

# **The Business Case for incorporating Sustainability in Office Buildings: the Adaptive Reuse of Existing Buildings**

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## **KEY WORDS:**

Sustainability, adaptive reuse, refurbishment, existing buildings.

## **ABSTRACT**

The effect of climate change and global warming has received increased attention in society with constant reminders about the importance of energy efficiency and sustainability in buildings. Whilst the focus is often placed on smaller items such as plastic bags, air conditioners and motor vehicles, the emphasis has recently shifted to structures in the built environment. Office buildings have been identified as contributing significantly to global warming during their building lifecycle with a substantial contribution to CO<sup>2</sup> omissions. In response, building designs and construction techniques have evolved over time to improve energy efficiency and reduce CO<sup>2</sup> omissions.

Within the property and construction sectors there is now more widespread acceptance by the profession of the impact of our use of resources within buildings and the links to climate change and global warming (Dixon et al, 2007). Whilst the focus has been placed on smaller items such as plastic bags, air conditioners and motor vehicles, the emphasis has shifted to the built environment. Buildings contribute significantly to global warming during their building lifecycle, typically of 80 years, with a substantial contribution to CO<sup>2</sup> emissions. In response, building designs and construction techniques have evolved over time to improve energy efficiency and reduce CO<sup>2</sup> emissions however there is a significant issue with the existing stock of buildings.

Most developed countries have a substantial stock of existing buildings in various states of repair and utility. Generally there is a correlation between building age and building condition, with the older stock typically in the poorest physical condition. This is especially apparent in low grade commercial and industrial stock where owners are reluctant to invest in repairs and maintenance because costs cannot be recouped easily. Given the lifecycle of buildings it can be said that we already have most of the buildings that will be with us in the next 50 or so years. Much of our existing older stock is in poor condition and operates very inefficiently – for example energy consumption is high (Wilkinson and Reed, 2005). However there are convincing social, environmental and economic reasons why we should consider the retention of buildings. This paper examines the arguments for adaptive reuse of existing buildings and poses some initial questions in relation to relevant areas of further study.

## **Introduction**

A substantial proportion of a nation's wealth is invested in its built environment. According to the Australian Bureau of Statistics the value of the constructed environment in 2004 was \$1,705.4 billion (ABS, 2006), which equates to approximately 44% of Australia's net worth at the same time. Note that estimates vary concerning the percentage of new stock added each year, for example arguably being 1% (Langston, 2006) or 2-3% (Jones Lang LaSalle, 2005) for commercial buildings and 5% for residential stock. Nevertheless it is clear that a large proportion of our current stock will be in use and occupied for many decades to come (RICS, 2007).

Clearly it is in the interests of all stakeholders, investors, owners, occupiers and the wider community to ensure that our commercial building stock is well utilised, well maintained and continues to meet our needs. Inevitably buildings decline in utility or usefulness over a period of time. Interventions will be required in order to ensure this stock retains its utility – these interventions come in the form of refurbishments, renovations, retrofits and adaptive reuse or conversion of buildings from one use to another e.g. industrial to office space. There are a plethora of terms covering these activities, which in turn occasionally leads to some confusion (Mansfield, 2002). Many previous studies have concluded that it has become necessary to work more efficiently with the stock we have rather than simply opt for demolition and redevelopment (Ball, 1999; Bullen, 2007).

Historically the emphasis, and consequently the business case, has been placed firmly on the economic rationale for demolition and redevelopment of buildings. This is in direct contrast to adaptive re-use, however this mindset is now changing as the triple bottom line approach to decision making forces the consideration of social and environmental factors as well as economic ones. Sustainability and the widespread acceptance of the relationship between buildings and climate change and/or global warming is changing both our perceptions and attitudes at a rapid pace. This paper posits that the landscape in which the business case is decided is undergoing fundamental change, which will have a considerable impact on the development and redevelopment of our built environment in the years to come. Although the bulk of the discussion about sustainability and commercial buildings focused on new-build, relatively little attention is given to

the adaptive reuse of a building as an alternative and sustainable option. This paper focuses on commercial buildings and not residential property.

