discussion about human behavioural and social responses to the issue of sustainability in buildings (Roulet et al. 2006), especially regarding the relationship between technological advances in sustainable buildings and how occupants interact and behave with these buildings (Wener & Carmalt 2006). Accordingly this paper examines the contribution of the built environment towards sustainability by identifying and examining an essential yet often overlooked stakeholder in the built environment – the occupier/tenant. To-date most of the attention has been placed on high profile aspects including the architecture/design, location and construction materials. Only recently there have been sufficient sustainable buildings to permit this type of preliminary investigation. The results will assist other stakeholders in the relatively short design and construction phases to ensure the occupiers continue to demand space in the building in the extremely long tenant phase.

2. THE CHANGING PERCEPTION OF THE OCCUPIER IN THE BUILT ENVIRONMENT

Property professionals have been discussing how to incorporate sustainability into property markets and the relationship with the building design, construction and in-use phases which is also further complicated due to varying land uses and locations. It is anticipated there is an inverse relationship in a generalised manner between the capabilities of the built environment and the perceptions of occupiers over time as shown in figure 1. Over a specified time period (i.e. depending on attributes such as the type of building, other competing buildings, state of the market) it is argued the utility of a building decreases (a) as a result of obsolescence which in turn causes depreciation. An example is a building which is unable to incorporate computer cabling due to the original design and construction phases. However at the same time the expectations of occupiers have been increasing (b) where an occupier now has higher expectations than before of buildings. For example occupiers expect the elevator waiting time period to be extremely short as every additional second to wait is a negative factor. When the additional dimension of sustainability is introduced into the equation this potentially has the dual effect of (i) increasing the level of obsolescence and depreciation of a new age sustainable building and (ii) raising the expectations of occupiers in this sustainable building. Hence the gap between a building's outcome and occupier expectations could be adversely increased.
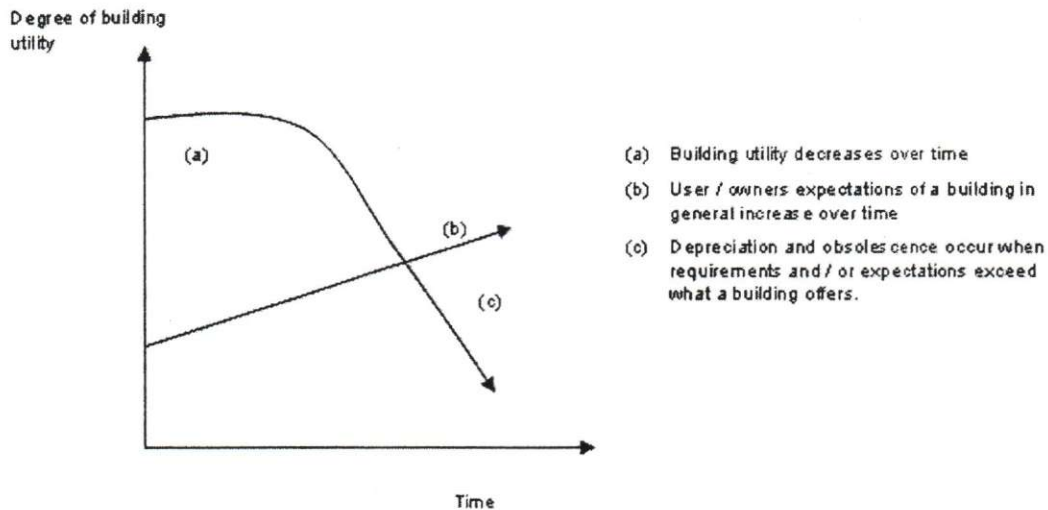
Degree of building
utility

(a) Building utility decreases over time

(b) User / owners expectations of a building in general increase over time

(c) Depreciation and obsolescence occur when requirements and / or expectations exceed what a building offers.

Time

Figure 1. Relationship between Building Utility and Occupier Expectations

The added dimension of sustainability has the potential to adversely affect the model in figure 1, partly because the concept of 'sustainability' differs depending on the view of each stakeholder. However as different people and practices have different perspectives about sustainability that meet their own needs, it has been argued no right or wrong opinion in sustainability actually exists. While there have been some rather varied and complex definitions, the most widely adopted definition was produced by the Brundtland Commission Report in 1987 which defined sustainability as *development that meets the needs of the present without compromising the ability of future generation to meet their own needs.* This accepted definition focussed on the users in the environment where the inhabitants of an office building are a sub-sector. Sustainability was further conceptualised and expanded with the development of three overlapping sustainable development principles known as the 'triple bottom line'.

