REHABILITATION VERSUS DEMOLITION
AND
REDEVELOPMENT

A Value-based Decision Framework for Private Commercial Properties

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ACKNOWLEDGEMENT

The earliest influence I had in my life concerning academic pursuits came from my father. I remember very well, when he used to walk me to school, the sort of career dreams he had for me: either becoming a newscaster with Ghana Broadcasting Corporation (GBC) or a 'Doctor'. Whatever sort of a 'Doctor', I do not know. But from his fascination with politics, I guess it might be of the kind such as those of Dr. Kofi Busia and Dr. J B Danquah, who were then active on the Ghanaian political scene. Sadly, my father passed away when I was ten but his dreams have stayed with me. In a way I feel an unspoken covenant had existed between us which the attainment of this degree would help fulfil. I am extremely grateful to my Dad, who, at a tender age, filled me with the desire to pursue knowledge. To his memory I dedicate this effort.

I also wish to, posthumously, express my eternal gratitude to my Mum, who sadly has also passed away. It was she who made my Dad's dream come true. She sacrificed everything to see to it that we had some education. She also taught us never to give up when things got tough. To her memory also, I dedicate this work.

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DECLARATION

I declare that the research contained in this thesis was solely carried out by me. It has not been previously submitted to this or any other institution for the award of a degree or any other qualification.

ABSTRACT

Property developers, investors and financiers usually have reservations about the investment performance of rehabilitated and refurbished properties.This is due to the uncertainties introduced by low rental income, higher yields and shorter leases associated with secondhand properties. This situation is thought to be changing as more and more successful schemes are reported in the property and business press.

What is changing attitudes is the improved economics of refurbishment schemes. Occupiers are seeking to reduce occupancy costs after the last recession. Rehabilitated properties which can offer facilities comparable to new build but at a fraction of new build rents are therefore becoming attractive. Furthermore, recent innovations in services and communication technology is making it possible to service older properties to the same level as new buildings. This is creating investment value in buildings that might otherwise have remained unlet.

Despite the improved situation, there seemed to be no formal framework to aid building rehabilitation versus redevelopment decisions in the private commercial property sector. The critical decision determinants are scattered over several publications. What this research has done is to assemble all factors within a single framework.

Examining the nature of buildings, it is apparent that different groups evaluate buildings differently. To some they are symbols of prestige or image and to others they help create the environment we live in. Yet more, some see buildings as shelters and investment assets. In the private sector, the main actors that influence property development are occupiers, developers and investors. Each of these actors evaluate buildings on different criteria. This makes the building rehabilitate-redevelop decision a conflicting multi-criteria problem. The framework created by this research is therefore based on Multiattribute utility theory (MAUT).

The research identified the objectives of building renewal from the perspectives of occupiers, developers and investors using the principles of value-focused

thinking. The common indicators linking these objectives became the decision attributes over which utility and value functions are to be created. By the research results, the option chosen in the decision scenario described above is determined by the attributes: profit, maintenance cost, energy cost, floor to floor height, floorplate area, floor load-bearing capacity, floorplate width and on-site car parking provisions. The preferred option is the one that maximises the subjective value of the decision maker over these attributes.

CHAPTER ONE
INTRODUCTION AND BACKGROUND

1.1 General

The research reported in this thesis is about how to improve renewal decisions on private commercial properties. Property renewal in this context does not only imply new build but also functional and physical improvement of an existing building through rehabilitation.

The dilemma over whether to rehabilitate an existing property or to demolish it and redevelop is considered as a decision problem. This is characteristic of any decision situation where more than one course of action exists (Keeney, 1988).

Since the mid 1960s, in both the UK and the USA, theoretical formulas have been derived (which will be discussed in the next chapter) mainly to address public sector housing renewal problems (eg. Needleman, 1965; Sigsworth and Wilkinson, 1967; Schaaf, 1969). It does appear that no such formulas or for that matter no framework exists for aiding renewal decisions in the private commercial property sector. Recent commentaries on the subject (Dubben and Sayce, 1991: chapter 10; Scarrett, 1995: chapter 2) are limited to illustrating the use of the concept of economic life in determining the time to redevelopment. They do not demonstrate a purposeful attempt to examine the issues involved to provide an aid to decisions. The objective of the research reported in this thesis was to create such a framework.

The approach followed in this research was to go 'back to the basics' of property development by asking the following questions:

- why are commercial properties developed?, and
- why does it become necessary to renew existing properties?

Answers to these questions provided the bases for the proposed framework. The first question brings to mind the motivations of the various interests that interact to produce buildings. The second question focuses attention on the function of buildings, what affects these functions and what determines the life span of buildings.

In the private commercial property market, building development is triggered by individuals and organisations demanding buildings to house their activities in certain locations. Developers respond by supplying the type of properties in demand at the required locations. In the private sector, these properties would usually be supplied with the expectation of making financial gains.

Viewed more generally , buildings are important to nations, communities, organisations and individuals. The greater proportion of the wealth of many a country's assets are in the form of buildings. In the UK, for instance, the value of property held by institutions at the end of 1991 amounted to some £90 billion (Investment Property Databank, 1992). Frazer (1984) highlights the economic importance of buildings to companies and corporations by referring to how they are used as the collateral on which the majority of corporate debt is secured. Companies raise money by either using their properties as security for their loans or selling them to investors and leasing back.

In addition to the economic benefits, buildings create the physical environment in which many human activities take place. These activities may be associated with domestic habitation, provision of services or some other industrial-commercial production. Buildings also do interact with the external environment to define the quality, character and identity of a place and people. This is aptly put by Lee(1986) thus:

"The condition and quality of buildings reflect public pride or indifference, the level of prosperity in the area, social values and behaviour and all the many influences, both past and present which combine to give a community its unique character."

This view is echoed by Reynolds(1993):

"A building is a human creation; as such it is an expression of human ideals. ... They are also an expression of a people's level of culture, their appreciation of beauty and their tolerance of banality."

Thus buildings are not only there to provide shelter or serve as investment assets, but also to provide appropriate environments for those inside and outside them.

The value of a building is dependent on its ability to serve the objectives of its owners and its ability to efficiently support the activities of its users. The relationship between the building and its external environment through the spaces created in conjunction with other adjacent built structures also has a bearing on its value.

To put all of these in perspective, the value of a building is determined by:

- durability as influenced by construction and design competence as well as the quality of the construction materials.
- the returns on the investment made.
- its ability to efficiently support the activities carried out in it which is dependent on the specification of its accommodation.
- its effect on the built environment, and
- the effect of the external environmental factors on the building.