### **Building obsolescence and building quality metrics**

When the level of usefulness or utility in a building falls below that required by tenants, the Building Research Board (1993), Clements-Croome and Kaluarachichi (2000) and Sutherland and Cooper (2000) all noted that levels of building obsolescence increase. Typically the facility manager, property management team and building owner will collectively seek to defer the problems associated with obsolescence such as declining levels of rent, increased vacancy rates and reduced overall capital values with associated higher capitalisation rate. Previous studies have sought to identify and then measure the attributes that stakeholders such as building users, owners, designers and facility managers seek in building quality or utility (Baum, 1993, 1994; Pinder et al., 2003; Ho et al., 2005).

Equipped with knowledge of the specific attributes and their levels of importance, it can be argued that premature obsolescence may be detected and the relevant action then taken. Within these measures indoor environmental quality is an attribute which many studies have concluded is of paramount concern to building users and facility managers (Pinder et al., 2003) mainly because of its association with building related illness, employee absenteeism and productivity. If indoor air quality is poor then potentially the building will have lower tenant demand, decreased rental income and decline in value at a faster rate than would otherwise be the case if indoor air quality was good.

When focussing upon office buildings, the level of utility or function provided changes over time as shifting political, economic, social, technological and now, environmental conditions, result in altered market expectations (Omeheng and Mole, 1996). These changes impact on the way different building attributes are perceived and valued in the market. Over recent years there has been a substantial shift in Australia with reference to the uptake and profile of sustainability in office buildings. For example, in 2006 the Building Code of Australia (BCA) included energy efficiency in commercial buildings for the first time while the Green Building Council of Australia introduced the Green Star rating tool in 2004 to encourage sustainability in the office stock. Finally,

in 2006 the building owner's representative body, the Property Council of Australia (PCA), adopted a sustainability rating for the premium quality rank in its building grade matrix which is a highly influential grading system in the Australian market. Thus a number of voluntary and legislative measures have come on-line recently signifying a fundamental change in the property market towards sustainability in office buildings in Australia.

Measurement and accurate assessment of the relationship between sustainability and commercial buildings remains difficult to fully encapsulate. Ho et al., (2005) argued that when property attributes were ranked for offices by various stakeholders including building owners, building users and architects, functionality and services were the two most important attributes overall and accounted for 53.6% of preferences. Out of six categories measured, property management which included sustainability issues such as recycling and energy conservation was ranked fifth and accounted for 11.5% of preferences. It could be argued the services category could be interpreted as including some aspects of sustainability indirectly – for example, well functioning equipment could include sustainable services. However this study, which was conducted in 1998 in Sydney, concluded that sustainability issues then did not feature highly as a measure of building quality. Consequently it can be assumed that a lack of these sustainability features included in the management category would not have had a substantial impact on accelerating building obsolescence during this period. In a short time frame since the Ho (2005) study there has been considerable advances in Australia in the uptake and acceptance of sustainability and ESD in buildings and thus it is clear that building quality metrics have changed in this period. Furthermore during 2006 and 2007 energy prices rose substantially, accompanied by increasing interest rates, and thus businesses are looking to reduce overall running costs. This includes both the day-to-day operational costs and also upkeep and maintenance expenses.

### **Office grades and office refurbishment**

In general, major refurbishment is required every 20 -25 years for offices with the primary drivers being reduction in vacancy rates, increases to rental levels, 'upgrading' of assets (e.g. from B Grade to A Grade using the PCA grading), and mitigation against obsolescence; not surprisingly, the drivers are predominantly financial. In Australia the Property Council of Australia (PCA) represents building owners and in this role lobby the government to exert considerable market

influence. The PCA office quality matrix classifies stock according to grade; premium is the highest grade, followed by Grades A to D. Premium is considered a ‘landmark office building located in major CBD markets’, A grade is a ‘high quality space’, B grade is ‘good quality space’, while C grade space is ‘older style with lower quality finish’ and D grade space is of ‘poor quality’. This classification is fully integrated into the market and was adopted in this research as a benchmark of quality. Importantly the PCA office building matrix is considered typical of grading systems in other global cities.

