SUSTAINABLE ADAPTIVE REUSE OF THE EXISTING BUILDING STOCK IN WESTERN AUSTRALIA

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Research into initiatives to improve the sustainability of buildings has tended to focus on new construction projects rather than existing buildings. One reason for this is our tendency to regard old buildings as products with a limited useful life that are eventually discarded and eventually demolished. However, the adaptability of the existing building stock provides it with a potential of being a renewable resource and thus a sustainable one. This study examines the factors that determine the opportunity for changes of use that subsequently extend the available lifetime of buildings. It builds on previous outcomes of a focus group held in Western Australia in 2003 to investigate questions raised about sustainable construction by CIB Working Commission W82. A further survey of the focus group was carried out to identify barriers and opportunities for the adaptive reuse of existing buildings. Particular emphasis was placed on how existing buildings can be adapted, the decision-making process and the balancing of occupant needs with considerations of sustainable adaptive reuse.

Keywords: sustainable buildings, existing buildings, adaptability, reuse, Western Australia.

INTRODUCTION

Adaptation is gaining recognition as an effective strategy to improve the sustainability of existing buildings (Ball 1999, Brand 1994, Pickard 1996, Kohler 1999, Latham 2000, Cooper 2001, Kohler and Hassler 2002, Douglas 2002, Gregory 2004). One reason is that old buildings are often cheaper to convert to new uses than demolition and rebuilding. Although the decision to adapt buildings can be made on sound economic grounds (Latham 2000, Douglas 2002), it makes sense environmentally to reduce the amount of new projects, as new buildings are a major source of resource use and waste production That is not to say that new buildings should be avoided as socio-economic growth will always generate a demand for new buildings. However we need to move away from the mindset that old, inefficient and out of fashion buildings need replacing regardless of condition or life expectancy just to satisfy our perceived need for something "new". There are signs of this change and according to Ashworth (1996) almost half the output of the construction industry around the world is work associated with existing buildings. In Australia there is a switch from new buildings to adaptation and rehabilitation of existing structures (De Valence 2004).

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The importance of this trend is that reuse of old buildings supports one of the key concepts of sustainability. It effectively extends the useful life of existing buildings by improving them and compared with new build, involves lower costs in relation to materials, transport, energy and pollution (Gregory 2004, Douglas 2002). In industrial countries we should stop constructing additional new buildings (Kohler 1999) and limit ourselves to improve the existing stock (Graham 2003). This form of continual improvement is one aim of sustainability and not surprisingly is considered one of the most effective strategies for sustainability. The strategy is firmly supported by Rovers (2004) who adds that the existing building stock has the greatest potential to lower the environmental load significantly within the next 20 or thirty years.

Old buildings comprise materials that have lifecycles potentially greater than those realized during their initial occupancy. Structural elements are capable of delivering their design performance longer than less substantial items (Graham 2003). Adaptive reuse is a process that reaps the benefit of the embodied energy and quality of the original building in a dynamic and sustainable manner (Latham 2000). It involves conversion of a building to undertake a modified change of use required by new or existing owners (Douglas 2002). Adaptation describes rehabilitation, renovation or restoration works that do not necessarily involve changes of use. Rehabilitation is the recycling of buildings involving restoration and new construction (Gregory 2004, Douglas 2002). The difference is that restoration returns a building to the condition it was when originally constructed whereas renovation modifies a building so that it meets current standards and codes. Although it extends the useful life of a building renovation does not involve a change in use (Douglas 2002). Adaptation is therefore a method of extending the useful life of buildings and hence their sustainability.

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Despite many questions for the construction industry, the government of Western Australia is convinced that sustainability is the only way forward and the State Sustainability Strategy will show the way for other states, if not countries of new approaches to sustainable building (Gallop 2004, Davidson 2004). In terms of sustainability policy the WA Government has stolen the march, a view supported by the World Business Council for Sustainable Development (Stigson 2004).

