

# **SUSTAINABLE MAINTENANCE OF OFFICE BUILDINGS: THE CURRENT PRACTICE IN SYDNEY, AUSTRALIA**

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## **ABSTRACT**

In Australia, approximately 2% of the demand for office buildings is satisfied annually by new construction which means that it will take 50-100 years to replace the current stock and its contribution to the environmental problem. The argument for upgrading existing buildings through sustainable maintenance is strong as it is relatively cheaper and less environmentally costly to upgrade than to rebuild. The upgrading will not only turn old buildings environmentally-friendly but also enhance their market values and competitiveness.

This paper examines the role, current practices and limitations of sustainable maintenance of existing office buildings in Sydney, Australia. The paper presents the results of an industry survey conducted in November 2012 on strategies to improve current practices. The survey revealed that the most crucial aspects of sustainable maintenance for existing office buildings are efficient energy and water management; the use of environmentally-friendly materials; improved waste management; education and knowledge of sustainable methods and Government incentives to compensate for any additional costs of sustainable practices.

The research found that most existing office buildings in the industry are currently maintained by non-sustainable practices. Sustainability is a relatively new concept but one that professionals are keen to introduce into mainstream practices.

*Keywords:* Existing buildings, maintenance practice, office buildings, sustainable maintenance, Sydney–Australia.

## **INTRODUCTION**

The building stock is an important section of the Australian economy. However, the major part consists of older assets that are great consumers of energy and producers of toxic gases. With the current rate of rebuilding, it would take 50-100 years to replace the current stock and during this time these buildings will continue to contribute negatively on the environment and the wellbeing of users. Previous research has

revealed several issues arising from the maintenance of existing office buildings. A sustainable maintenance strategy can offer higher living standards and energy efficient spaces; and meet the current need for environmental protection. The case for sustainable maintenance strategies is strong although issues like cost, time, knowledge and technologies are still debated in the industry. To answer questions on improved maintenance of office buildings, a research project was carried out in Sydney in November 2012, based around a survey of professionals in the building industry. The aim of the project was to identify practices that best suit a sustainable use of office buildings and this paper reports the results from the survey.

The research found that most office buildings in the industry are currently maintained by non-sustainable mainstream practices. However, both owners and occupiers believe that sustainable maintenance practices should be a mainstream approach to upgrade and maintain office buildings even though it may be associated with some problems. The paper will examine the literature, discuss the survey, present the outcomes of the data analysis and discuss the implications of the findings at the end of the paper.

## **LITERATURE REVIEW**

Traditionally, to maintain its intended function a building needs to be well maintained and, particularly, refurbished every 20-25 years (Wilkinson and Reed, 2006b). However, according to Wilkinson and Reed (2006a and 2006b) and the Adelaide City Council (2007), the average age of the office building stock in major Central Business Districts (CBDs) throughout Australia is 25-31 years since construction or last refurbishment. In Sydney it is 28 years. This building stock will continue, for a long time, to contribute negatively to the environment – by producing 10% of all greenhouse gas emissions – and be detrimental to the wellbeing of users (Taylor, 2009; Wilson and Tagaza, 2006). Therefore, improving maintenance of office buildings until they conform to current environmental standard is an attractive way to solve problems of the existing building stock (Remøy and Wilkinson, 2012; Strachan and Banfill, 2012; Xu et al., 2012). In addition, a system for routine maintenance associated with regular inspection will provide significant savings over unexpected repair works for a building and building services.

### **Building Maintenance Practice**

Building maintenance management is “the preservation of a building so that it can serve its intended purpose” (Arditi and Nawakorawit, 1999a, p. 107 and 1999b, p. 117). This is “the continuous protective care of the fabric, contents and setting of a place” (Burra Charter cited in NSW Heritage Office, 2004, p. 1). The most importance factor in building maintenance management is that “maintenance management involves the organising of resources to deal with the problems of maintenance within

an estate to obtain maximum benefits from the investment" (Pitt et al., 2006, p. 154). Operation and maintenance are complex and costly parts of a building's life cycle. Building maintenance is a core part of the business of maintaining or adding economic value to buildings (Idrus et al., 2009; Pitt et al., 2006; Witt, 2004). It is a strategic approach to keep the building and equipment functioning without breakdowns, particularly when the owner is faced with limited resources (Witt, 2004).

