1

Defining Adaptation

1.1   Introduction

This chapter defines adaptation and alternate terms commonly adopted around the world. The distinctions between in-use and across-use adaptations are identified before describing the significance of adaptation within the context of sustainability. Sustainability is discussed to illustrate why the need to adapt our existing stock becomes more of an imperative as time passes. Adopting the standard convention, sustainability is explored with the context of environmental, social and economic paradigms. The chapter then moves on to show the relationship between adaptation and building life cycles and how this can vary the timing and extent of adaptation projects.

Contextual placing of adaptation within our systems of governance is then discussed with reference to the drive for climate change adaptation such as carbon neutrality that is prompting city authorities around the world to implement legislation and policy to encourage sustainable building adaptation. The scope and extent of these initiatives will increase as the manifestations of anthropogenic climate change become more apparent with the passage of time. The framework currently adopted in Melbourne, Australia, is used to illustrate what is being done in this respect.

The final section examines the stakeholders and decision-making issues in sustainable building adaptation and how they affect the degree of adaptation and sustainability that may be achieved. The numerous levels of adaptation as well as the different stakeholders can make the possible outcomes vary extensively.

1.2   Terminology

Adaptation, in the context of buildings, is a term that has been broadly interpreted and defined by many researchers (Ball 2002; Mansfield 2002; Douglas 2006; Bullen 2007). Adaptation is derived from the Latin 'ad' (to) 'aptare' (fit). Typically the definitions refer to 'change of use', maximum 'retention' of the original structure and fabric of a building as well as extending the 'useful life' of a property (Ball 2002; Mansfield 2002; Douglas 2006; Bullen 2007). Frequently there are terms such as renovation, adaptive reuse, refurbishment, remodelling, reinstatement, retrofitting, conversion, transformation, rehabilitation, modernisation, re-lifing, restoration and recycling of buildings used to define adaptation activities. The terms all have different meanings, for example, 'refurbishment' comes from the word refurbish which means, 're', to do again and, 'furbish', to polish or rub up. On the other hand, 'conversion' literally means to convert or change from one use to another, for example, a barn converted to a residential property, and this aspect of adaptation is dealt with specifically in Part II. Three decades ago Markus (1979) noted these terms existed in an 'unhappy confusion'; it is an unhappy confusion which still exists and one we must be cognisant of.

Building adaptation occurs 'within use' and 'across use'; that is, an office can undergo adaptation and still be used as an office (i.e. within-use adaptation), or it may change use to residential ('across-use' adaptation) (Ellison and Sayce 2007). Adaptation of existing buildings can encompass some or all of the terms renovation, adaptive reuse, refurbishment, remodelling, reinstatement, retrofitting, conversion, transformation, rehabilitation, modernisation, re-lifing, restoration and recycling of buildings. For this part of the book, a broad definition is adopted, which includes all forms of adaptation, except for minor day-to-day repair and maintenance works. A useful definition of building adaptation, adopted for this book, is

> any work to a building over and above maintenance to change its capacity, function or performance, in other words, 'any intervention to adjust, reuse, or upgrade a building to suit new conditions or requirements'. (Douglas 2006:4)

1.3   The Significance of Building Adaptation

With the rise in consensus within the scientific community regarding anthropogenic activity and climate change, increased sustainability in the built environment is an imperative (Stern 2006; Garnaut 2008). One method of reducing mankind's environmental impact is to adapt buildings rather than default to demolish and new build. This book examines the case for adaptation, adaptive reuse and decision-making with regard to the building adaptation.

Buildings are inextricably linked to sustainability issues, and the construction industry has a major role in reducing the adverse effects on the

environment as buildings contribute around half of all greenhouse gas emissions (UNEP 2006). Sustainability has a broad and differing definition depending upon the context in which it is used. It is most commonly defined as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (WCED 1987:2) or 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased' (Commonwealth of Australia 1992). Brundtland (WCED 1987) described the concept of sustainable development as a strategy to optimise the relationship between the global society and its natural environment with consideration of the social, economic and environmental goals of society.