Perth in Western Australia is experiencing increased residential construction activity as a consequence of continual urban growth. Coupled to the decline of average Australian household size (2.6 persons in 1996 compared with 3.3 persons in 1976) and the increase in average floor space (3% per annum over the last 7 years) pressures on the environment are growing (APCC 2002). There has also been an increase in the amount of vacant commercial buildings in the Perth CBD. Current vacancy rates for office building are 12.2% which is the highest since 1999 (Property Council of Australia 2004). As this trend appears to show little sign of changing it may force building owners to contemplate adaptation of their vacant buildings for alternative uses. For this reason and due to the diverse style, age and construction of the existing building stock, Perth was considered to be a valuable source of feedback from building owners about the implications of adaptation as a sustainability strategy. There are examples of adaptive reuse of old commercial buildings in Perth but most office building assets are not new and few would ever match ESD standards which means buildings owners see no economic benefit in updating buildings to green standards (O'Donnell 2004).The reverse view is held by Gulliver (2004) who feels that failing to spend money upgrading the ESD standards of existing buildings could

have dire consequences such as a diminished potential market. The industry is in the early stages of sustainability and the biggest issue it faces is churn in commercial buildings. The industry is great at knocking down buildings and pushing up new ones whereas real sustainability is achieved by optimizing the use of the existing stock and minimizing churn rate (Salmon 2004). Past development has created incredible damage to the Australian landscape; however, it has also made Australians unusually environmentally aware in the world community and therefore uniquely placed to help avert a looming global environmental crisis. By facing their problems, Australians will be able to develop technological advances that will be of great use to the rest of the world, as well as ensuring a far better future for themselves (Raven 2002).

OPPORTUNITY FOR CHANGE

Buildings should not be viewed in isolation and in fact form essential parts of an indefinable aura they add to our complex social, heritage and cultural perceptions (Kibert et al 2000, Kohler and Hassler 2002). Only by treating old buildings as a reusable resource rather than a product we consume and eventually discard will we start to move towards sustainability of the built environment. The reuse of old buildings is conservation of the effort, skill and dedication of the original builders and as much energy conservation as it is heritage conservation. Many buildings are capable of adaptation to different uses that bear no resemblance to their original design intent. Old buildings offer a greater challenge than new build but potentially equal if not greater awards in the shape of meeting the social and heritage requirements of sustainability. Although new buildings can be designed for greater adaptability and reuse they still represent a major source of resource use and waste. More environment friendly buildings can be more robust to alternative uses and hence more flexible and durable ensuring longer life (Bartlett and Howard 2000).

Because buildings are inextricably part of our lives their ability for adaptive reuse and hence sustainability helps to maintain our own sense of being. However, the ability to undergo adaptation and deliver an outcome that is more sustainable than demolition and redevelopment is not an intrinsic quality of all buildings. Any assessment of this ability should identify decisions that must be made to balance occupant needs with considerations of sustainable adaptive reuse. By examining the way in which a building interacts with social, economic and environmental conditions to create the opportunity for changes of use that subsequently extend the available lifetime of the building. Understanding historically how buildings react to external change provides the key to developing buildings that can adapt to internal changes in the future.

Buildings contain long-life energy intensive refractory materials and represent a large part of the asset base passed to future generations. If they do not meet the needs of the future they have failed the sustainability test (Fisk 2001). It is only by adaptation that the long-term utility of buildings is prolonged, which makes for a more sustainable built-environment (Douglas 2002). Surviving buildings are often badly documented and even less information exists on the total historic industrial building stock including the buildings that have disappeared and why (Hassler et al 2000).