The purposes described above, which buildings serve, are usually long term. Buildings are therefore designed to be durable. This desirable attribute of durability is also the source of renewal pressures.

Buildings and the activities they support exist within several environments. These environments include political, social, economic, geographical and technological environments. These environments have effect on the value of buildings as described above. They also change with time. For instance, prevailing economic conditions do change affecting financial returns and existing technologies do change inducing changes in functional requirements. Locations also do change in their built and use form. The only objects that appear to be static in this dynamic space are buildings. Usually buildings are built to the standards existing at the time of construction, using the materials of the time to serve activities and practices of the time. Besides they are tied to the same location. The inference that can be made is that because buildings are durable and can span several changes, the life span of every building is determined by its ability to respond to changes.

According to Byrne and Cadman(1984), buildings are usually trapped in a certain physical, social, technological and environmental frame that makes it difficult for them to be flexible to respond to changes. This is the basis of obsolescence. This is a characteristic of a point in the life of a building where there is a marked mismatch between current functional requirements and performance. It can be seen, from the discussions so far, that every building is susceptible to obsolescence.

To reverse the effects of building obsolescence, owners have to consider renewal at some point in the life of their buildings. For rented properties, failure to do this may lead to the loss of tenants to newer and modernised properties. They may also fail to attract new tenants. In a recent survey conducted by the refurbishment specialist, Connaught Group of 326 senior property executives from some major UK companies, the key motivation factors for refurbishing offices were given as to attract tenants and to increase yields (Chase, 1996). Making a renewal decision in the situation described above is made much more complex when the effects of obsolescence have to be considered alongside physical deterioration.

By studying the nature of buildings as objects, it became clear that buildings can serve a multiplicity of functions to different people and groups of people at the same time. In the private sector, the main actors who influence building development are developers, investors and occupiers. Each of these groups assesses the value of buildings along different and often conflicting criteria. The aim of this research was to address the building renewal problem as a value problem by bringing all the decision determinants from the different perspectives together in a single framework. The most appropriate model in these circumstances was a multiattribute utility theory (MAUT) model.

The basic input into MAUT models are value objectives derived from the motivations and preferences of decision makers. To obtain the value objectives of the main private sector actors mentioned above, procedures based on what is now known as 'value-focused thinking' (Keeney, 1992), which is a recent derivation of utility theory (see chapter three) were employed. Value-focused thinking is about focusing on the values of the people impacted by a decision and then determining how best to achieve them.

Initial data on the value objectives of the main private sector actors (ie. developers, investors and occupiers) were sought from secondary published sources. These were then augmented and confirmed by primary research data (refer to chapter four for detailed research methodology).

One other observation made from the background study was that because there are different interests with conflicting value criteria, it is difficult generating a unique set of criteria to evaluate buildings. The research concentrated on determining the core building performance indicators arising from the motivations of the impacted interests within the constraints of development controls, statutory regulations and resource availability. These were then used as the bases for creating the decision model described in this thesis.

1.2 Building Life and the Timing of Intervention

The life cycle of a building may consist of several periods of different ownerships and/or uses. These periods of use refer to time spans where functional and physical requirements remain largely unaltered.

Performance Gap = obsolescence + physical degradation

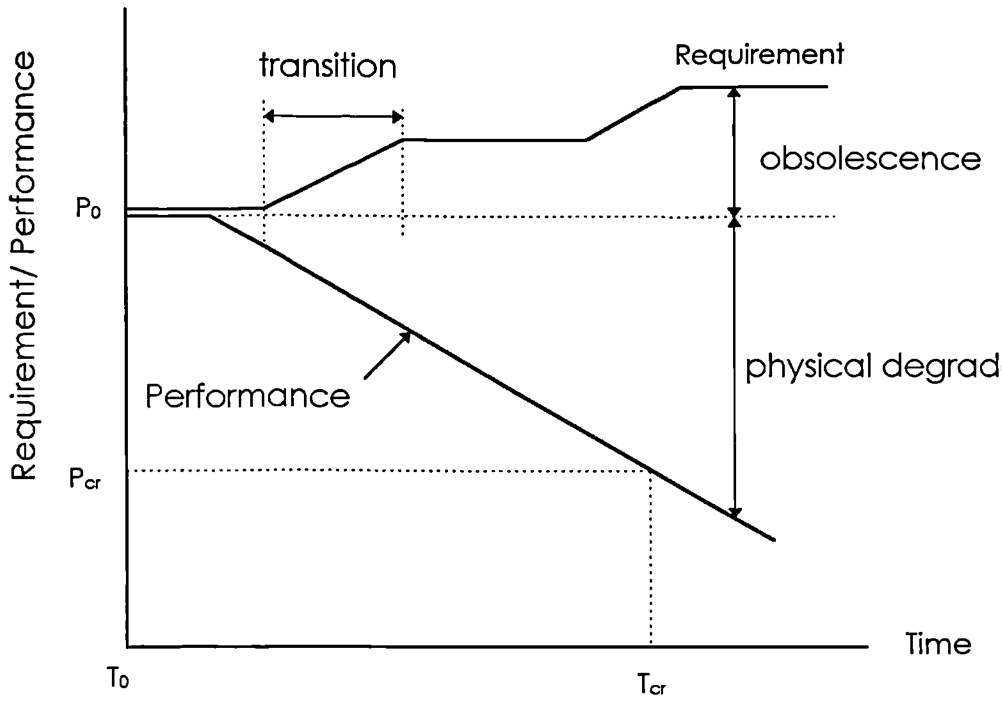


Figure 1.1: Building performance/ requirements over time

To illustrate briefly the life cycle of a building, figure 1.1 shows that at the beginning of occupation, (t= T_0), functional and physical performance of a building closely matches the requirements. As the building ages, the performance of the building and requirements diverge thereby creating a performance gap. This gap opens due to two reasons (Aikivuori, 1996):

- the level and character of requirements change over time. Generally requirements either increase or rise with time which forms the basis of obsolescence. There are periods when requirements are in transition and there are others where they are fairly stable.

- at the same time that requirements are changing, the building structure physically deteriorates due to wear and tear from usage and attacks from the elements. The rate of decline, however, depends on the level of maintenance over the years. But as illustrated by figure 1.1, some form of intervention would inevitably be required to reverse the effects of obsolescence irrespective of the level of maintenance.