As most buildings are already constructed it is important to focus on existing buildings (Jones Lang LaSalle 2008). This is further emphasised when it is appreciated it would take approximately 300 years to regain the embodied energy in new building through its more efficient performance; consequently the argument to adapt existing office stock gains

more momentum (figure 2). Clearly there is an urgent need to act quickly if greenhouse gas emissions reductions are to be achieved.

Nevertheless the occupant of a building is a key stakeholder and also the end user in the building's overall lifecycle post-construction (Zagreus et al. 2004). Furthermore, every occupier with have different demographic characteristics and their own personal demands or views. Previous studies into sustainable buildings suggested a benchmark of sustainable building success is the occupants' satisfaction with the building design and performance (Peretti, Schiavon, Goins, Arens, & De Carli 2010). It is acknowledged occupants can be satisfied or dissatisfied with a sustainable building attributes depending on their personal needs, therefore it is essential their wishes and demands are aligned with what the building can offer (De Croon et al. 2005). Despite recognising the occupant and the end user of the building, relatively little research has been conducted into sustainable building occupiers (Abbaszadeh et al. 2006). For example: *is today's sustainable building able to meet the long-term future needs of occupiers?* This paper investigates this question and discusses a preliminary investigation into the gap (if any) between the occupants and the building they occupy.
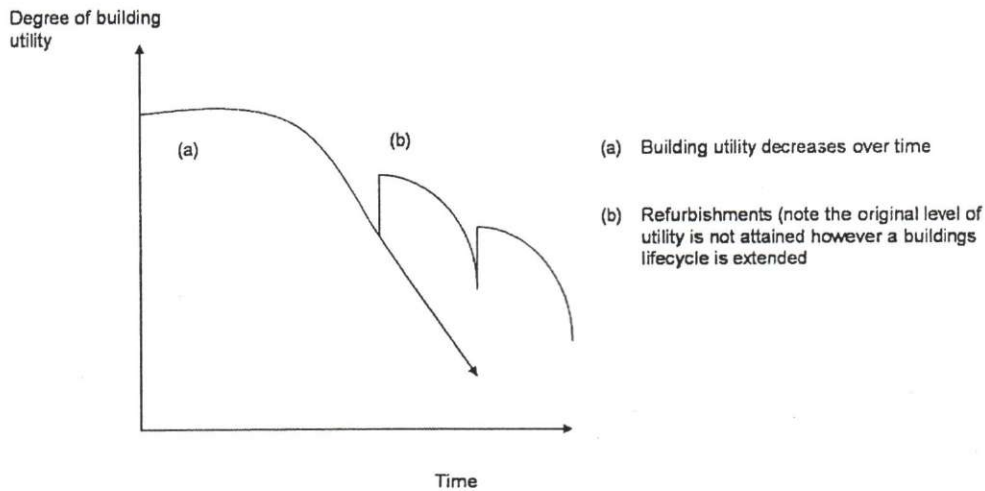
Degree of building utility

(a)

(b)

(a) Building utility decreases over time

(b) Refurbishments (note the original level of utility is not attained however a buildings lifecycle is extended

Time

Figure 2. Building Utility over Time

3. RESEARCH METHODOLOGY

The perceptions of the occupiers were investigated using individual questionnaires to collect information about the level of satisfaction and expectations of sustainable building occupiers/tenants with their building. There was 100% rate of responses as the surveys were collected by the researchers in person. The respondents worked in 8 buildings (6 respondents per building) located in Melbourne, Australia. The buildings were divided into five (5) categories of sustainable building ratings (table 1) as designated by the Green Building Council of Australia (www.gbaus.org.au) based on highest to lowest: (i) premium building (Premium), (ii) design as a "sustainable building" (DFS), (iii) 4 Star Green Star Rating (4 Star), (iv) 5 Star Green Star Rating (5 Star) and (v) 6 Star Green Star Rating (6 Star).