According to RICS (1993), approximately 60% of all construction activity relates to existing stock and co-incidentally about 60% of all completions in Melbourne CBD and since 1995 were refurbishments (JLL, 2005). Thus the volume of activity and expenditure in this sector is high and consistently so. However, most Australian buildings are relatively inefficient as energy efficiency was only mandated in 2005. Moreover it is impossible to deliver sufficient reductions in CO<sub>2</sub> emissions to effect climate change through the building regulations within the timeframe for action identified by Stern (2006). Therefore the onus is placed on stakeholders in the real estate market to relay the message that improving energy efficiency in the stock is vital. Although there are convincing reasons for energy efficiency in refurbishment, much improvement in energy efficiency in refurbishment is fortuitous resulting from improvements in technology or imposed by legislation and the minimum to satisfy the building code (Wilkinson and Reed, 2006) rather than intentional (Cook, 1997).

In refurbishment building owners have the option of taking a number of different measures to reduce emissions - for example with regards to the building façade and using shading devices or low ‘E’ glazing where appropriate. The use of Building Management Systems increases the efficiency of plant and services operation (Jones Lang LaSalle, 2005) and high efficiency chillers and variable speed drives on pumps or fans offer the opportunity to decrease energy usage and increase efficiency. In Australia it is perceived that owners need to attain Australian Greenhouse Building Rating (ABGR) rating of 3 – 3.5 stars to remain competitive in the market, however substantial amounts of stock fall below this level. A key driver in the office sector is that government, public administration and major corporate tenants are looking for ESD buildings - for example in Victoria government tenants lease buildings only with 4.5 Greenstar ratings. Since 2007 owners selling office buildings have to disclose to purchasers the energy consumption of the

property as part of the due diligence process, which in turn increases pressure to provide energy efficient buildings.

### **Sustainability issues and office buildings**

Sustainability issues for offices are reducing water consumption in construction (GBCA, 2008), materials and resources use, embodied energy issues, health related issues such as the use of volatile organic compounds and formaldehydes. Transport related emissions from building occupants are also included with many environment assessment methods (such as BREEAM) and constitute a building related sustainability issue. The use of recycled materials and the reuse of materials in construction are also key issues, as is the operational energy and water consumption. Loss of eco-systems, habitat destruction and increased urban salinity are other impacts of the built environment which need to be considered.

The association between the built environment, fossil fuel consumption and climate change has been clearly acknowledged (Dixon et al., 2007; Reed and Wilkinson, 2005) - in westernised countries buildings contribute approximately 50% of all CO<sub>2</sub> emissions and offer scope for reducing emissions through energy efficiency (BRE, 1996). Climate change projections show that unless global greenhouse emissions are substantially reduced by 2070 Victoria's mean temperature could increase by 5 degrees Celsius (CSIRO, 2002). Though CO<sub>2</sub> emissions can be decreased by retrofitting filters to power generation plants, there is no cut in energy consumption per se but on the other hand an improvement in the performance of an office building thermally reduces usage and user costs. Previous research confirmed that although available means of cutting energy usage existed, the 'business as usual scenario' will clearly not deliver adequate reductions (Australian Greenhouse Office, 1999; ABCB, 2001) and that wider acceptance and uptake of measures to reduce carbon dioxide emissions in existing building stock is necessary (DSE, 2005).

While Fisk & Rosenfeld (1998) highlighted the social and economic benefits of Environmentally Sustainable Design (ESD), a large proportion of the research has focused specifically on the technical ways to cut carbon dioxide emissions. The argument is based on the premise that energy efficient buildings cost less to operate and have better internal environments for occupants, which

in turn lead to healthier buildings that contribute to mitigating climate change (Scrase, 2001). However consumption is increasing, especially in the office sector where carbon dioxide emissions are high due to excessive electricity demand for heating, cooling and lighting (Scrase, 2001). In Australia it is forecast that the commercial building sector will escalate its greenhouse gas emissions from 32Mt to 63 Mt of CO<sub>2</sub> annually between 1990 and 2010 under a ‘business as usual’ scenario (DSE, 2005. AGO, 1999).