International concern for the environment was reflected via the UN conference in Stockholm in 1972 and the idea of eco-development emerged as 'an approach to development aimed at harmonizing social and economic objectives with ecologically sound management' (Gardner 1989). Although eco-development was the precursor of the concept of sustainability, the early concept of sustainable development was firmly entrenched within the environmental movement, and sustainability was often interpreted as sustainable use of natural resources (Hill and Bowen 1997). Debate continued on the appropriate definition of the concept of sustainability. It was argued that development inevitably leads to some drawdown of stocks of non-renewable resources and that sustainability should mean more than the preservation of natural resources (Solow 1993), while it was believed that sustainability had three dimensions, those of environmental, social and economic sustainability (Goodland 1995; Elkington 1997). The divergence of opinions demonstrated that sustainability is so broad an idea that a single definition cannot capture the concept; however, there is agreement that uncontrolled exploitation of natural resources is not beneficial to humankind in the long term (Hill and Bowen 1997). It was proposed that sustainable construction meant 'creating a healthy built environment using resource-efficient, ecologically-based principles' (Kibert 2005). Four principles, adopted by Hill and Bowen (1997) in the concept of sustainable construction, were social sustainability, economic sustainability, technical sustainability and biophysical sustainability. This notion of sustainable construction provides the building and construction industry with a practical framework to guide the implementation of sustainable buildings (Hill and Bowen 1997).

Adaptation is inherently environmentally sustainable because it involves less material use (i.e. resource consumption), less transport energy, less energy consumption and less pollution during construction (Johnstone 1995; Bullen 2007). The embodied energy within existing stock is considerable, and the Australian Greenhouse Office (AGO) estimated the reuse of building materials saves approximately 95% of embodied energy (Binder 2003). Even when economic costs for adaptation are high, the environmental argument along with social factors may sway the decision in favour of adaptation (Ball 2002). The process of demolition is a wasteful process in terms of materials unless they are reused or recycled (Department of the Environment and Heritage 2004). Since the late 1990s the concept of

sustainability has been one of the major drivers of adaptation due to the notion of recycling of buildings (Ball 2002). Upgrading performance of existing stock, through adaptation, is the most critical aspect of improving sustainability of the built environment (Cooper 2001).

Humans have adapted buildings since they started constructing. Over time, the usefulness of any building for its original function diminishes; this process is known as obsolescence and represents a lack of utility. Obsolescence takes several forms such as physical obsolescence, where buildings or their component parts literally wear out. Functional obsolescence occurs where the original function of the building becomes redundant, for example, the workhouses built in the Victorian period throughout England for the poor and destitute are no longer perceived as appropriate methods of housing people experiencing economic hardship and unemployment. Economic obsolescence occurs when the economic rationale for a building is removed; an example is the 2007 closure in Geelong, Victoria, of the Ford Motor Company factory as a result of cheaper production elsewhere and a downturn in vehicle sales generally. Locational obsolescence occurs when the location of the building is no longer suitable, such as warehouses sited on canals in England that became obsolete when motorways overtook canals as rail and road primary means of transporting goods and materials in the nineteenth century.

Obsolescence can affect any building at any time during its life cycle and can trigger an opportunity for adaptation. Building obsolescence is the subject of much research (Cowan et al. 1970a, b, c; Nutt et al. 1976; Baum 1991; Building Research Board 1993; Khalid 1994; EKOS Limited and Ryden Property Consultants 2001). Previous studies examined the causes and impact of building obsolescence and ways to defer the time when a building has no utility whatsoever and demolition remains the only viable option. One way of deferring obsolescence in buildings is to adapt them either through a change of use or within the existing use (Kincaid 2002). Selected examples from Hong Kong (China) are provided in Figure 1.1, Figure 1.2 and Figure 1.3. Further discussion of obsolescence is contained in Part II.