According to Goodall (1972), the gap mentioned above opens up because the rate of maintenance and modernisation does not usually match the rate of change of requirements or the rate of degradation.

To illustrate the timing of any intervention, a critical point (T_{cr}, P_{cr}) is defined as shown in figure 1.1 which refers to the point in any building's life where further divergence between requirements and performance cannot be tolerated. The choice of this critical point is dependent on the attributes of the particular building, its usage, its location and ownership. However when this point is reached, it may be considered inappropriate and inefficient to continue to use the building for the original purpose and probably for any other purpose without a major intervention. Such interventions may include refurbishment, rehabilitation or demolition and redevelopment.

1.3 The Operational Definition of Rehabilitation

Rehabilitation means a lot of things to a lot of people. To a tenant, it may mean an extensive transformation of a property to make it nearly as 'good' as new. To the property owner, it may be part of a temporary strategy to 'buy time' for an obsolete and inefficient building before embarking on redevelopment (John Kiely, 1992).

The scope of rehabilitation can range from the cosmetic, involving just internal redecoration and refurnishing, to the comprehensive involving the stripping back of a building to its bare structural form.

The various levels of rehabilitation, and hence various definitions, make it difficult to assess the objectivity of the generalised statements often made about the merits and demerits of rehabilitation. For instance, apart from conservation arguments, one of the main advantages of rehabilitation is reported to be that it is generally faster and less expensive than new build (Sidwell, 1984). This view is counterd by some studies (eg. Industrial Market Research Limited, 1987) which found the cost of refurbishment to be, if not more than, of the same order as that for redevelopment. Both views may be right! What seems to be missing is the differences in scale of rehabilitation on which the various studies were based. Is it a lick of paint or a total and comprehensive strip out?

The term rehabilitation is often used interchangeably with refurbishment. It may even be confused with maintenance if the maintenance activity contains some elements of modernisation. In a research report by Industrial Market Research Limited commissioned by Touche Ross and Company (1987), refurbishment was defined as:

'Work that involves the structural alteration of buildings, the substantial replacement of main services or finishes and/or the substantial improvement of floor space whilst at the same time including associated redecoration and repair works on the one hand and related new building on the other'

To some property professionals, the above could also be used to define rehabilitation. There is however no problem with this definition if used within the context of the study. However any attempts to generalise the findings of the study to cover all scales of rehabilitation without this definitional qualification could be misleading.

It is argued that in the belt tightening 1990s property owners have no choice but to view rehabilitaion and refurbishment as a management strategy to uphold the values of properties held in portfolios (Harding, 1995). If this statement is true, then the establishment of universal definitions of terminologies in connection with work on second hand properties may be appropriate.

The existence of universal definitions for work on second hand buildings will aid the collection of statistics. This lack of universal definitions was the biggest problem encountered by DTZ Debenham Thorpe's research department when they embarked on the compilation of a database for shopping centre refurbishment activity in the UK (*ibid).* Harding, DTZ's national shopping centre management director wrote:

'Inevitably, the biggest problem faced in compiling such a database concerns the issue of definition. Refurbishment comprises a spectrum of activity ranging from little more than a timely lick of paint to full enclosure'.

In making decisions about whether to rehabilitate an existing building or to redevelop, it is essential that there is a clear understanding of the terms used in connection with this type of work. This is to avoid confusion and the possibility of misrepresentation.

Coffey (1993) saw work involving existing buildings as spread across a spectrum with renovation and remodelling as the upper and lower anchors respectively. In between these end anchors are rehabilitation and restoration. He referred to all the work involving existing buildings as the four R's: renovation, rehabilitation, restoration and remodelling.

Coffey (1993) gave the aim of renovation as to create a new building within an existing frame. This, he wrote, may involve the complete strip out of the existing building to the bare structural frame. Slightly less extensive in scope is rehabilitation which he considered as involving the repair and upgrading of a building's basic system and elements of construction. Restoration, as the name suggests, is the attempt to return a building to its original condition or condition at some past date.

Of the four R's mentioned above, Coffey considered remodelling (used interchangeably with refurbishment or modernisation) as the least complex, least expensive and least time consuming. He reckoned it may entail a cosmetic change to reflect changes in tastes or usage and may include the cleaning and redecoration of finishes, furnishings and minor equipment. This definition is close to the *Chartered Institute of Building's* (CIOB) definition of refurbishment (Supplement Number one to the *Code of Estimating Practice*, 5th edition: 1983) given as:

"*Work carried out on an existing building in the attempt to improve and to update it to modern standards whilst retaining its current use.*"

Johnson (1994) also saw work on second hand properties as varying on a scale which depends on the scope. Unlike Coffey who drew clear distinctions between the various activities, Johnson saw the various activities as varying degrees of rehabilitation. He thought of rehabilitation as 'ranging from interior redecoration to near-total reconstruction with a wide range of intermediate prescriptions for upgrading, remodelling and renovation'.

The operational definition of rehabilitation in the context of this research is close to the definition of refurbishment given by Industrial Market Research Limited (1987) stated earlier in this section. For this study,the definition of rehabilitation is given as:

The repair, strengthening and upgrading of building structure, fabric, finishes, decorations, furnishings and services to reverse the effects of obsolescence and physical degradation or to satisfy the needs of an alternative use. It may or may not involve the rearrangement of internal spaces and the upgrading of the external environment but of a scale that is comparable to new build, at least in terms of capital outlay.

It was observed from the literature that the prevalent term used in connection with development activities on second hand buildings is refurbishment irrespective of scale. This definition of refurbishment by Quah (1988) confirms this observation:

"Refurbishment is a generic term including rehabilitation, modernisation, renovations, alterations, improvements, additions, repairs, renewals, retrofitting; the term does not include domestic maintenance work such as cleaning and emergency maintenance"

Hence the term refurbishment is used interchangeably with rehabilitation throughout this thesis.

1.4 The Need for this Research

The use of the term rehabilitation often brings to mind the restoration of some old cotton mill, church or factory building which is in the main inflexible and structurally unsound to cope with modern requirements. The motive for carrying out rehabilitation on such buildings was and is quite often preservation and conservation. An evidence of this can be seen in the fact that most of the authoritative literature on rehabilitation (eg. Highfield, 1987; Cunnington, 1988; Eley and Worthington, 1984) tend to emphasise its conservation aspects. For commercial properties, the conservation arguments may still be valid, but the overiding factor may be economic and functional flexibility (Chandler, 1991).