In terms of energy consumption, electricity is the largest source in Australian commercial buildings (65%), followed by gas (25%), petroleum products (7%) and coal (3%). Electricity results in larger emissions of CO<sub>2</sub> and accounts for 89% of the total greenhouse gas emissions, whereas gas, is responsible for 7% of total emissions (ABARE, 2006). Substantial reductions could result if commercial buildings changed from electricity to gas as a source of energy, however current predictions do not envisage such a switch. A substantial impact on the heating, cooling and lighting requirements for commercial buildings (AGO, 1999) is derived from the building envelope performance and improvements in the thermal, daylighting and natural ventilation of commercial building envelopes will decrease greenhouse gas emissions. Globally, western countries are increasing thermal standards of new buildings and new build has the highest levels of thermal efficiency through improved standards in building regulations (BCA, 2005). These improvements will deliver a building stock with higher levels of energy efficiency though, as Boardman (1991) demonstrated the replacement of the existing stock is so slow that it will take hundreds of years to bring all stock to current standards of energy efficiency. Boardman (1991) showed that it would take from 1990 to 2700, on a business as usual basis, to upgrade all UK housing stock to 1984 building regulation standards of energy efficiency. Typically replacement rates for office stock is around 2-3% per annum in most global cities (Jones Lang LaSalle, 2005). According to Cooper (2001) upgrading the existing stock is one of the most critical aspects of improving sustainability in the built environment.

When the proportions of energy use and greenhouse gas emissions are considered, 1990 figures for Australian commercial buildings revealed that heating was the largest single end use at 33% but fourth largest with respect to greenhouse gas emissions. Cooling, lighting and ventilation step up in significance when greenhouse gas emissions are calculated and amount to 71% of total emissions, though actual proportions applicable to a specific building will vary from the average.

In Australia the breakdown of operational energy applications mainly responsible for greenhouse gas emissions are cooling (28%), air handling (22%), lighting (21%) and heating (13%). Heating, lighting, ventilation and air conditioning amount to 84% of commercial building sector greenhouse gas emissions and it is here that the opportunity to reduce emissions lays (Australian Greenhouse Office, 1999). Thus it is the services components, with a life cycle of 15 - 25 years typically that have the greatest impact on carbon emissions and are also most likely to suffer from technological and functional obsolescence within a relatively short time frame. This research focussed upon the question yet to be answered in the commercial building sector, namely: *'how is greenhouse consumption apportioned amongst different groups?'* Australian figures for 1990 showed the largest sub-sector was public administration and commercial services with 36% of total emissions, followed by the retail/wholesale sector with 32% of emissions. The finance and business sector ranked third at 17%, followed by recreation at 11% and lastly communications at 4%. When all building types are reviewed the largest single building related source of greenhouse gas emissions came from offices, and the focus for making substantial reductions of emissions lies here.

### **Age profiling the existing office building stock in Melbourne Australia**

To provide some context for the scope of the problem, this paper uses Melbourne as an illustrative case study city. Melbourne is fairly typical of many global cities in the global and thus this research will have relevance and applicability elsewhere. Melbourne is the capital of the state of Victoria in Australia of around 4 million inhabitants with a large central business district or CBD where major business occupiers are located.

Based on previous research conducted by the authors (Wilkinson & Reed, 2005), table 1 shows the total number of office buildings in the CBD, the years passed since construction, and their respective proportion as measured against the total stock of office buildings in Melbourne. Note that the classification of an office is not straightforward as many buildings are mixed use that is to say they contain more than one use say office and residential or office and retail use.