At the end of the 20th century firms are probably still putting together buildings that may not be sustainable as habitable spaces. From the long viewpoint of sustainable development the most important question is how this under-performance is addressed (Fisk 2001). Managing and upgrading the performance of the existing stock has been identified as the most critical aspect of the sustainability of the built environment

(Kohler 1999, Salmon 2004).As current new buildings get older most will become available for reuse increasing the available stock every decade. This process will stabilize our townscape and city structure directing investment towards the improvement of what exists. Reinvestment in fabric that already has value is likely to achieve more overall value than clearance and new investment (Latham 2000, Douglas 2003, Graham 2003). There will always be exceptions – buildings so poorly constructed they become a liability or so badly conceived that they are unusable. The process of creative adaptation needs to be a continuing process with each building responding to the particular needs of each user. In this way each building will have its own cycle of reuse dependent on its location, use, economic climate, structure, servicing and the creativity of its original conversion (Latham 2000).

OBJECTIVES OF RESEARCH

The purpose of the research was partly explorative, (Sarantakos 1998) as the literature showed few examples that describe how adaptive reuse of existing buildings makes them more sustainable. The research was also correlational and sought to provide insights into how adaptive buildings might accommodate sustainability while staying within the parameters of acceptable performance and standards.

The aim of the research was to carry out a preliminary investigation of building owners' views about adaptive reuse and strategies for improving the sustainability of existing buildings in Western Australia. The significance is that examining how existing buildings have adapted to change may identify the key factors needed to develop adaptable and sustainable new buildings. Analysis of these factors will identify the features that will increase the likelihood of a building being adapted and consequently becoming more sustainable. The key issue for sustainability is whether assets handed on to a future generation offer the potential of operating under various conditions. It is only through adaptation that the long-term utility of a building can be prolonged. This makes for a more sustainable built-environment (Douglas 2002).

The majority of research into assessing the adaptability of buildings has focused on new or proposed development projects and tended to concentrate on environmental criteria of sustainability. It is clear that the majority of buildings represent cultural as well as ecological resources which typically are not put into use due to ignorance about the possible transformation and adaptation. There has been little work to investigate new comprehensive strategies based upon better knowledge of the existing building stocks, a need identified by Hassler at al (2000). The issues of adaptability and sustainability are discussed primarily in the context of buildings in WA but also extend to publications and opinions expressed in the USA and UK, which show similarities in the development of buildings with some regional variations.

RESEARCH METHOD

It was decided that the first stage of the research should investigate building owners/occupiers instead of the more traditional area of design as the drive for sustainable buildings will come from the former. According to Wall (2004) there is a genuine intent by Australian building owners to embrace sustainability. The validity of this approach is justified by Kohler and Hassler et al (2002) who argue that the building stock plays a minor role in the conscience of the architectural profession. As owner-occupiers are the only stakeholders with a financial interest in the building over its life they are often the unwitting victims of a poor building (Bartlett and Howard

2000). The longevity and potential obsolescence of built facilities is a concern for all owners and the usefulness of these facilities is often compromised by their inability to accommodate changes over time. Increasing their capacity to accommodate change over their full life can improve the value of the facility to the owner and reduce disruption to the occupier (Slaughter 2001).A postal questionnaire was developed to gather data relating to the seven research questions. The questionnaire consisted of a range of response formats including open-ended questions and ranked questions. A mixed format of funnel and inverted funnel formats was chosen for the questions as this was felt to be the most appropriate for the sample and allowed a full range of movement from general to specific comment and back again to maintain the interest of the respondents (Sarantakos 1998, Burns 2000).

The population for the survey was a multi-stakeholder group of business, public sector and education professionals from the WA Sustainable Industry Group (WASIG). The main activity of WASIG is to operate as an informal network of professional that promote consideration and implementation of best practice in business and sustainable development. It is a member of the Regional Network of the World Business Council for Sustainable Development. The method used to survey the participants was by a questionnaire distributed by e-mail as it was the quickest and easiest way of obtaining results from the geographically diverse population. It was also felt to be the best way of obtaining the most considered and objective views since respondents can consult their files and may prefer writing as opposed to talking about the issues. Although this approach is limited because it does not allow probing, prompting and clarification of questions, overall it was felt that the advantages of the questionnaire approach would outweigh its weaknesses (Sarantakos 1998, Burns 2000). The questionnaire was designed to question the effectiveness of adaptive reuse as a sustainability strategy for existing Western Australian buildings. The research is a preliminary stage of a progressive program to obtain some understanding of the opportunities and barriers for sustainability of adaptive reuse of buildings in Western Australia. Questionnaire survey forms were sent to all 30 representatives of the companies making up WASIG and fourteen responded to the survey, thus achieving a response rate of about 49%.