The questionnaire was divided into four sections as follows. Section one includes questions about demography where sections two and three focus on each occupant's perception and experience about interior aspects of their office building design, operation and appearance based on five key categories as follows: (i) thermal comfort and air quality (ii) aesthetics and level of amenity and maintenance (iii) personal control over windows, blinds and HVAC; (iv) lighting and acoustics; (v) open space design and flexibility for a range of uses. A five point likert scale was used to rank the levels of satisfaction and expectation from 1 (strongly agree) to 5 (strongly disagree) based on these five categories. Section four investigates knowledge sharing and communication where the respondents were asked to what extent their office building design, operation and appearance affected their level of satisfaction with sustainable building performance.

Table 1. Sustainable Grading of Buildings

	Premium	6 Star	5 Star	4 Star	DFS
Building Properties					
Tenant	Private Officer	Government Officer	Government Officer Private Officer	Government Officer Private Officer	Student Academician
Type of Building	Office	Office	Office	Office	Office Educational Facilities
Year of Completion	< Year 2004	2006	2008	2005	2002
Size	> 1300 m2	12536 m2	25600 m2	52000 m2	19000 m2
No. of Floors	>26	10	19	34	5
Floor Design	Open Plan	Open Plan	Open Plan	Open Plan	Room
HVAC SYSTEM					
Heating System	Air Conditioner	Thermal Mass	Air Conditioner	Air Conditioner	Air Conditioner
Cooling System	Heater	Thermal Mass	Heater	Heater	Heater
Ventilation	Mechanical Ventilation	Natural Ventilation	Mechanical Ventilation	Mechanical Ventilation	Natural Ventilation
Personal Control					
Window	No Opening	Control Opening	No Opening	No Opening	No Opening
Blinds	No Blinds	Control Blinds	No Blinds	No Blinds	Manual Blinds
HVAC	Centralised Control	Personal Control Fresh Air Vent	Centralised Control	Centralised Control	Centralised Control

4. ANALYSIS

The preliminary questions in the individual questionnaires sought background information about the participants where 62% were male and 38% were female. Most respondents were adults aged from 21 to 44 years (71%) with 29% aged over 45 years. More than half of the respondents shared their office with other workers (67%). The percentage of respondents worked in the middle of the building without outside view (36.0%) lower than respondents who are working near to the window (64.0%). Most respondents (69.0%) spent at least 8 hours each working day inside their office building.

In the section 1 of the questionnaire the participants were asked to rate (on a scale from 1 to 5 where 5 was the highest) their satisfaction level in relation to twenty (20) sustainable building characteristics. The characteristics were separated into five key criteria as follows:

i.   *Thermal comfort and air quality;*
ii.   *Aesthetics, level of amenity and maintenance;*
iii. *Personal control over windows, blinds and HVAC;*
iv.   *Lighting and acoustics;* and
v.   *Design and flexibility.*

The results in figure 3 highlight the gap between (a) the expectations of the occupier and (b) their actual experience. The largest gap referred to personal control over *windows, blinds and HVAC* with a difference of 34%. *Lighting and acoustics* in the buildings recorded a 25% gap between occupiers' experiences and expectations, closely followed by *thermal comfort and air quality* (25%) then *design and flexibility* (17%). The smallest observed gap between occupiers' satisfactions and expectations with sustainable building key criteria is *aesthetic pleasing, well equipped and well maintained* (14%).
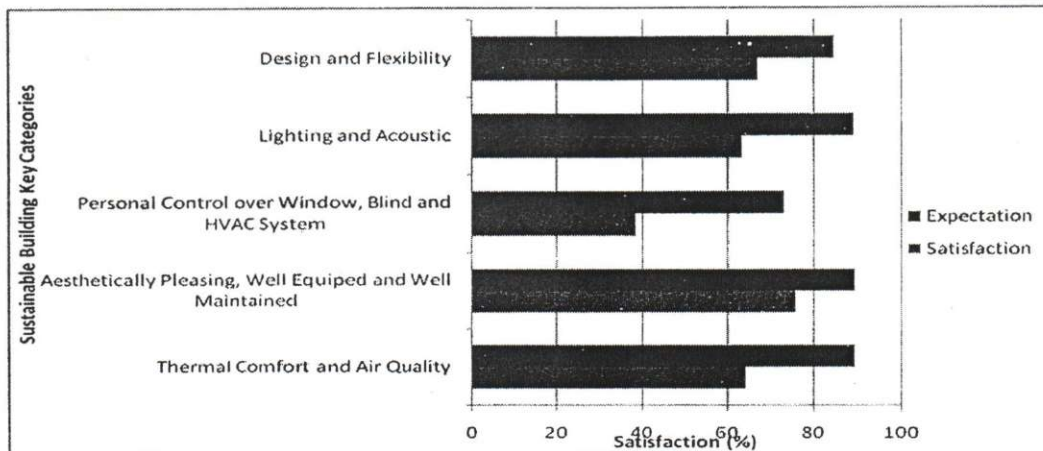