Substantial expenditure is directed to building adaptation across developed nations, and in the UK more work is undertaken on adaptation than new build (Egbu 1997; Ball 2002). Half of the total expenditure on construction in the UK was on existing buildings (Cooper 2001), and in 2004 £45 billion was spent on UK building adaptation (Goodier and Gibb 2004). Looking at the Australian built environment, construction normally contributes between 5% and 6% of national Gross Domestic Product (i.e. 6.7% in 2002/2003) (Australian Bureau of Statistics 2013). A median percentage of 17.8% of all construction work undertaken in Australia for the decade between 1991 and 2001 was on existing buildings. With an estimated $267 billion of new commercial property to be built in Australia before 2018, the performance gap between new and old stock looks set to increase (Romain 2008). The proportion and amount of annual expenditure on building adaptation in Australia and other national economies of developed countries demonstrates the importance of adaptation to business and commerce, both in the past and increasingly into the future. Similar circumstances for stock

Figure 1.1   Western Market (1906–2003), Sheung Wan, Hong Kong.

Figure 1.2   60–66 Johnston Road (1888–2008), Wan Chai, Hong Kong.

Figure 1.3 Former Marine Police Headquarters (1881–2009), Tsim Sha Tsui, Hong Kong.

condition and proportions of expenditure on adaptation exist in other developed nations globally.

'Highest and best use' is defined as 'the use which results in the most efficient and/or profitable use' of the building (API 2007). Highest and best use is a key appraisal and zoning principle employed in valuing land or buildings and is an important influencing factor in determining obsolescence. Clearly the value of a building and its use are linked closely: highest and best use leading directly to highest present value providing the greatest return for investors and owners. Furthermore, a building's value is influenced by the surrounding environment, so land use has to be consistent or complimentary to neighbouring land uses. Other influencing factors affecting value are local competition and political forces; therefore, the timing of a development or redevelopment is vital to achieve the highest and best use. In city centres, multiple uses are not uncommon, and this makes an appraisal of highest and best use more complex given a combination of land uses may be optimal. Highest and best use appraisals consider four factors: legal permissibility, physical possibility, financial feasibility and the maximum productive use (API 2007). Even so the most comprehensive appraisal is only relevant to a specific point in time and is an expert opinion only (Tosh and Rayburn 2002). Some argue for consideration of social criteria and not only economic factors in the appraisal (Jarchow 1991; Nahkies 2002). Over time the methods of accounting for the costs and benefits of social and community aspects in development have been acquired and may be integrated into the assessment. In this book the underlying assumption is that adaptation is predicated on the goal of achieving and maintaining highest and best use for a building at a given point in time.

Globally, the market is noting an increasing amount of adaptation in buildings over the last 20 years. For example, increased levels of adaptation were noted in Alabama and Chicago (Olson 2005; Colchimario 2006). There was a 'frantic pace' of adaptation activity in the UK that outstripped new building activity (Kincaid 2000). A study into the adaptation of offices to residential uses found a large upturn in activity in Boston, Sydney, Melbourne and Vancouver during the 1990s (Heath 2001), while a UK study reported an increased level of adaptation in the retail sector (Douglas 1994). This increase in the rate and amount of adaptation across developed countries is, in part, a response to the case that adaptations are typically faster to complete and occupy than new build and that adaptation often costs less (Chandler 1991; Highfield 2000). Subsequent to the 2008 global financial crisis, there has been a slowdown in all areas of construction. Since the early 2000s there has been a discernible response to the emerging importance of sustainability within the built environment and embodied energy within existing buildings, and thus adaptation can represent a more sustainable solution to new build (Bullen 2007). This move towards incorporating sustainability has occurred alongside significant UK and Australian Government-led global economic reports (Stern 2006; Garnaut 2008) highlighting the potential outcomes of ignoring global warming and climate change. The momentum for sustainability in buildings has been further increased through the adoption of corporate social responsibility (CSR) reporting by leading business organisations around the world and the subsequent adaptations that enhance the sustainability of their building stock (Newell and Sieraki 2009).