**Table 1. Melbourne CBD office buildings according to age**

<b>Age (years since construction)</b>	<b>Number of buildings</b>	<b>Proportion of total stock</b>
< 10	7	2%
10 – 25	66	20%
26 - 50	95	29%
> 50	158	49%
<b>Total</b>	<b>326</b>	<b>100%</b>

In 2005 nearly half the CBD office stock was over 50 years old and an aging stock presents an increasing potential for obsolescence and adaptive reuse or refurbishment. 29% were aged between 26 to 50 years old and likely to have had at least one major refurbishment and possibly two major refurbishments in some cases. One fifth of the office buildings were aged between 10 and 25 years and should be at a phase where minor refurbishments are being undertaken - for some buildings a first major refurbishment will occur in the short term. Note only 2% of the office stock are under 10 years old and would incorporate recently manufactured plant and services with associated higher efficiency and sustainability standards.

It is apparent therefore that most of the stock is aged and likely to be in lower quality bands, the C and D grades according to the PCA classifications (PCA, 2006). Some of the stock will have more potential for vacancy and is likely to have little or no attention paid to maintenance and repair requirements. Finally the lower grade stock is more likely to be owned by individuals rather than superannuation funds and organisations which employ property consultants and facility managers to ensure their property remains in good condition or is improved. Furthermore national and international property investment companies are more likely to adopt corporate social responsibility in their business planning which will make them more likely to incorporate sustainability into their building stock. The C and D grade stock therefore is in most need of refurbishment and/or adaptive reuse but the least likely to receive attention and repair and maintenance expenditure by owners who may not be aware of these building related issues.

Inevitably some stock will come to the end of its useful life; this might be due to an area undergoing transition, for example from a light industrial area to a mixed use area with new

residential and retail land uses being introduced. When this transition takes place the best potential highest and use might no longer be the original use and it may be that a change of use or adaptive re-use of the property is the new highest and best use.

### **Definitions of adaptive reuse**

Many authors have posited definitions of adaptive reuse (AR). Bullen (2007) stated it was ‘rehabilitation, renovation or restoration works that do not necessarily involve a change of use’, and that AR ‘extends the useful life and sustainability in a combination of improvement and conversion’. Bullen also cites Latham’s 2000 definition which posited that adaptive reuse ‘retains as much of the original as possible, upgrading performance to modern standards and changing user requirements’. Douglas (2003) however felt that adaptive reuse involved conversion to change of use required by new and existing owners’ and this is a view held by others (DEH, 2004, Dolnick and Davidson, 1999). However just to confuse matters, Mansfield (2002) states that refurbishment is defined by some as a ‘conversion describing a change in use’. Therefore for some the terms refurbishment and adaptive reuse could mean the same thing.

However it would seem that there is agreement on the following:

- Adaptive reuse can involve a change of use (but not necessarily);
- Adaptive reuse involves improvement (upgrade of building performance); and
- Adaptive reuse must meet new and or existing user/owner requirements.

### **Reasons for adaptive reuse**

There are a number of arguments for and against adaptive re-use of buildings. The rationale has been grouped into the following categories; social, environmental, economic and technological. Each category is explained below.

#### **Social**

Firstly it is said (Bullen, 2007; Kucik, 2004) that existing buildings represent social and cultural capital, which is to say our past is imbedded within the bricks and mortar of our buildings. Ball (1999) noted this move to adaptive re-use has come about from a wider appreciation and more

enlightened attitude towards heritage value particularly of our industrial building stock. It is inevitable that as time passes social conventions also change and as a result some buildings will lose their original use value. Franchini's study (2007) looked at Italian university education buildings which, as a result of social changes, were no longer 'fit for their purpose' and new uses had to be found.

Kucik (2004) illustrated the impact of social changes with respect to Sanatorium buildings in the US, whereby attitudes towards the care of mentally impaired people no longer required patients to reside in specially built sanatoria located on the outskirts of a town. Furthermore the urban sprawl that had taken place since the original construction meant that many of these sanatoria buildings were now well within the urban areas and suburbs and no longer outside the urban centres.