Figure 3. Gap between Occupier Satisfaction and Expectations in a Sustainable Building

Table 2 lists the ranked order by occupiers of twenty (20) sustainable building attributes. The occupants have ranked personal *control over the ventilation* and *temperature* in the office as their most important building attributes. On the other hand *tidiness* was ranked as the least issue they perceived.

Table 2. Ranking by Occupants Sustainable Building Attributes

Sustainable Building Attribute	Ranking
Control over the ventilation in the office	1
Control over the temperature in the office	2
Conversation privacy in the office	3
Control the opening of external windows in the office	4
Visual privacy in the office	5
Functions at a comfortable temperature	6
Control over the natural lighting in the office	7
Feels well ventilated	8
Heating/cooling system that is responsive in temperature change	9
Functions at a comfortable level of humidity	10
Adequate natural lighting	11
Good acoustic quality with acceptable noise level	12
Flexible enough to accommodate changes in different employee teams	13
Visually appealing	14
Contains up-to- date IT/Telecommunication services	15
Layout/design that facilitates movement within the building	16

Good common amenities (e.g. toilets / kitchen facilities)	17
Adequate artificial lighting in the office	18
Facilitate collaboration/ interaction with other colleagues	19
Tidy in appearance	20

Figure 4 highlights the gap between occupiers' satisfactions and expectations of *thermal comfort and air quality* of their office building based on five building categories: Premium, DFS, 6 Star, 5 Star and 4 Star. When responses related to *thermal comfort and air quality* were examined, occupants who worked in a 5 star rated building had the lowest satisfaction level with *thermal comfort and air quality* (57%) compared to occupiers in other four building categories. Also occupiers in a sustainable 5 star rated office building recorded the highest expectation level (97%) with *thermal comfort and air quality* compared to the other four building categories. The gap between occupiers' satisfaction and expectation levels for 5 star office buildings is 40% which was closely followed by occupants working in DFS building (39%). Occupants who are working in Premium and 4 Star buildings recorded the highest levels of satisfaction (18% and 17% respectively) between expectation and actual experiences.
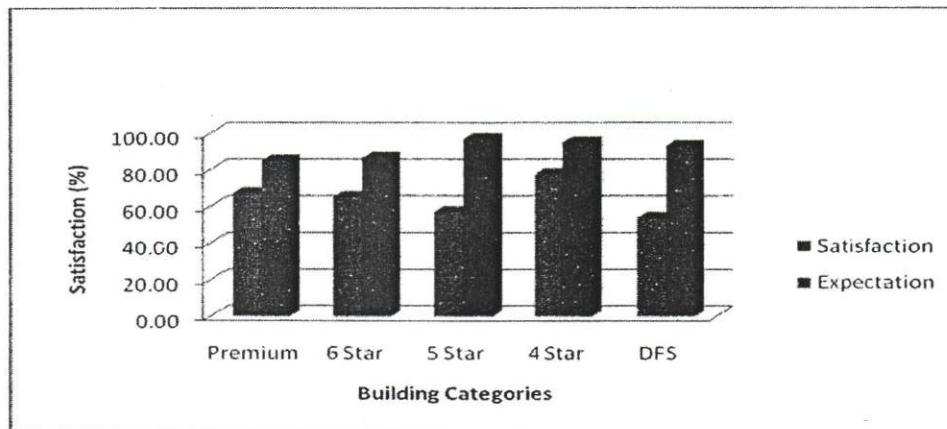

Figure 4. Occupier Perceptions and Expectations with Thermal Comfort and Air Quality

Table 3 is ranked on a scale of 1 to 5 (where 5 is the highest) the most important sustainable building characteristic as indicated by occupants working in an office building. The questions related to control and the indoor air quality of the building. Whilst many of the responses are as expected there was wider variance in responses for aspects of 'control' rather than referring to natural environmental characteristics such as *natural lighting* and *ventilation*.