Discussions in the literature on building rehabilitation are dominated by problems that are encountered when working with 1960s and 1970s buildings. Such buildings are said to be typically system buildings which are structurally unsound, 'tired' and inflexible to accommodate modern uses. The problems encountered usually include (Kiely, 1992):

- poor ceiling heights.
- inadequate riser provision for services and cabling.
- attempt to provide ceiling voids interferes with window openings.
- inadequate floor loading capacity, and
- small floor sizes.

Occupiers do not like buildings with the characteristics above for they constrain their ability to respond to short-term changes in requirements (Cadman and Topping, 1995). Due to these same reasons, refurbishment of second hand properties did not appeal to investors. Normally the institutions prefer flexible buildings (ie. with raised floors and ceiling voids) with air-conditioning, in prime locations which can be let easily. This impression about second hand buildings among occupiers and investors is considered to have changed since the 1980s due to a multiplicity of factors including:

1. not all the offices built in the 1960s and 1970s have the limitations above. There have been numerous successful cases of refurbishments of some 1960s and 1970s buildings in the UK. An example is the refurbishment of Companies House carried out by Derwent Valley Holdings (Morgan, 1996). In his article, Morgan described the building as 'having relatively good ceiling heights, immensely strong floor loadings and good daylight from windows on all elevations'.

2. the oversupply from the boom and bust cycle of the 1980s has left a lot of unlet and unsold speculative buildings. By the summer of 1992, the amount of unlet space was estimated to have peaked at 3.2 million square metres (Gann and Barlow, 1996). These buildings are modern and do not suffer from the limitations of the 1960's and the 1970's buildings. To make them lettable, their owners are having to embark on refurbishments and conversions.

3. the grand architecture of some older buildings, the soundness of their structures and the economics of some situations are combining to

make refurbishment appealing to investors and occupiers (Coffey, 1993). Investors can provide refurbished properties at a fraction of new build rents and still realise returns on their investments. Occupiers too can benefit from occupying high quality space at lower cost. An example of this situation is said to have existed in Croydon (Macrae, 1995) where local business was said to want good, usable space 'at under £10 per square feet'. This, according to local agents, was not enough to support a new building. Another refurbishment scheme which is thought to have benefited occupiers was that of Clifton Heights in Bristol (van Dijk, 1992). After a £3 million refurbishment, this property was put on the market for up to £14 per square feet compared to £21 per square feet on new build.

The reasons above demonstrate the need for a framework which will assist in taking a balanced view of the situation rather than rushing to generalise about the merits or demerits of a particular course of action. There are other compelling reasons why this research is necessary. These include:

- the fact that property has now matured as an investment asset:- all the sophisticated analysis applied to other established investment assets such as gilts, stocks and shares are now being extended to cover property investments. Properties can therefore not be abandoned or demolished easily without careful and detailed analysis. According to Harding of DTZ Debenham Thorpe (Harding, 1995), refurbishment can no more be viewed as a defensive action against events outside the control of the property owner. It should rather be seen as a proactive tool to maintain and enhance portfolio values.
- the existence of conflicting commentaries and research studies on the merits and demerits of refurbishment:- some research studies and observations (eg. Industrial Market Research Limited, 1987) cast doubt

on the often claimed development cost advantages of refurbishment compared to redevelopment. The IMR study found that refurbishment cost is of the same order as, if not more than, redevelopment. Yet other commentators (eg. Macrae, 1995) do still maintain that this cost advantage exists. These conflicting observations may owe more to the unfounded generalisations referred to earlier. Every situation therefore merits examination. The need for a logical procedure in these circumstances cannot therefore be overstated.

- the fact that the determinants of the renewal decisions are scattered over several references:- this research attempts to assemble all the critical factors involved in making renewal decisions in one volume. Secondly, a majority of the available literature do stress mainly the economic determinants in making a choice. This current research however attempts to incorporate, in addition, all the physical and functional attributes of buildings that underlie expected economic performance.

1.5 What is a Decision Framework?

According to Bodily (1985), a decision framework is any quantitative or logical construction of a problem reality that is created to help decision making. A decision framework assembles and explores the relationships between the critical determinants on which the outcome of a decision depends. It is usually, but not essentially, represented by mathematical description or function of the relationships between decision variables.

The creation of a decision framework requires a statement about the basis on which the status quo is being compared to some future desirable state. An explicit statement about the basis of evaluation and the direction of preference is known as an objective. It is usually linked to the consequences of the alternatives being tested. A decision model uses all such objectives and the statements of direction of preference to establish rules for aiding decisions.

In general (Kwak and Delurgio, 1980), a decision model contains:

- variables derived from the objectives and the means of achieving them.
- an indication of the direction of preference of the variables, and
- relationships between these variables.

A decision model comprises of four types of variables (Bodily, 1985):

- decision variables;
- intermediate variables;
- environmental variables; and
- outcome variables.

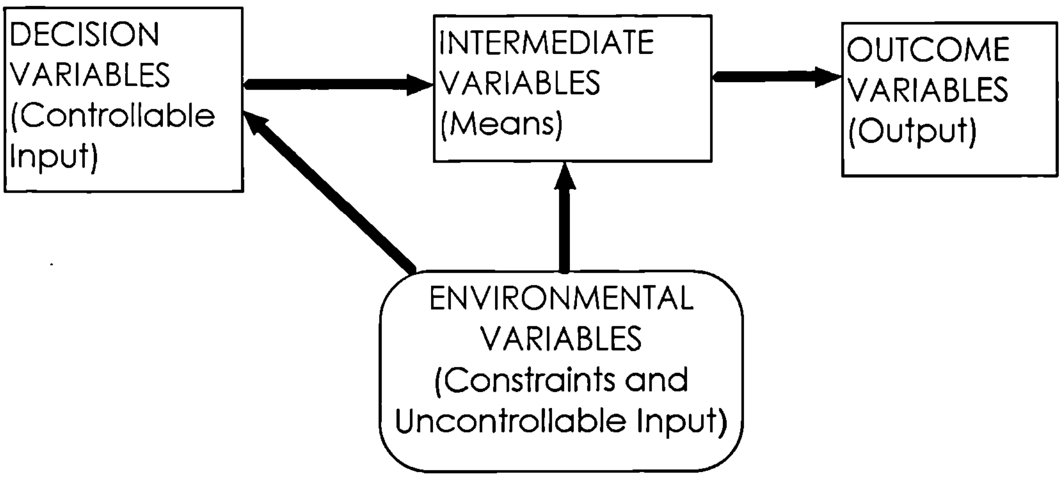


Figure 1.2: Relationship between the variables in a decision framework
Source: Bodily, S E (1985)

The relationship between the variables is illustrated in figure 1.2 above.