The age and quality of the stock in an area affect the amount and scope of adaptation undertaken. Within Australia, previous studies estimate between 85 and 90% of the commercial building stock is aged over 10 years (Davis Langdon 2008). In older more established cities, the average age of the building stock is higher still. Furthermore, in established urban centres, only small percentages of new buildings are added to the existing stock total each year. For example, in London 1–2% is added to the total stock of commercial buildings annually (Knott 2007), whereas Melbourne typically has 2–3% added to total stock (Jones Lang LaSalle 2008). It is estimated that 87% of the residential stock the UK will have in 2050 is already built and 89% of the stock Sydney will have in 2030 is already built (Kelly 2008). As a result there is an ongoing need to adapt the existing stock to meet the changing current and future needs of investors and building users. Pressure is placed on existing building stock in Australia from increased immigration, resulting in further opportunity to adapt buildings (Foran and Poldy 2002). Melbourne is seeking to grow to a population of five million by the year 2025, and recent growth exceeded this prediction (Department of Premier and Cabinet 2008). The UK also experienced population growth in the first decade of the twenty-first century through immigration within an expanding European Union. Population increases put pressure on the existing stock to meet societal needs that can make adaptation attractive. Moreover, the situation is compounded with a construction labour skill shortage in Australia which has driven new build construction costs upwards, and adaptation can be an attractive economic alternative in some cases.

Globally in some urban areas, vacancy rates for office buildings are high and rates are increasing with the ongoing global economic turmoil (RICS 2009). Vacancy rates are higher for lower-grade stock, and some sections of stock that have been vacant for three or more years are considered to be a structural and long-term issue (Remøy and Van der Voordt 2006). For instance, in the Netherlands there was seven million square metres of office space vacant in 2012, which presented challenges to owners by way of lost income (DTZ 2012). Moreover, empty buildings are more vulnerable to vandalism, arson and squatting that drive up ownership costs and, in the long term, the effects of vacancy including social blight and economic decline. It was concluded that one million square metres of Dutch office space (or 2% of total stock) should be removed from the market because it is outdated and suffering to various degrees from technical, functional, locational and physical obsolescence (Remøy and Van der Voordt 2006). In Australian cities the positive economic conditions of the early 2000s have led to comparatively low vacancy rates. Melbourne had an all-time low vacancy rate for office space in 2007 when rates were 4.7% (Savills 2009). However, as a result of the global financial crisis in 2008, national office vacancy rates increased across Australian cities to 9% in July 2011 (PCA 2013). Adaptation offers a new economic life for a building at a fraction of the cost of new construction, and with a greater amount of lower-grade space available, there is an opportunity for businesses to occupy better-quality space as developed countries move out of recession in due course.

1.4   Decision–Making Issues in Building Adaptation

Building adaptation decision-making is complex (Blakstad 2001; Douglas 2006). There are many stakeholders involved, each representing a different perspective. Decision-makers are investors, producers, developers, regulators, occupants/users and marketers (Kincaid 2002). An additional layer of complexity is that these stakeholders make decisions at different stages in the process and each has different degrees of influence (see Table 1.1).

Generally decisions made at the early stages of the process have an ongoing impact throughout the project. For example, the decision to change the use affects all the decisions that follow. Furthermore, the capacity of stakeholders to influence decisions can be classed as either direct or indirect. Another layer is added where a stakeholder intends to be an occupier or user, in which case the decisions will have a daily impact on their ongoing business operations. The motivations of stakeholders influencing decision-making vary, for example, a developer who intends on selling the property post-adaptation experiences different drivers than if the intention is to retain the property within the developer's property portfolio. In summary, stakeholders are multiple and exert their influence to different degrees at different stages.