Table 3. Ranking of The Importance of Building Characteristics

Sustainable Building Characteristic	Mean	Std. Deviation
Adequate natural lighting	4.80	.405
Feels well ventilated	4.64	.484
Contains up-to- date IT/Telecommunication services	4.60	.539
Good common amenities (e.g. toilets / kitchen facilities)	4.58	.543
Function at a comfortable level of humidity	4.52	.505
Functions at a comfortable temperature	4.51	.661
Adequate artificial lighting in their office	4.47	.661
Flexible enough to accommodate changes in different employee teams	4.44	.659

Good acoustic quality with acceptable noise level	4.44	.546
Visually appealing	4.43	.625
Facilitate collaboration/ interaction with other colleagues	4.42	.621
Layout/design that facilitates movement within the building	4.40	.618
Tidy in appearance	4.36	.679
Heating/cooling system that responsive in temperature change	4.33	.707
Conversation privacy in the office	4.11	.745
Control over the natural lighting in the office	4.04	.796
Control over the ventilation in the office	3.80	1.079
Visual privacy in the office	3.67	.929
Control over the temperature in the office	3.47	1.179
Control the opening of external windows in the office	3.27	1.156

Respondants working in a sustainable building were asked to identify the relevant medium communication they used to receive information about their office building. The results in figure 5 the highest ranked medium for receiving information was via in the form of tacit knowledge from *friends/colleagues* followed *by email and communication system*. This was followed by *signage or information boards* and *organisation announcements* were next highly ranked medium for the occupier to receive information. On the other hand, *architects* were not used by the occupants as a medium to receive information about their building, neither were *publications* or the *internet*.
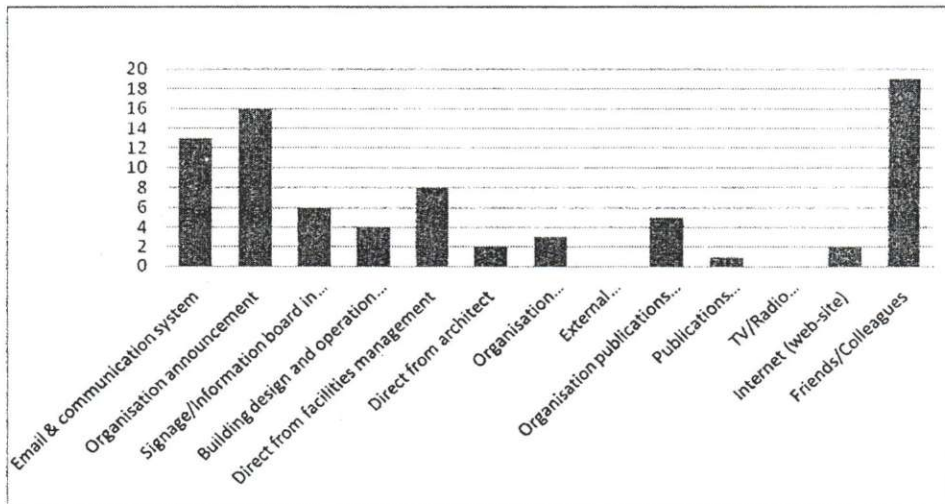