The decision variables, also known as controllable input variables, are those variables under the control of the decision maker. They vary in accord with each alternative in the decision context.

The intermediate variables are those variables needed to link the decision variables to the outcome variables. They are derived from the means to the outcome variables.

The outcome or output variables are those required to evaluate the performance of the decision alternatives on the prespecified objectives.

Finally, the environmental variables refer to the variables which affect the decision outcome but over which the decision maker usually has no control. Examples may include the effects of the national economy or legislation on investments. The environmental factors usually act through the intermediate variables but may also at times affect the decision variables through the alternatives which are permitted or are possible. Where an environmental variable affect the decision variables, they may be in the form of internal and external constraints or restrictions. These constraints can be used to pre-screen the 'undesirable' or prohibited alternatives before undertaking detailed analysis.

The prerequisite for creating a decision model to aid the choice between rehabilitation and redevelopment of an existing building is to determine the variables that are important to the decision. This is done by first discussing the interests affected by building development. This is followed by a discussion on the functions of buildings. These are then used as the basis for operationalising the problem for research study.

1.6 Interests in Buildings

The forces that drive private commercial property development are derived from three main sources (Frazer, 1996): the occupational or user sector, the investment sector and the development sector. These sectors operate within the context of the actions of external actors and external factors. The external actors can operate directly through the planning and control of development such as Local Authorities or through objecting to whole or some aspects of certain developments like local pressure or conservation groups. They can also operate through indirect means such as central government regulating the national economy.

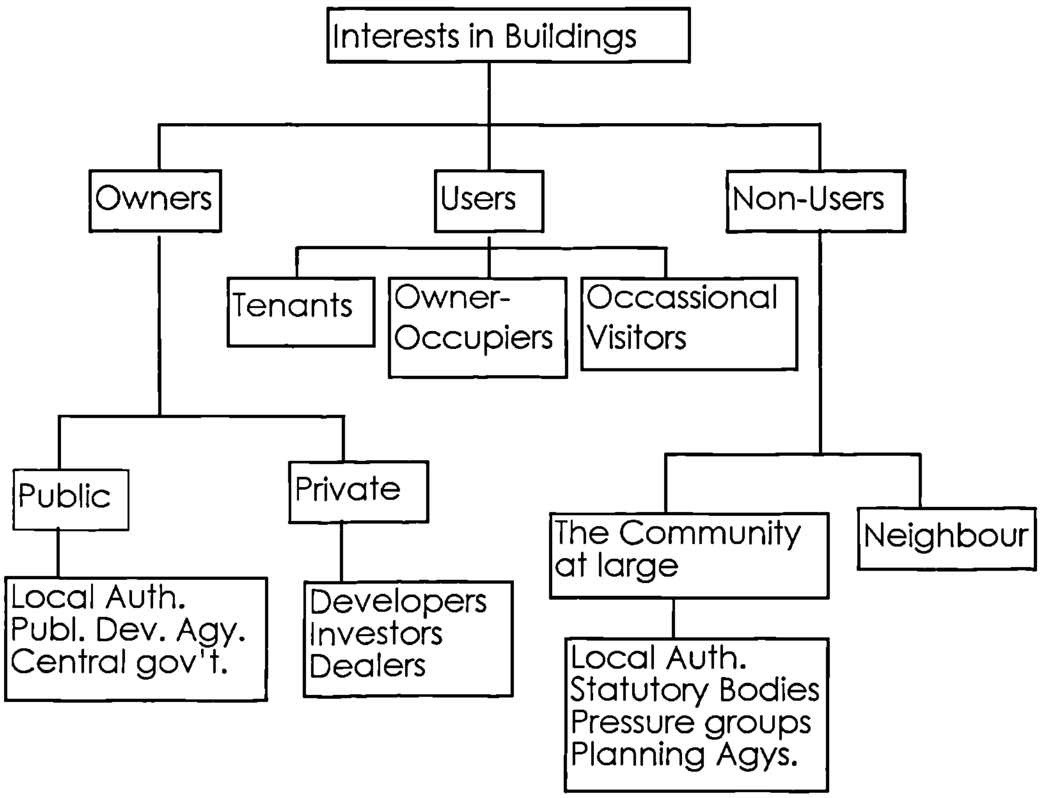


Figure 1.3: Interests in Buildings

In a more broader sense, the interests in buildings can be categorised into ownership, occupational and non-occupational interests. The investment and development sectors and owner-occupiers belong to the ownership category. Tenant lessees and owner-occupiers belong to the occupation category and Local Authority and central government planners as well as local amenity and conservation groups belong to the non-occupational categories. The interests break down as shown in figure 1.3. This is not an exhaustive list but is meant to illustrate the several actors involved.

The motivation of each interest group is different. Hence the indicators of the value of buildings among these groups are different. In a market where ownership and occupational interests are separate, the value indicators can be in conflict (Ohemeng and Mole, 1996). This conflict is considered by some commentators (eg. Edwards, 1996) to be at the root of the property industry's problems. Whereas occupiers are seeking to cut occupational costs through flexible and shorter leases, investors and owners are seeking longer leases that will guarantee security of income.

From figure 1.3, actors on the supply side of the building industry include investors, developers, local authorities, financiers and public planning agencies. On the demand side are owner-occupiers and tenants, who may be individuals or organisations requiring premises to house their activities. Actors on these two sides interact to determine the condition of the commercial property market within the general context of the economy and legislation.

Caught in the middle of the demand-supply dynamics are the neighbour, the local community and the passer-by who may have no direct involvement but may have to bear some of the costs associated with any adverse effects of building development. Public planning and regulatory agencies such as local authorities intervene by setting minimum standards to limit any adverse effects.

The general value objectives of the different interest groups are briefly discussed below.

1.6.1 Ownership Interests

A property owner may be a speculative or commercial developer, a local authority, a public-private development partnership, a property dealer, an investor or an organisation or individual seeking premises for use. Each of these own buildings for different reasons and with different motivations.

The motivations are determined by whether the interest in the property is long or short-term. For instance, the typical developer's motivation is profit driven. This profit is expected over the short-term, usually after completion of the development. On the other hand, a typical investor's aim is to realise streams of income and capital appreciation over the long term. Investors therefore usually prefer properties with flexible configurations in prime locations which will continue to appeal to occupiers over the long term.