Son and Yuen (1993; cited in Pitt et al., 2006) suggested that maintenance of a building can be organised into four categories which include (a) planning and carrying out the day-to-day maintenance that comprises all activities of servicing, cleaning and inspecting facilities and components; (b) rectifying works due to defects in design or improper use of materials; (c) replacing any items with high-relative cost; and (d) retrofitting or modernising works to modify, add and improve existing buildings. Moreover, building maintenance may focus on repairing or replacing an item, performing regular maintenance or requests from users (Pitt et al., 2006). Building maintenance in this study will range from service maintenance, routine maintenance, planned maintenance, corrective maintenance, preventive maintenance, emergency corrective maintenance, deferred maintenance, condition-based maintenance, and extraordinary maintenance that involves substantial rehabilitation, replacement, or refurbishment of units, buildings, or grounds (Arditi and Nawakorawit, 1999b; Chanter and Swallow, 2007; NSW Heritage Office, 2004; Pitt et al., 2006). The extraordinary maintenance is the greatest and most expensive type of maintenance aimed to improve buildings or components into environmentally-friendly products.

#### **Sustainable Building Maintenance Practice**

In the past, maintenance of a building or building system was commonly practiced as repair works. Building systems were used until no longer useful and then either repaired or replaced. There was no system to forecast malfunctions or engage in preventive maintenance (Takata et al., 2004). A change of maintenance from unplanned to planned needs to be considered. It is also necessary to identify a logical and prudent approach for a set of expected achievements. Innovation in building maintenance management can support this and achieve better results (Pitt et al., 2006).

To respond to such a need by society while minimising material and energy consumption in the life cycle maintenance of a product, Takata et al. (2004, pp. 643-644) stated it is a "need to change the paradigm of manufacturing from 'how to produce products most efficiently' into 'how to avoid producing products while still maintaining customer satisfaction and corporate profits'". Building maintenance management is a process of continuous innovation and enhancement to meet the requirements desired by the client (Pitt et al., 2006). The roles and duties of buildings

maintenance managers are to oversee and upgrade in accordance with the dynamics of a changing industry (Khalil et al., 2011).

The development of sustainable maintenance practice is quickly growing (Elmualim et al., 2010) and will certainly reduce the consumptions of energy and carbon emissions (Gohardani and Bjork, 2012; Khalil et al., 2011; Ma et al. 2012; Remøy and Wilkinson, 2012, 2012b; Takata et al., 2004; van de Wetering and Wyatt, 2011; Wilkinson, 2012b). It will assist office buildings to remain competitive by making them more environmentally-friendly (Bullen, 2007; Pfaehler, 2008). Sustainability is the way forward where aged buildings need to meet a triple bottom line of social, environmental and economic measures (Ellison and Sayce, 2007; Sev, 2009). Current practices show that key stakeholders in the building industry have limited understanding of costs and benefits of sustainability designs, products and features. These limitations hinder the implementation of changes towards sustainable buildings. Key stakeholders should be provided with information about costs and benefits. This will raise public awareness and appreciation of sustainable buildings and hence increase the demands for sustainable buildings (Hinnells et al., 2008; Miller and Buys, 2008). Furthermore, the significance of changes in the relationship between tenants and landlords and the way buildings are maintained can lead to policy changes and green leasing practices. This helps to reduce environmental impact and promote going green (Hinnells et al., 2008). This will also attract existing tenants for an extended period, and further entices new occupants in the market (Bullen, 2007; Larsen, 2009). Therefore, sustainable planning should consider low energy demand for heating, cooling, ventilation and lighting while meeting the needs of the occupants at the same time (Juan et al., 2010; Schakib-Ekbatan et al., 2010) while implementing government policy objectives (Higham and Fortune, 2011).