Table 1.1   Decision-makers in building adaptation.

Decision-makers	Professional and other affiliations	Stage in adaptation where decisions are made
Investors	Pension/superannuation funds, insurance companies, banks, independent investors, professionals who find capital to invest	Beginning/early
Producers	Professional team – facilities manager, quantity surveyor, architects, engineers, contractors, surveyors, suppliers, fire engineers, structural and mechanical and electrical engineers	Quantity surveyor/architect at feasibility stage Design stage Construction stage
Marketeers	Surveyors, stakeholders, professionals who find users for buildings	During design (if selling off plan) and/or construction stage
Regulators	Local authorities, planners, heritage, building surveyors, fire engineers	During design stage (and possibly during construction if amendments are made)
Policymakers	Federal, state and local government departments	Indirect effect on decision-making in adaptation at all stages
Developers	Organisations that combine investment, production and marketing in whole or in part. Professionals from aforementioned bodies and others	Beginning/early
Users: corporate, residential	Large institutional owners and users, individuals, business organisations and occupiers	—

1.5   Decision Options and Levels of Adaptation

A further aspect is the range of options available to stakeholders (Kincaid 2002). Kincaid rationalised the options as follows: Option one is to change the use with minimum intervention because of the inherent 'flexibility' of the building. Option two is for adaptation with minor change, while option three requires a higher degree of intervention and is typically referred to as 'refurbishment' or 'retrofitting'. Option four involves selected demolition, whereas option five is the extension of the facility. Finally, option six is demolition and redevelopment and is selected when the social, economic, environmental, regulatory and physical conditions are such that the building is at the end of the life cycle, lacking utility (Bottom 1999). This part of the book is focused on decision-making that occurs through options two to five inclusive. Effective decision-making demands the consideration of issues such as framing the issue properly, identifying and evaluating the alternatives and selecting the best option (Turban et al. 2005; Luecke 2006).

Current state diagnosis   Potential outcome   Future state possibilities
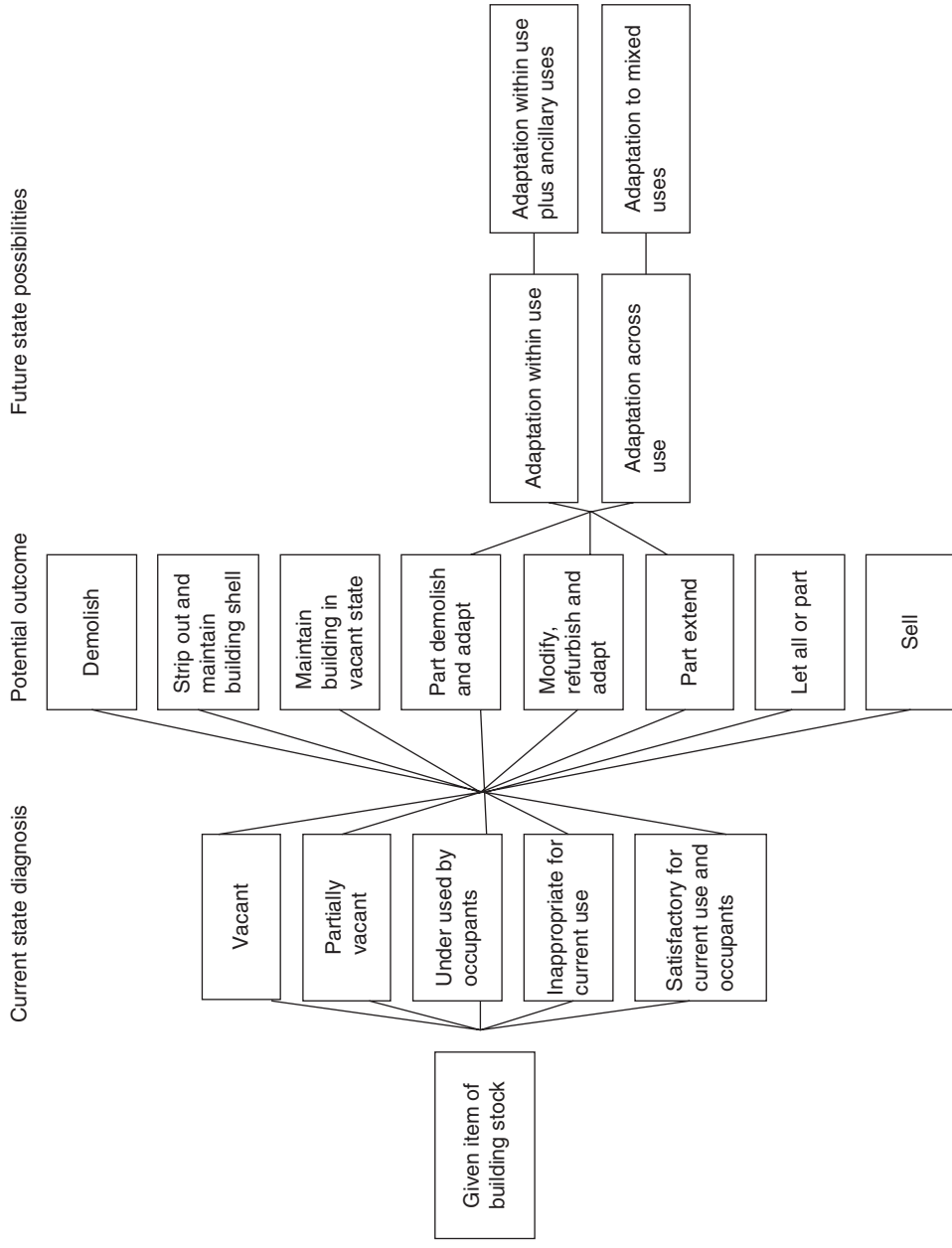
Figure 1.4 Options for adaptation.