The motivations may also depend on whether the owner operates in the private or public sector. The motivation of private sector owners is to make direct or indirect profit. The direct profits may be realised through profit from development or the holding of property as an investment. The indirect profit may accrue to owner-occupiers through the activities the buildings support. The public sector however owns properties with social as well as economic objectives. This may be to aid the workings of society's business and to create some harmony between the relatively well off and those least able to help themselves.

1.6.2 Occupational Interests

Occupational interests in properties include owner-occupiers, tenant lessees and all those who work for them and those who have occassion to visit them. It is the actual and perceived unsatisfied demand of occupiers that leads to development opportunities.

Occupiers of commercial buildings view them as factors of production. Building occupiers are therefore usually concerned with matters relating to running costs, regardless of whether they belong to the public or private sector. In the private sector, tenants are now seeking flexible leases and shorter periods with break clauses (Edwards, 1996; Harrington, 1994). Occupiers are also concerned with functional efficiency as determined by location, accessibility and specification of accomodation with respect to their particular requirements.

Occupiers can lease or buy property depending on the course of action that gives them more profit or satisfaction. Occupiers who choose to rent property retain greater flexibility allowing them the freedom to move subject to their lease terms (Adams, 1994). Those who choose to buy seek to protect themselves from uncertainties associated with rent reviews and are able to time repairs and maintenance to suit their cash flow positions (*Business*, September, 1988).

1.6.3 Non-occupational Interests

Non-occupational interests in property in this context refer to all other people and organisations who have no occupational or ownership interests in a property but are concerned about its impact on the amenity of a place and the built environment.

Non-occupational interests may include those of the local community, the neighbour who is directly affected by development and the passer-by who visits a place for pleasure. Public opinion is derived from the values of non-occupational interests. Of those mentioned, perhaps the neighbour is the most affected by building development but the one with the least political weight to affect the course of things. He is often seen as standing in the way of things and defending the status quo (Healey, 1990).

The neighbour may stand to lose not only amenity but also business by adjacent new construction accelerating the rate of obsolescence of his property. This could probably force him into carrying out early rehabilitation or refurbishment to enable him keep existing tenants and/or maintain rent levels and hence value.

The local community and the public at large carry enormous political weight if the values they are defending or protecting are held collectively by a large number of people (Healey, McNamara, Elson and Doak, 1988). The assertion of such values form the basis of public opinion which is championed by pressure groups, resident action groups, the media, local and indeed central governments.

1.7 Functions of Buildings

The image called up by a building differ among different groups and people depending upon their age, background and interest in the building (Roddewig, 1993). As a result, each individual or organisation has got a correspondingly different notion about a building's function.

According to Roddewig (1993), who was writing about office buildings, understanding the various perceptions and functions provides insights into why buildings are planned and built in the way they are. She also thought that this understanding helps "one to appreciate how buildings are related to each other and to other portions of the built and natural environment and ultimately to society's business, social, cultural and political needs".

Most of the time, a building is thought of in terms of its basic function: providing shelter for individual and organisational activities. However, examined deeply, it is apparent that a building serves other variety of oftentimes conflicting functions. As Roddewig wrote, the image of a building may 'be business as well as civic, aesthetic as well as functional and symbolic as well as actual'. Building functions include the following (Broadbent, 1984):

- container of activities;
- economic investment;
- environmental filter;
- cultural symbol;

- historical symbol;
- symbol of prestige and image;
- social investment; and
- part of the built environment.

These functions are briefly discussed below.

1.7.1 Container of Activities

On the most basic level, building are built and developed to serve the need for an enclosed space by contemporary businesses, institutions, governments and individuals to carry out their activities that cannot be otherwise carried out in the open.

The quality of accommodation, which includes the condition of the interior environment, services and the size and relationship between spaces, influences the efficiency with which activities are carried out. It also ensures the comfort and health of those who use the buildings.

1.7.2 Economic investment

Building development involves the conversion of materials and resources such as land, labour and money into durable capital assets. They also cost resources to run and operate in service. These resources are expended on the expectation that they will yield economic returns. These returns may be direct or indirect or both.

Individuals and organisations get directly involved with built properties to derive some economic returns either from the sale, rental or use of the completed building. Others get involved indirectly by investing in property shares and unit trusts for both income and capital growth.

Owner-occupiers invest in buildings to provide suitable accommodation for economic and business activities which can indirectly create profit or loss. The buildings concerned contribute in two ways (Roddewig, 1993):

- first as centres of economic activities, they directly participate in and contribute to the profit and loss generated by the companies concerned, and,
- their actual design, construction and operation may increase or decrease profit and loss.

Buildings can generate economic activities as well. Their construction, management and operation generate jobs. By the physical environment they create, buildings can also attract other related economic activities into a locality.

1.7.3 Environmental Filter

Buildings separate the users from the vagaries of the wider external environment. They insulate them from the elements of the environment such as rain, wind, sunshine and cold.

Buildings ensure users' privacy and afford security to occupants. In addition, they protect users from external air pollution and noise from traffic, people and nearby activities. Similarly they should be able to protect the public from pollution and noise arising from the activities carried out in the building.

1.7.4 Cultural Symbol

Buildings are human creations that project the cultural values of the society in which they are built. As such building themes differ from society to society and culture to culture. For instance Japanese and Chinese architecture are distinctly different from say English architecture.

Buildings possess aesthetic properties that enable them to give communities their unique characters. These aesthetic qualities impart cultural attributes to buildings that are meant to satisfy and delight the senses of people living in the community in which they are built. They also enable society to identify with the built environment.

1.7.5 Historical Record

Buildings serve as a link between generations and since buildings reflect the culture of a people, they help to preserve the cultural heritage of society. Functioning in this capacity, buildings then serve as historical records.

A great deal of what has been learnt about the past has been through buildings both ruined and standing. For instance, the pyramids of Egypt and their surroundings have long interested historians and archaeologists because of the vivid account they give of one of the earliest civilisations known to man.

Buildings are also commissioned to mark events such as coronation of monarchs, war victories or major tragedies. It can also be to celebrate the life of a great person or the birth of a new nation. All these serve as historical pointers and help to focus the energy of society towards avoiding past mistakes and upholding the good.

1.7.6 Symbol of Prestige and Image

For some companies and organisations, buildings serve as part of their product promotion strategy. Prestigious glass buildings lining the skyline of major cities in the world belong to large national and multi-national corporations who believe that such prestige augurs well for the business they are engaged in.