## **SUSTAINABLE MAINTENANCE OF OFFICE BUILDINGS SURVEY**

### **The Survey Process and Data Collection**

The questionnaire is based on the review of the literature. A series of questions was created with the aim to gather opinions and experiences of professionals in the building industry involved with office buildings, over the negative impact of existing buildings on the environment, current and future methods of maintaining the buildings. A pilot study conducted in March 2012 resulted in comments that were incorporated into the final version of the survey<sup>1</sup>.

Through the professional institutes - AIQS, API, CIOB, FMA and RICS – professionals were invited to participate in the survey. Emails. Participants accessed the survey and responded through a link to the UTS Online

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<sup>1</sup>The survey was approved by the University of Technology, Sydney (UTS)/Human Research Ethics Committee, Reference number 2011-097A.

Survey Manager. Data collected from the survey was systematically organised into electronic coding files for analysis.

### Background of Respondents

The survey received 219 responses (179 males and 40 females). The respondents were categorised into six industry professional groups. The most frequent backgrounds of the participants were Asset/Property Managers, Facility/Sustainability Managers and the Building Service Professional, together accounting for 162 respondents. The mean age was 43 years and 72 per cent had a Bachelor degree or higher. Sixty-eight per cent of the respondents were working directly in maintenance of office buildings<sup>2</sup>.

### Sustainable Maintenance Practices on Existing Office Buildings

The first part of the survey aims to identify current maintenance practices of office buildings. It focuses on three areas. The first is an examination of strategies for sustainable maintenance of existing buildings, where 93% of the respondents agreed that sustainable strategies need to become mainstream practice with the objective of reducing the uses of energy and water. The second area is the identification of the main factors which influence the present uptake of sustainability initiatives. The most significant factor here is perceived additional costs of sustainable practices, nominated by 91% of respondents. The third area is the identification of the main practices that can be adapted to achieve sustainable buildings and the response was the replacement of existing system with energy efficient devices, rated by 89% of respondents as shown in Table 1.

Table 1 Factors in achieving sustainable maintenance practices for office buildings

Issue	Neutral (%)	Disagree (%)	Agree (%)
Replacing existing system with energy efficient devices	8	3	89
Developing of sustainable management strategies for the building	15	0	85
Improving indoor air quality	13	3	84
Developing legislation for sustainable maintenance of office buildings	17	5	78
Using of low environmental impact building materials	23	3	74
Harvesting rainwater	25	11	64
Using specified cleaning products / paints	32	6	62
Using of recycled building materials	37	4	59
Recycling grey or black water	31	10	59

<sup>2</sup> For detailed information on survey sample and responses, please contact the authors.

The survey revealed that a high number of professionals in the industry are aware that the negative impact of office buildings on the environment is significant and agree that sustainability should be developed and implemented for maintaining office buildings. The most efficient way to promote sustainability is to improve services. Certainly, out-dated devices/systems, such as HVAC and lighting systems, consume very high rates of energy. The same applies to old water systems. The responses indicate that these systems need to be replaced by efficient systems with well-developed management plans. Such upgrading will not only reduce the consumptions of energy; but also improve indoor air quality, promote wellbeing of occupiers and increase the productivity of office personnel.

The response indicated the most significant factors affecting the performances of sustainable maintenance practice are an additional cost of sustainability but building owners would consider bearing the cost with the support of Government incentives. Because of the additional costs the co-operation between building owners and tenants should be developed to speed up the application of sustainable practices. However, a faster uptake would require that professionals were equipped with sustainable technology and knowledge as well as legislative support.