BARRIERS AND OPPORTUNITIES FOR ADAPTIVE REUSE

More is being spent on changing buildings than on constructing new ones (Latham 2000, Douglas 2002, Property Council 2004). Commercial buildings have to adapt quickly and often radically because of intense competitive pressure to perform. Buildings which allow multiple uses like warehouses tend to survive longer (Hassler et al 2000). Almost no buildings adapt well. They're designed, financed, constructed, administered, maintained, regulated, taxed and even remodelled not to adapt. But all buildings adapt anyway however poorly because the usages in and around them are changing constantly. Adaptation however is anathema to architects and most of the building professions (Brand 1994, Gregory 2004).

The more flexible a building is the quicker and easier it is to adapt which represents a saving in the time and productivity lost during office churn (Boehland 2003). It appears that the opportunities created by adaptation outweigh those presented by demolition and rebuilding. It is usually cheaper to adapt than to demolish and rebuild because it is quicker, the structural components already exist, contract periods are shorter and the cost of borrowing is less (Gregory 2004). Adaptation is a much safer process than demolition and site work is more convenient because existing buildings provides a work enclosure against inclement weather. More importantly adaptation

retains our sense of place and conserves the architectural, social, cultural and historical values that old buildings represent.

Structural durability alone is not enough to ensure a building's longevity. In order to last a building also needs two types of adaptability. First a building should be capable of withstanding reconfigurations while retaining the same larger purpose. Second a building should be capable of accommodating major shifts in function (Boehland 2003).The concept of design for adaptability was named long life loose fit by the architect Alex Gordon. The more flexible a building is the quicker and easier it can be rearranged. Reconfiguring flexible buildings results in less waste as the parts were chosen or designed to be dismantled or reused. Adaptive reuse has long been championed by forward thinking environmentalists. Each building represents not only the materials that enclose and decorate the space but also substantial embodied energy. Designing buildings for adaptive reuse factors time into the equation of sustainability. For a building or facility to be truly sustaining it needs to endure. As the architect John Ruskin (1849) stated "Therefore when we build, let us think that we build forever. Let it be for such work as our descendants will thank us for".

The majority of buildings represent cultural as well as ecological resources which typically are not put into use due to ignorance about the possible transformation and adaptation. There is a need for new comprehensive conservation strategies based upon better knowledge of the industrial building stocks (Hassler et al 2000). There are also negative aspects to adaptation and it can sometimes be advantageous to demolish and rebuild. There will be cases where old buildings have reached such an advanced state of disrepair that makes their adaptation uneconomical or their internal structural layout may be totally inappropriate for any change of use. Existing buildings may make inefficient use of the site whereas new buildings could maximize plot ratios etc. Generally an adapted building will not completely match a new building in terms of performance although the shortfall should be balanced against gains in social value. Life expectancy of an existing building may be less than a new alternative despite any improvements that adaptation may inject and certainly the life cycle expectancy of the existing materials may well fall short of new ones. This will directly affect the ongoing maintenance costs of the adapted building which may well be higher than those for a new building. In terms of environmental performance old buildings even after adaptation may not reach the desired standards of new buildings. According to O'Donnell (2004) this applies to office building assets in Western Australia.

OCCUPANT NEEDS

A deeper understanding of the link between the needs of building users and adaptation can provide insights into how future buildings might accommodate changes and yet stay within the parameters of acceptable performance and standards. The opportunity to make the changes that impact on the sustainability of buildings will depend on how questions of social, economic and environmental issues are delineated by the various stakeholders. Literature confirms that there is a big difference between what is built and what the user wanted or intended (Zimmerman and Martin 2001, Cohen et al 2001). The gap between theory and application relating to the specific questions of occupancy ideal and that which is built and operated needs to be identified.