Through the adaptive re-use of existing buildings we are able to revitalise neighbourhoods and help to control urban sprawl. Bromley et al (2005) highlighted a planning issue that had arisen through land use planning policies which made city centres devoid of life after office hours, adaptive reuse of existing property brings about an 'urban renaissance' bringing life back into the city centres. Our built environments need to have social sustainability that is to say they need to be places where people continue to want to reside and socialise and work. If our parts of our built environment cease to have any degree of social sustainability they become derelict ghost towns where crime and vandalism pervade. There is evidence of this happening in the American city of Detroit for example, where residential properties have been deserted by their owners unable to meet mortgage repayments due to unemployment, as a result areas have fallen in dereliction with high levels of vandalism and crime.

Within Australia the Department of Environment and Heritage (DEH, 2004) has stated that 'adaptive reuse is an essential component' of sustainable development. Older buildings provide citizens with a glimpse of the past, lend character to a place, identify places as Australian and provide a footnote to our histories. Socially then the argument for adaptive reuse is strong and globally accepted. There is also an inter-generational argument for adaptive reuse and that is by saving these buildings then future generations will be able to enjoy them (DEH, 2004).

The arguments against adaptive reuse are that the standards required of new building cannot be achieved within older buildings (O'Donnell cited in Bullen, 2007). Furthermore, new building design is seen as creative whereas adaptive reuse is not perceived in this manner (Bullen, 2007). Bullen also argues that some building stock is simply too ugly, citing the office buildings of the 1950s, however it is also possible to argue that beauty is subjective and others might see 1950s office as being attractive. At a deeper level Bromley et al. (2005) noted that the social objective of the London Docklands adaptive reuse and regeneration failed to provide the affordable housing for local residents. Other projects in Swansea, Cardiff Bay and Bristol also failed to provide a social mix in the regenerated areas (Bromley, 2005). There is a risk therefore that some of the social goals may not be realised with adaptive reuse in practice.

## **Environmental**

One of the environmental arguments for adaptive reuse is that there is lower material usage in the project. Existing buildings have embodied energy in the existing materials used in construction and savings are realised because new materials do not have to be mined, manufactured or transported to the site and therefore the overall energy consumption and greenhouse gas emissions are reduced (Johnstone, 1996; Bullen, 2007). In Australia the DEH (2004) also noted the benefits of retaining heritage building because of the embodied energy content and the Australian Greenhouse Office (AGO) states that reuse of building materials saves approximately 95% of embodied energy. In fact Ball (2004) noted that even when economic costs are high, the environmental (and social) benefits may sway the decision in favour of adaptive reuse. To-date no environmental arguments against the adaptive reuse of existing building have been sourced by the authors.

## **Economic**

Bullen (2007) argued in his study of Western Australian practice that adaptive reuse is cheaper than demolition and rebuilding. His findings are supported by Ball's (1999; 2004) more extensive and earlier study of industrial buildings in Stoke on Trent in the UK. Johnstone's (1996) study into the residential sector also confirmed costs can be cheaper compared to new build. In Australia the DEH report of 2004 showed that in New South Wales the additional costs associated with heritage buildings were offset by the savings associated with adaptation of existing stock (DEH, 2004).

Chau et al. (2003) in a study of residential apartments in Hong Kong showed that the completed property also had a higher resale value (an additional 9.8%) compared to similar apartments in the vicinity. Their findings were supported by Yui and Leung (2005) who looked at the Hong Kong residential sector and showed that rehabilitation of housing was marginally preferable to redevelopment on a cost benefit analysis.

There are some who argue that adaptive reuse of existing buildings can be more expensive. Hollyoake and Watt (2003 as cited in Bullen 2007) noted that adaptive reuse can be more expensive and that new build can be easier – but this begs the question: *‘how do you determine whether a building is going to be more expensive or less expensive to carry out adaptive reuse?’* Bullen (2007) also stated that many existing buildings are of such poor construction quality; meaning that adaptive reuse will be expensive as some form of remediation is necessary in addition to the changes required to make the building suitable in spatial layout and internal comfort for the new use., for example the removal of asbestos or repairs to corroding steel reinforcement in concrete framing. Finally Chau et al. (2003) made the observation that hidden costs such as loss of tenants’ goodwill and loss of amenity are not factored into the costs of adaptive reuse projects.