Financial institutions such as banks and insurance companies are particularly noted for spending much money in creating the 'appropriate' images. This may involve the use of lavish and expensive materials such as marbles in entrance lobbies and receptions as well as panelled boardrooms.

Local authorities and central governments are known for promoting expensive 'state-of-the-art' flagship developments in run down areas in towns and cities in a bid to improve the image of such areas. This is undertaken with the view of attracting investment and hence jobs into these areas.

For individuals, the house one lives in and its location seem to confer some social status. In some cases, this becomes one of the major criteria that financial institutions use in assessing creditworthiness.

1.7.7 Social Investment

Buildings transform the outlook of communities by the environment they create. Whereas a good environment instils pride, gives a sense of belonging and depicts society at peace with itself, run down and dillapidated buildings on the other hand give the impression of general poverty and hopelessness. It is even believed that a link exists between the stability afforded to communities by the built environment and incidence of crime and vandalism. Local authorities and central governments therefore consider building redevelopment, rehabilitation and upgrading as major components of their community regeneration schemes.

Buildings, by providing confined spaces, concentrate people in certain locations. With time, these people come to share some common values which foster co-operation. This could augur well for the advancement of society.

1.7.8 Part of the Built Environment

Buildings form an integral part of the environment in which they are built. There is therefore a relationship between buildings, the spaces they create and the communities that they serve.

Buildings have significant visual and environmental impacts by their physical attributes. Physical attributes such as height, size, shape as well as appearance enable buildings to either enhance or detract from the spatial arrangement of the environment. The confined spaces they provide can also add to or reduce street congestion, infrastructural costs and public service concerns. This has led societies and communities, who are becoming increasingly aware of the environment, to ask questions about the role buildings play in solving or contributing to environmental problems.

1.8 The Research Study

The background review presented so far was employed as the basis for rendering the building renewal problem operational for research investigation. In the paragraphs that follow, the research objectives are stated followed by the abstraction of the problem. The main research questions are then generated from this abstraction. The section ends by discussing the scope and limitations of the study which was used to bound the research exercise.

1.8.1 The Aims of the Research

The main objective of this research study was to establish a framework that will aid the making of renewal decisions (ie. between rehabilitation and redevelopment) on private commercial properties.

Following on from the general description of a decision framework presented in section 1.5, the research task involves the identification of the objectives of the stakeholders affected by commercial property development. It also involves the exploration of the the appropriate relationships between the objectives to reflect the preferences of the stakeholders. The following abstraction, derived from the background discussion, is used as the basis of making the problem amenable to research investigations.

1.8.2 Abstraction of the Problem

This current research assumes that at the beginning of a building's life, it possesses certain physical attributes that enable it to function in a way that closely matches the requirements of its owners and users. It further assumes that as a building ages, certain forces act on it to open a gap between what is required and what the building can offer.

These assumptions can be stated in operational terms as follows:

i. there are performance objectives which building owners and users would like to maximise subject to the constraints of legislation and limited resources. The degree of achievement of these objectives can be indicated by the levels of measurable performance indicators derived from the objectives.

ii. there are goal levels of these performance indicators at which the owners and users derive maximum satisfaction from a building, and finally

iii. there are also minimum levels of these performance indicators below which a building is neither suited to its intended use nor meets the motivation of its owners.

The task of this research study is to find what the value objectives mentioned above are and the indicators that mark their achievement.

1.8.3 Main Research Questions

From the abstraction above, the research questions generated to guide the informational requirements of the research are:

1. **what are the value objectives of the main actors impacted by the effects of building development?**
2. **what variables indicate the achievement of these objectives?**
3. **what external factors could affect the achievement of the objectives above?, and**
4. **what is the appropriate rule for combining the levels of the indicators into a single scalar quantity to reflect relative values?**

1.8.4 The Scope of the Research

The decision to rehabilitate or replace a building depends as very much on the values of the decision maker(s) as on the particular circumstances of the building. It is acknowledged that values will differ from group to group and from person to person. It is therefore impossible to come up with a prescriptive model that will cater for all situations. Rather the goal of this study is to establish a framework based on core decision variables that will allow the problem to be approached in a logical and orderly way, within any context.

A further objective of the research is therefore to categorise the uncovered decision variables into primary and secondary variables. The primary variables refer to those that are deemed to be universal to all development decisions. The secondary variables refer to those that may be situation specific that could vary from case to case. The research also aims to investigate whether the uncovered decision variables differ between sub-groups of the survey population.

The research focuses on the private commercial property market. This is because no adequate framework was found for this sector of the property market. Besides, refurbishment of commercial properties is forecast to increase over the coming years (Macrae, 1995; Mirza, 1997) and a decision framework for this sector of the property market seemed appropriate.

There are two circumstances under which buiding renewal can be contemplated. There is the situation of an existing building looking for use (which may include the existing use) and there is also the situation of a use looking for a building. In either case, it is assumed that the model would be utilised after a use has been identified and the existing building is adjudged to possess some attributes that give it possibilities for re-use. The dilemma here is whether a new building will serve the intended use better than a rehabilitated existing one. Therefore the economic, environmental and social effects of location are assumed to have been considered before the decision to assess the best manner of renewal. The only effects of location that may need consideration is where they are differential or where they physically restricts the range of options available. The effects of the available options on the location is however a valid consideration.

The research methodology including the data collection methods used are described in chapter four.

1.9 The Expected Contributions of this Research

The model proposed in this research study does not only aid the making of building renewal decisions but also demonstrate the application of contemporary management science (value-focused thinking) to the building renewal problem. It would be of value to property professionals including planners, surveyors and property analysts. It is also hoped that occupiers, owners and their agents would find it valuable too. The specific contributions of this research are summed up as follows:

- it demonstrates the application of decision theory in general and value-focused thinking in particular to the building renewal decision problem and hence building development.
- it provides an insight into the building development decision making process by highlighting the critical isues of concern.
- it provides a logical and consistent framework for making renewal decisions. By pooling together economic and non-economic factors in a single decision framework, the model can be of use to property developers, investors, dealers, occupiers as well as local and central governments agents.
- finally, the introduction of a structure into the renewal decision making process will ensure consistency and offers the potential to computerise the entire process. This will not only permit quicker evaluations, it will

also enable a greater number of alternative options to be assessed. Through sensitivity analysis it will also help decision makers to isolate the critical factors on which they can concentrate.