A static internal environment that cannot easily be adapted is wasteful in terms of resources and often not warranted in terms of the needs of the occupants. A key objective therefore is to address the building occupant both directly through user

needs surveys and indirectly through the assumptions made about their current and future needs. The question of whether adaptability makes an impact on the sustainability of buildings depends on how social, economic and environmental issues are delineated by the various stakeholders that make up the force of critical opinion. To answer these questions the gap between theory and application relating to the specific questions of occupancy ideal and that which is built and operated needs to be filled. Decision makers are also changing their approach to assessing a building's economic and environmental performance over time; it is no longer acceptable to consider the two factors independently (Bartlett and Howard 2000).

MAIN FINDINGS

Implications on Sustainability of the Built Environment.
Philosophically it is preferable to adapt rather than demolish but it is only viable if the costs and benefits are factored in over the life of the building. Generally adaptation is a more sustainable option but it is case sensitive. It is critical that decisions should be based on finding the option that leads to the most effective use of land such as increased density. Adaptation has important implications for the heritage debate. In some cases building reuse can inhibit energy efficiency and increased urban density but has other benefits in this context such as visual amenity and cultural heritage values. Sustainable building technologies are largely designed for the new projects and not suited to retrofit of existing building stock.

Provided the structure of existing buildings is invariably still functional, adaptation should be the prime consideration by designers. It must be assessed on a case by case basis but with an innovative approach the longer term sustainability of a building is enhanced by adaptation. Adaptive reuse is effective because the costs to demolish outweigh the costs to improve the building and case studies have shown that eco-efficiency of buildings is increased using efficient heating, insulation and low impact materials. Retention of streetscapes can be satisfied, our sense of place maintained and attention given to the future recyclability of materials during adaptation. Utilising existing buildings gives us the opportunity to make the total built environment more aesthetically pleasing and productive.

Existing buildings in WA as exemplars of sustainability.
Buildings that provide good examples of heritage should be preserved for their sense of place regardless of their sustainability. Heritage buildings represent the states history and therefore where possible should be preserved. Examples where adaptation was not really successful include the Old Perth Boys School in West Perth and the 'E' Shed Markets at Victoria Quay in Fremantle. The school is important architecturally and historically but is totally unsuitable for its new use ironically as a heritage centre. 'E' shed market was adapted from warehouses and relocated from its original site. This is an example of successful adaptive reuse but moving the building has in effect robbed it of much of its historical significance. Heritage buildings are cultural icons their preservation impacts on community well-being, sense of place and therefore social sustainability. Due to the importance of these factors, it is preferable to retrofit heritage buildings rather than replacing them regardless of bad plot ratios and lack of efficiency. Heritage invests local communities with a powerful reason to look after their local environment and lead more sustainable lifestyles.

Decision process
Respondents identified various factors that should be considered during the feasibility stage of the decision process. Cultural and heritage significance should be assessed collaboratively with stakeholders particularly those from occupants. Respondents also felt that the practical aspects of various use options should be fully explored while keeping community values and heritage values uppermost in their mind. Feasibility studies should determine whether projected outcomes would meet sustainability benchmarks and whether demolition and subsequent rebuilding would increase density and plot ratio. It was important to establish how technically and economically challenging the adaptation would be. For example how easy it would be to match existing components and how the intended construction methods would maintain the structural integrity of the building. In conjunction, a cost benefit analysis extending to triple bottom line objectives should be carried out and other questions should include whether the adaptation would be innovative. Respondents also provided general comment on the overarching concept of adopting adaptive reuse as a sustainability strategy for the built environment. It was felt where policy decisions are being formulated consideration should be given to the extent to which adaptive reuse of buildings will raise public awareness of sustainability. Also the extent to which adaptation processes will contribute to development of sustainable building technologies should be assessed and the influence this may have on the economics and institutional dynamics of the local building industry.