## **Technological**

One of the reasons for adaptive reuse is the technological changes that take place which mean that buildings can become obsolete in a relatively short space of time (Vijverberg, 2002). The functionality or utility of the space in terms of physical layout, quality of services, telecommunications and data communications, indoor climate control and energy efficiency are all important factors which affect how a property is perceived by the market. Therefore a building might be in good condition but unable to meet the requirements of the market and therefore become vacant or attract lower rental income. There are other factors which affect the desirability of a property for adaptive reuse including locational factors. For example a building might be located in an area which can provide no suitable adaptive reuse. Table 2 below summarises the arguments for and against adaptive reuse in buildings

**Table 2 Arguments for and against adaptive reuse in buildings**

Arguments for adaptive reuse	Arguments against adaptive reuse
<p><i>Social</i></p> <ul style="list-style-type: none"> <li>▪ existing buildings represent social and cultural capital</li> <li>▪ wider appreciation and more enlightened attitude towards heritage value</li> <li>▪ as time passes social conventions also change and as a result some buildings will lose their original use value.</li> <li>▪ the impact of social changes with respect to some buildings</li> <li>▪ adaptive re-use enables revitalisation of neighbourhoods and controls urban sprawl.</li> <li>▪ adaptive reuse brings an ‘urban renaissance’ into the city centres.</li> <li>▪ If our built environment ceases to have social sustainability they become derelict and crime and vandalism pervade.</li> <li>▪ an essential component’ of sustainable development.</li> <li>▪ older buildings provide a glimpse of the past</li> <li>▪ lend character to a place</li> <li>▪ identify places as Australian</li> <li>▪ provide a footnote to our histories.</li> <li>▪ inter-generational argument that by saving buildings future generations are able to enjoy them</li> </ul>	<p><i>Social</i></p> <ul style="list-style-type: none"> <li>▪ the standards required of new building cannot be achieved within older buildings</li> <li>▪ new building design is seen as creative whereas adaptive reuse is not</li> <li>▪ some building stock is simply too ugly</li> <li>▪ the social objectives of the London Docklands failed to provide the affordable housing for local residents. Other projects in Swansea, Cardiff Bay and Bristol also failed to provide a social mix in the regenerated areas</li> <li>▪ some of the social goals may not be realised in practice</li> </ul>
<p><i>Environmental</i></p> <ul style="list-style-type: none"> <li>▪ lower material usage in the project.</li> <li>▪ Lower overall embodied energy</li> <li>▪ even when economic costs are high, the environmental (and social) benefits may sway the decision in favour of adaptive reuse.</li> </ul>	<p><i>Environmental</i></p> <p><i>To date no environmental arguments against the adaptive reuse of existing building have been sourced by the authors.</i></p>
<p><i>Economic</i></p> <ul style="list-style-type: none"> <li>▪ cheaper than demolition and rebuilding.</li> <li>▪ Johnstone’s (1996) study into the residential sector confirmed costs can be cheaper compared to new build.</li> <li>▪ the additional costs associated with heritage buildings were offset by the savings associated with adaptation of existing stock</li> <li>▪ completed property had a higher resale value (an additional 9.8%) compared to similar apartments in the vicinity.</li> <li>▪ In the Hong Kong residential sector rehabilitation of housing was marginally preferable to redevelopment on a cost benefit analysis.</li> </ul>	<p><i>Economic</i></p> <ul style="list-style-type: none"> <li>▪ adaptive reuse of existing buildings can be more expensive.</li> <li>▪ many existing buildings are of such poor construction quality; meaning that adaptive reuse will be expensive as some form of remediation will be required in addition to the changes required to make the building suitable in spatial layout and internal comfort for the new use.</li> <li>▪ hidden costs such as loss of tenants’ goodwill and loss of amenity are not factored into the costs of adaptive reuse projects.</li> </ul>
<p><i>Technological</i></p> <ul style="list-style-type: none"> <li>▪ technological changes mean that buildings can become obsolete in a short space of time</li> <li>▪ functionality or utility of the space in terms of physical layout, quality of services, telecommunications and data communications, indoor climate control and energy efficiency affect how a property is perceived by the market.</li> </ul>	<p><i>Technological</i></p>