The aim of the second part of the survey is to identify problems in current practices of maintenance of office buildings. This also focuses on the critical factors that would improve sustainability. There were 149 respondents who had been working directly in maintenance of office buildings. The first objective was to establish limiting factors and a total of 251 responses were received. The most common difficulty mentioned was budget/financial management, agreed by 89% of respondents. Table 2 summarises the problem areas key stakeholders perceive. The next issue concerned routine maintenance of office buildings. Approximately 14% of respondents stated that they "always" applied sustainable practices and 57% did so "mostly". 29% of respondents stated that they would apply sustainability initiatives in the next two years. Finally, it seems that almost all respondents are aware of the importance of applying sustainability in maintenance. However, due to the difficulties, such as the additional costs, the lack of strategic policy and/or management, the limitation of knowledge and information of technologies on sustainable maintenance, and so forth, the application of sustainable maintenance is still low. Even though 64% of the respondents stated that their organisations had a sustainability policy; only 17% of the respondents stated that sustainable maintenance was company practice while 36% considered applying it in the next five years; and another 29% considered it in more than six years.

This means that currently, most office buildings are still maintained with traditional maintenance methods as the accepted policy as suggested by 83% of the total responses. In addition, 64% of respondents confirmed the building owners and facility managers still employ conventional

building materials and finishes in their maintenance practice. This indicates that sustainability is not widely applied in the office buildings. The most effective way to implement sustainable maintenance for office buildings are efficient energy and water managements. The appropriate key factors include the use of environmentally-friendly/reused/recycled building materials; waste management; and education to promote sustainable knowledge and skills. Environmental improvement in office buildings normally attracts tenants as green buildings typically denote lower operational costs to occupants. The new targets now for both building owners and tenants are to share all liabilities and benefits in the improvement of building services. Sustainability upgrade of existing buildings would help to harmonise economic growth, society and environmental protection. A balance must be achieved between protecting and improving the natural environment, contributing positively to the economy, and achieving social equity.

Table 2 summarises the problem areas key stakeholders perceive

Issue	Disagree (%)	Agree (%)
Budget/Financial	11	89
Commitment of key stakeholders	12	88
Energy efficiency	28	72
Government policies/legislation/incentives	33	67
Scheduling/planning maintenance programme	36	64
Education/Training/knowledge	37	63
Time management	40	60
Sustainable maintenance skills	44	56
Building service systems	47	53
Sustainable technologies	53	47

The survey has identified that a large number of existing office buildings in the industry is currently maintained by non-sustainable mainstream practices. The survey also found that sustainability is a relatively new concept in maintenance practice in the building industry; however, key stakeholders are eager to consider the design and may apply it into mainstream practices in maintenance strategies for their existing office buildings.

## CONCLUSION

The study has examined the awareness of key stakeholders in the building industry about the impacts of existing buildings to the environment. The literature review and the survey both indicated that an existing office building can be retained to meet the environmental protection standards by applying sustainably maintenance. The survey revealed the most significant factors in applying sustainable maintenance practice for existing office buildings. They are as follows:

Factors that can be adapted to achieve sustainable maintenance practice include managing efficient energy and water systems, developing of sustainable maintenance strategies, using low environmental impact materials/finishes; and improving/upgrading the building management control systems (BMCS). Factors that are difficult in undertaken sustainable maintenance practice include managing organisation's budget/finance due to additional cost on sustainability; commitment of owners/key stakeholders; improving energy efficiency; inadequate education/knowledge/skills on sustainability.

Significantly, strategies on sustainable maintenance practices can be carried out for the improvements of energy and water in the built environment. However, the survey has found that most buildings are currently maintained by non-sustainable mainstream practices. The survey has also identified a number of key factors and limitations in applying sustainable maintenance for existing office buildings. It reveals that sustainability is a relatively new concept of maintenance for existing office buildings and professionals are eager to consider the idea and may apply it into mainstream practices. However, to speed up the application of sustainable practices, Governments' support would be needed, such as legislation to enforce the implementation of sustainable practices and government incentives and taxation to compensate for the additional costs of sustainable practices.

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