Others have noted different option outcomes for adaptation such as rebuild, demolish and refurbish (Ohemeng 1996; Arup 2008). The 'options for adaptation' model is shown in Figure 1.4 and represents identification of all the potential outcomes found. Any building, for example, could be satisfactory for its current use and occupants, inappropriate for current use, underused by occupants, partially vacant or vacant. Following on from any of these states, the potential outcomes for the building are as follows: demolish; strip out and maintain building shell; maintain building in vacant state; part demolish and adapt; modify, refurbish and adapt; part extend; let all or in part; or sell. Where the decision is to either part demolish and adapt; modify, refurbish and adapt; or part extend, choices need to be made between an adaptation within use and an across-use adaptation. Finally, an adaptation within use may add ancillary uses, and an across-use adaptation could include mixed uses (Kincaid 2002).

Another way of distinguishing different levels of building adaptation modifies an approach developed by Arup (2008) where level 1 is very minor adaptation, level 2 is 'alterations' adaptation such as fit-outs to individual floors, level 3 a 'change of use' adaptation and level 4 major alterations and possibly extensions known as 'alterations and extensions'. Adaptation works are more or less progressively more extensive with each level.

1.6   Adaptation and Different Land Uses

Land use is the anthropological usage of land that involves the management and modification of natural environment into built environment. Land use practices differ around the globe. It is a term used by urban planners, who undertake land use planning and regulate the use of land in an attempt to avoid land use conflicts. Land use plans are implemented through land division and use ordinances and regulations, such as zoning regulations.

As time passes, some land uses become obsolete. For example, industrial land uses change as technological innovation renders premises outdated. At this point there is an opportunity through changes to planning zones, to adapt the buildings through change of use. Without change of zoning, the options are limited to within-use adaptation.