Figure 5. Communication Medium used by Occupiers about their Building

The next question related to a problem occuring with the occupant's building, more specifically whom the occupier would contact in the first instance. The options available were the *human resources or facilities manager, facility manager only, architect* who designed the building or *other*. The results in figure 6 confirm 58% of respondents prefered to contact *human resources or facilities manager* of their organisation and 36% prefered to contact the *facilities manager* of their building only. Surprisingly *architects* who designed the building were not nominated as a preferred contact by any of the respondents.
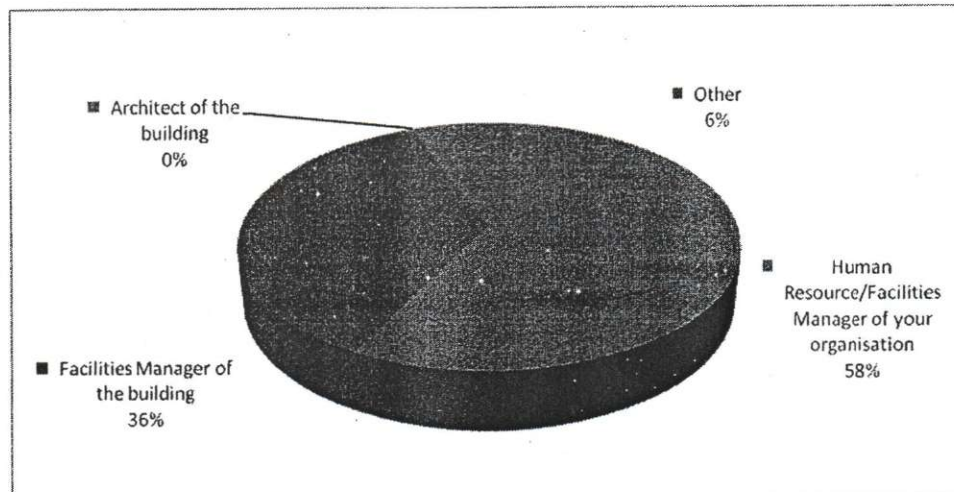
Figure 6. Section of the Organisation An Occupier Would Contact If There Was A Problem

5. CONCLUSION

This study was focused on two variables in the built environment with regards to sustainable buildings, namely (a) the attributes and expectations associated with sustainable buildings and (b) the experience of the occupiers. Although buildings are produced to meet the needs of the end user in the form of the long-term occupier or tenant of the sustainable building, the needs of other stakeholders (e.g. the investor, architect, wider society regarding the environment) may potentially appear to have higher importance. This is an incorrect assumption. At the same time there is a level of uncertainty about the depreciation and obsolescence rates of sustainable buildings which are designed to have a lifecycle of many decades rather than years.

In order to address these concerns a preliminary study was undertaken of eight office buildings in Melbourne, Australia to identify the gap (if any) between the actual perceptions and expectations of occupiers. The information was viewed as 'post occupancy' since this data is rarely examined. For example most of the attention in office buildings is placed on the design and construct phases, including the sustainability rating phase of the building which is undertaken in the 'design' phase only.

The examination commenced with an overview of the relationship between (a) the degree of building utility and (b) the increased expectations of building owners (figure 1). This

relationship can potentially be further complicated due to the perceived additional attributes of sustainable buildings (e.g. complex design and sustainable attributes). An underlying concern may be a possible shorter lifecycle for buildings which incorporate a higher level of sustainability, which in turn would have an adverse effect on the built environment. The objective is to achieve a balance between the objectives of incorporating sustainability in the built environment including an extended lifecycle.

The preliminary research data was collected in 2012 via an individual questionnaire survey of 48 occupiers equating to 6 occupiers from 8 office buildings located in the Melbourne, Australia. The selection criteria for the office buildings was based on identifying buildings with a range of different sustainability ratings. The respondents to the individual questionnaire were all occupiers of office buildings and most worked inside the buildings for at least eight hours per day. The survey was divided into five key criteria:

i.   *Thermal comfort and air quality;*
ii. *Aesthetics/level of amenity and maintenance;*
iii. *Personal control over windows, blinds, HVAC;*
iv. *Lighting and acoustics;* and
v.   *Design and flexibility.*

The largest gap between perception and expectations was personal control over *windows,*

blinds and HVAC (34%) followed by *lighting and acoustics* (25%) and *thermal comfort and air quality* (25%). This finding confirms a substantial difference exists between the expectations of occupiers and their actual experiences. These attributes are directly related to the 'comfort' levels of occupiers and tenants in the building as opposed to other variables; for example *aesthetic pleasing, well equipped and well maintained* recorded the smallest difference (14%) and was linked to the actual building characteristics rather than its level of environmental comfort for occupants.

The respondents ranked 20 attributes of their office building in order of perceived importance. In a similar manner to the initial survey question (see above) the highest ranking attribute was linked to occupier comfort being *control over the ventilation in the office* followed by *control over temperature in the office.* At the other end of the scale the lowest ranked building attribute was *tidy in appearance.* This finding confirms the high priority the occupiers place on the comfort and indoor environment of the building as their number one priorities, rather than the actual building itself.

With reference to expectation levels the occupiers of 5 star sustainable buildings (i.e. the highest sustainable rating) had the higher level of expectation (97%) regarding their building. However the occupiers of the same buildings recorded the highest gap (40%) between expected and actual experiences. This emphasises the higher expectation of occupiers in sustainable buildings.