Opportunities and Barriers to Adaptive Reuse
Respondents identified a wide range of barriers and opportunities to adaptive reuse. Although economics was a common thread running through their opinions, there was evidence of a shift, albeit a subtle one, towards the other tenets of sustainability. It was generally considered more difficult to estimate the costs of adapting a building than constructing a new one. But it was even more difficult to provide a value of the social and environmental factors of sustainability. Generally respondents identified a need for education to illustrate and raise the awareness of the possibilities that adaptive reuse presents. There were other barriers to adaptive reuse that invariably concern cost but this was seen as a smoke screen obscuring the real reason that it is easier for everyone in the development process to produce a new building. Also a new building is considered a creation whereas adaptation of existing building is less creative and attracts less kudos. Respondents felt that many buildings would be suitable for some form of adaptation as the key issue is ongoing environmental impact of buildings in use. This could be improved by efficiencies incorporated during adaptation. Opportunities would stem from maximising the proven benefits of a building while at the same time addressing any shortcomings, almost like having the benefit of a test drive. However there are other benefits in the form of visual amenity and cultural heritage values which are powerful drivers of sustainability.

Adaptation would be cost effective in most cases but the availability and price of materials to match existing may be a problem. Retention of older buildings rather than building more and more new ones creates more interesting community environments but may also obstruct the opportunity to increase urban density using a demolition and rebuild approach. Would the aesthetics of the building fit with surrounding streetscape after adaptation? It was felt that many buildings particularly those constructed during the 50s and 60s were easy to adapt but the finished article would still be ugly. Location of old buildings are on sites that are very desirable and while this makes them ideal for adaptation there could be problems with orientation, sightlines, bulk

and scale. Adaptive reuse of a building was in some cases seen to inhibit energy efficiency, especially as older commercial buildings often do not support passive techniques. However, the varying architecture and construction provides opportunity to test many new technologies and develop diverse solutions to sustainability issues.

Assessment process

There should definitely be an assessment process in WA that considers sustainably reusable buildings. For every redundant building a concept plan should be produced by an architect based on a brief prepared in conjunction with the potential user. The assessment should incorporate social, environmental and economic impacts of the adaptation. Rating proposed adaptation schemes would not only guide developers as to how well their plans are performing but also give regulatory bodies a basis to judge planning applications. In Fremantle building owners are awarded a bonus for retaining old buildings and although effective they are granted ad-hoc. By awarding adaptive reuse projects a sustainability rating the assessment process would be more effective.

All existing building stock should have an environmental management audit which perhaps could be incorporated within current schemes such as the Greensmart assessment system. Additionally, prior to any demolition all existing buildings should be assessed for their suitability to undergo adaptation as part of a sustainable reuse feasibility study. Any assessment that considers the adaptability of existing buildings should also incorporate criteria that ensure the adaptation will not affect heritage.

CONCLUSION

The consensus of opinion generated by the questionnaire generally supported the comments and opinions expressed in the literature reviewed. The concept of adaptation also appears to be supported but doubts about viability invariably focused on economic criteria and partially excluded social and environmental issues. This indicates a need for further research to investigate the extent to which the feasibility of adaptation is influenced by the latter issues.

The diverse range of styles and materials used for buildings in WA during the last 150 years provides a unique opportunity to examine the opportunities and barriers to sustainable adaptive reuse. The contribution of heritage buildings to the three tenets of sustainability has not been explored comprehensively in WA. As a result there is a situation where there is a perceived conflict of interest between the preservation of heritage values and progression of the sustainable urban design agenda. In some cases it appears that the heritage requirements attached to buildings may obstruct the use of new materials or techniques needed for adaptation. The literature review in conjunction with the survey has highlighted several broad questions concerning assessment methods, user needs and the decision process for adaptive reuse. These will be investigated in greater detail in future phases of research to answer the over-arching question of where adaptive reuse fits within a more sustainable built environment.

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