Although land use practices vary from country to country, in developed nations broadly the framework is similar. There are regulations that have to be followed in order to change land use. Increasingly planning authorities are adopting sustainability as a goal, and their policies and strategies reflect these aspirations. Furthermore, many planning authorities are also responsible for transportation policy and endeavour to link urban development to transport planning. The following list gives an indicative overview of the terms adopted in some jurisdictions:

- *Land use*: the way that land is used by people
- *Zone(s)*: areas that allow certain land uses
- *Commercial zone*: businesses that sell goods and services to local citizens (retail) or other businesses (wholesale)

Table 1.2 Land uses in the Melbourne CBD.

1. Office, premium	18. Entertainment/recreation indoor
2. Office, A grade	19. Cultural and community use
3. Office, B grade	20. Conferences/meetings
4. Office, C grade	21. Flats/apartment/unit
5. Office, D grade	22. Hotel/motel
6. Ungraded office	23. Hostel/backpackers accommodation
7. Retail, premium	24. Private hotel/boarding house
8. Retail	25. Institutional accommodation
9. Retail – stand-alone shop	26. Serviced apartment
10. Wholesale	27. Student accommodation
11. Manufacturing	28. Corporate supplied accommodation
12. Workshop/studio	29. Student apartment
13. Equipment installation/plant room	30. Parking – private, covered
14. Transport	31. Parking – commercial, covered
15. Storage	32. Common area
16. Education/research	33. Showroom
17. Hospital/clinic	Gallery/museum/public display area

- *Industrial zone*: Factories, warehouses or manufacturing plants that produce mass quantities of a product
- *Residential zone*: places for people to live
- *Public/semipublic (civic) zone*: an area that serves or is used by all people
- *Parks/recreation zone*: an area of land reserved for public use and recreation
- *Agricultural zone*: land used for livestock, growing crops and farm buildings

Using Melbourne as an example, it is the state capital of Victoria, Australia, with approximately 3.6 million people or 72% of the state's population residing there (Australian Bureau of Statistics 2006). In June 2007 the population for the City of Melbourne was estimated to be 81,144 – a growth of 60% since 2001. Recent planning policies have increased residential accommodation in the city encouraging more people to live in the city; this is in common with other Australian and international cities. State and city government is located in the city, along with academic institutions, theatres, restaurants, arts centres, commercial head offices and business organisations, retail and recreational facilities. Table 1.2 shows 34 land uses in the Melbourne CBD. It is clear that many land uses exist, though sometimes similar, for example, office land use is split into six categories and retail has three classifications. Compared to the more generic list in Section 1.6, it is a good example of how different authorities classify land uses.

1.7   Conclusion

The definitions of adaptation and the concepts presented, analysed and discussed in this chapter are concerned with the decisions of separate stakeholders and their collective behaviour that is reflected in the form of our cities and towns globally. Clearly it is difficult to determine the reasoning behind the subjective decisions executed by individuals and collectively as a society, and this section of the book describes the environment in which adaptation decisions are effected. Other parts

of the text examine decisions made in respect of different stakeholder groups or specific types of adaptation such as conversion or across-use adaptation.

The various terms used with regard to adaptation to a large extent reflect changes in fashion and terminology that inevitably occur over time and in different locations. For example, the term adaptation is a preferred US term, whereas the UK favours the word refurbishment. Wherever one comes across these terms, it is important to seek clarity as to exactly what work is planned to avoid confusion. This chapter has also shown that policymakers and legislators are increasingly developing and implementing strategies to mitigate the perceived impacts of climate change. Due to the contribution of and impact of the built environment on carbon emissions, adaptation is perceived to be an area where significant positive outcomes are possible.

Finally, the complexity of decision-making was described, a situation with multiple potential outcomes influenced by a number of stakeholders and decision-makers who exercise influence and power at different stages of the process. It is apparent that discussions and decisions in respect of adaptation and sustainability will undergo much iteration before final outcomes are realised. Clearly framework and decision-making tools are needed to assist stakeholders to make informed and, above all, effective decisions in respect of sustainable building adaptation for all our sakes.

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