This brief literature review of the reason for and against adaptive reuse will form the initial investigations into an extended research project into identification of adaptive reuse potential in existing buildings.

## **Conclusions**

This paper argued that the existing building stock represents nearly half the net worth of a developed country and needs to be adequately maintained and upgraded. Building obsolescence is a risk if repair and refurbishment is not undertaken along with adaptation to changes in the market. The paper has shown that significant amounts of money are spent on refurbishments each year especially in the office sector. Within the office sector the focus was placed on the C and D grade stock which is the least likely to receive adequate repair and maintenance and the most likely to become vacant and attract lower rental income. It is also most likely to be owned by individuals who do not subscribe to CSR and invest in sustainability upgrades of their stock.

Sustainability has become a key driver in the need to upgrade office stock in the market and the relevant issues of energy and water consumption, embodied energy, materials specification and recycling, specification of healthy materials and good indoor air and environmental quality were noted as key aspects. Not only are the design and construction phases of the building lifecycle important but also the operational phase which typically lasts up to 80 years or so. Melbourne CBD was used as an example of a city in a developed country to illustrate the amounts of office stock and the age profile of the stock. The profile showed that older stock prevails and that it is likely to be less energy efficient and sustainable in operational terms.

The need to define adaptive reuse was discussed along with some examples of different definitions posited by different interest groups. The final section of the paper set out some of the current arguments for and against adaptive reuse of existing buildings. The business case for adaptive reuse has been broadened to incorporate social and environmental factors as well as technological aspects. However the economic arguments remain powerful. This paper has illustrated that one of the problems facing decision makers and stakeholders in the current marketplace: *how does one establish the adaptive reuse potential in a property?* It is this question that is to be taken further and requires additional research.

## **Further study**

Working Title: Evaluating the adaptive reuse potential of existing buildings.

According to Phillips and Pugh (2005) PhD research is concerned with either exploratory research or testing out the theories and hypotheses of others. This proposal falls into the latter category and will develop a tool for estimating the useful life of a range of building typologies via an evaluation and modelling process. There is a considerable body of work positing the social, economic and environmental benefits that accrue from reusing existing buildings (see Ball, 2002; Ignjatovic and Ignjatovic, 2006; Bullen, 2007; Remoy and van der Voordt, 2007). Given the small amount of new buildings added to the total stock annually, clearly reliance on the building regulations that affect newly constructed buildings to deliver sustainability is not viable, as Boardman's 1991 study into energy efficiency and housing standards in the UK demonstrated.

Arguably the market needs to embrace the concept of adaptive reuse (i.e. working with what we have); however in order to do so relevant stakeholders in the market must be convinced of the robustness of the decisions made during the initial phases of selecting appropriate buildings and the design phase. This highlights the focus of this research. Currently there exists a gap in bringing into line project design decision making and environmental performance knowledge because of gaps in data (Lenzen and Treloar, 2003). The findings from this research will improve the knowledge base about the adaptive reuse of existing buildings and assist stakeholders to make better informed decisions incorporating sustainability criteria.

This research comprises three stages:

Stage one will develop a tool for estimating the useful life of buildings based on obsolescence from physical, economic, functional, legal, social and technological criteria;

Stage two will use the tool to rank a database of existing buildings according to their adaptive reuse potential;

Stage 3 will validate the tool via case studies using a multi-criteria decision-making tool. This will allow adaptive reuse options to be ranked according to the perceived level of achievement of sustainable development objectives. Recommendations will be given regarding alterations and improvements to the modelling process.

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