The occupiers identified there were a variety of communication mediums used to receive information about their building. It was observed the highest ranked source was from *friends/colleagues* followed by the *email/communication system.* However other potential sources of information including the *architect* and the *internet* were ranked very low. This indicated a large proportion of information received was secondary information (with associated interpretation) rather than from a direct source.

When asked, the occupiers indicated they would not the architect of their building if they encountered a problem. They responded that

they are most likely to contact the *human resource/facility manager* (58%) or the *facilities manager* (36%) in these instances.

The four major findings from this preliminary study can be summarised as followed:
- The occupiers of sustainable office buildings are interested in their own personal comfort levels as their first priority e.g. ventilation, temperature.
- Occupiers of 5 star sustainable buildings have the highest level of expectations (97%) but also have the largest gap between these expectations and their actual experiences (40%).
- The communication channels used to transfer information occupiers of sustainable buildings are poor; the highest ranked source was second-hand information from friends/colleagues. This problem may be further complicated by the high proportion of jargon associated with sustainable buildings including how to actually operate the building to follow the original intention of the architect.
- The overwhelming majority (94%) of occupiers of buildings would contact the human resource manager or the facility manger regarding operation of the building.

These preliminary findings have identified a clear gap between (a) expectations of occupiers of sustainable buildings and (b) their actual experience. This appears partly due to the lack of post-occupancy communication and feedback from the occupiers to the architects. This may be further complicated by the poor communication channels available to occupiers who have little or no contact or information from the architect. In contrast to other products (e.g. motor vehicles) there are no user manuals supplied to occupiers of sustainable buildings. Another complication may be linked to the added complexity of sustainable buildings, especially higher rated (e.g. 5 star) sustainable buildings.

Concerns are noted here about the importance of ensuring occupiers of sustainable office buildings are content and satisfied with the indoor air quality of their building. Additional pressure will be placed on architects and developers of sustainable buildings with high

sustainability ratings. A gap between expectation and actual experience may result in the potential for future stigma to be attached to a sustainable building, which in turn may shorten its lifecycle and inadvertently place additional pressure on the environment. Clear two-way communication channels between the existing occupiers and the original architect would assist to ensure future sustainable office buildings meet the needs of future occupiers. In today's sustainable office buildings most occupiers would contact the facility manager and human resource manager when seeking information about the operation of the building. Accordingly it is critical both professional groups are fluent with the original intentions of the architect with regards to the meeting the indoor environment needs of the tenant.

It is suggested that consideration is given to agile office buildings, especially in regions where climate changes will affect the temperature surrounding the building and hence the occupiers of the building. This requires careful consideration in light of the rapidly changing area of sustainability and the relatively long anticipated life of a new office building.

6. IMPLICATIONS FOR FURTHER RESEARCH

This preliminary study has identified the need for additional research to be undertaken in this area. The downside risk may be the design and construction of supposedly sustainable buildings which have a shortened life prior to demolition.

Further research is needed as follows:
(a) Identifying (on a ranking basis in order of priority) the most important attributes in a sustainable building from an occupier's perspective which would likely differ between geographical locations.
(b) Monitoring on a regular basis the gap (if any) between the anticipated and actual expectations of occupiers of sustainable buildings.
(c) Educating occupiers of sustainable buildings about the design of the building with reference to their indoor comfort. This will have reference to the original design intentions of the architect.
(d) Identifying the optimal communication channels to transmit information to

occupiers of sustainable buildings about the operation of the building in which they are a tenant. This may include the facility manager but a link to the original architect is considered essential.
(e) Investigating the involvement of the architect in the post-occupancy phase of the building. For example *does the original architect remain in contact with the building post-occupancy?* Furthermore *does the architect communicate information about their original design intentions and building operation either directly or indirectly to the occupiers for the life of the building?*

When considering the substantial focus in today's global market placed on incorporating sustainability into the built environment there needs to be a higher level of emphasis placed on the post-occupancy phase. At present the feedback from the occupier appears to be largely ignored. The needs of the occupiers as a major stakeholder in the building requires further research to ensure the built environment is operating in a sustainable manner, both now and in the future for the betterment of the environment and society at large. The risk attached to designing and constructing an inappropriate building for a 50 year lifecycle can be substantial unless ongoing analysis of occupier satisfaction levels is undertaken.

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