1.10 Thesis Layout

To guide readers through the thesis, the structure of the thesis is briefly presented here. The thesis started with the background discussion and definition of the problem. It then proceeds to review of some of the past frameworks established to aid the building renewal problem.

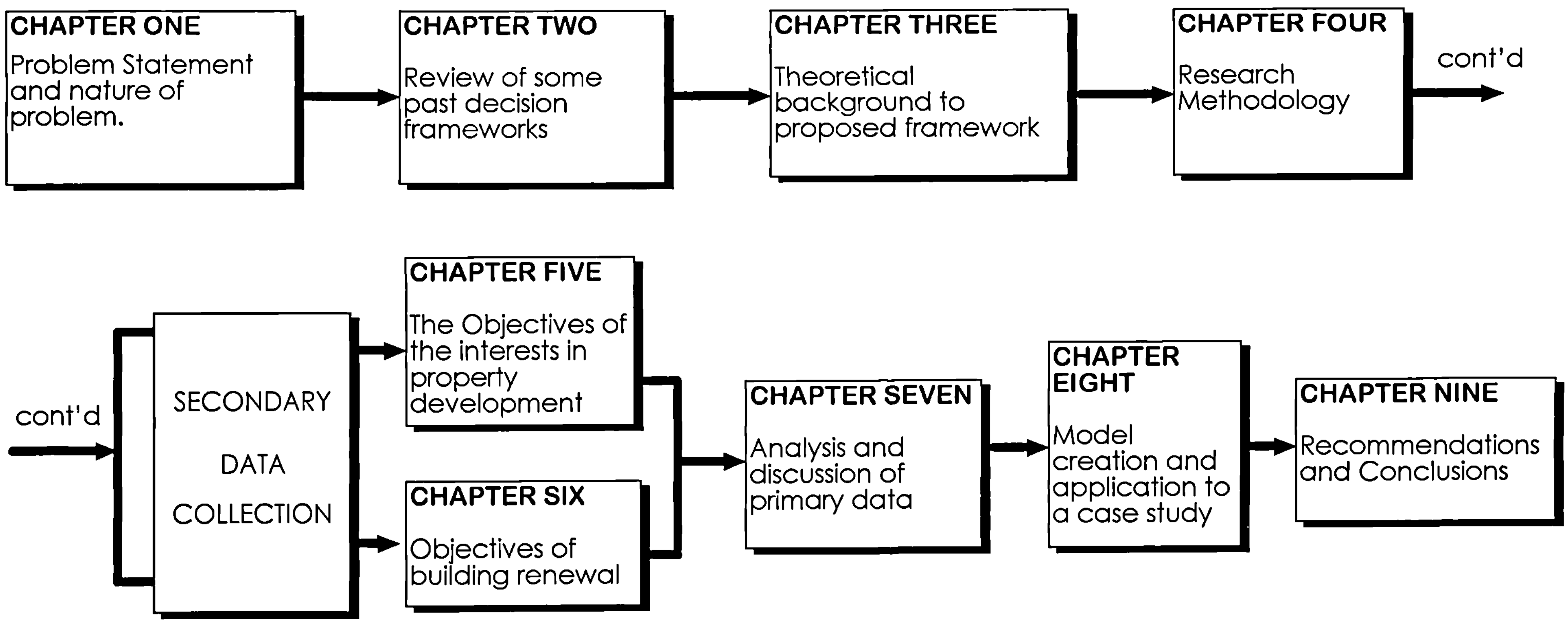
The thesis is laid out by focusing on the objectives of the research and how they are to be achieved. The main objective is to establish a building renewal decision model. After creating the model, its use is demonstrated by applying it to a hypothetical case study.

Between the definition of the problem and the creation of the proposed model are the determination of the data requirements, the identification of the sources of these data and the means of collecting them. Consistent with these research tasks and objectives, the layout of the thesis is as shown in figure 1.4.

This introductory chapter has presented the background to the problem. This has enabled the problem to be stated and defined in a form suitable for research investigation.

In chapter two, a review of the current state of knowledge in the problem area is carried out. This focuses on some of the building renewal decision models proposed in the past by highlighting any inadequacies. The argument is then presented as to how the decison framework in this current study can overcome these inadequacies.

Figure 1.4: Thesis layout



The theoretical background to the proposed framework is presented in chapter three. The chapter discusses the concept of value-focused thinking, utility theory and some of the properties of value models and techniques for constructing them.

Chapter four begins with the general application of the principles of value-focused thinking to the building renewal problem. This then leads to the identification of the data required to fill it in. The sources of the data are determined followed by descriptions of the data collection methods, analysis methods and how they lead to the required set of data.

Chapters five and six present the secondary data collected from published materials such as books, journals and periodicals. Chapter five describes the general objectives of the major stakeholders in property development - particularly those of developers, investors and occupiers. These objectives are then discussed in the context of building renewal in chapter six. The decision variables that were tested by mail questionnaire survey were shortlisted from the secondary data search in chapters five and six.

The results of the analysis of the data collected from the questionnaire survey are discussed in chapter seven. The critical variables identified from the analysis are structured and used as the bases of the building renewal decision model. In chapter eight the proposed model is created followed by its application to a hypothetical case study.

The thesis ends in chapter nine with conclusions on the research findings and the performance and value of the new model. Comments on the general quality of the research and how it affects the research findings are also made in chapter nine. The chapter ends with recommendations on the application of the model and possible areas of further research to enhance its use.

CHAPTER TWO

REVIEW OF SOME PAST DECISION FRAMEWORKS

2.1 Introduction

This chapter reviews some of the frameworks and formulae created in the past to aid building renewal decisions. Since the middle of the 1960s, when building rehabilitation began to be viewed as a serious alternative to comprehensive redevelopment, building renewal policies have continued to evolve. As part of this review, the chapter will also present the historical evolution of renewal policies by focussing on parallel developments in both the United States and Britain. The historical review is not meant to be exhaustive but is intended to give a flavour of the complexities involved in choosing a building renewal option.

It is apparent from the literature reviewed that attempts to deal with the building renewal problem appear to have been started by the public sector in the context of urban renewal. Most of the early literature on urban renewal (eg. Wingo, 1966; Rothenburg, 1967) reports efforts by the public sector to improve living conditions of slum dwellers through the improvement of housing conditions.

Historically, private sector involvement in renewal is not covered in as much detail to enable past renewal strategies in this sector of the property market to be discussed. The few references made to private sector involvement in building renewal seem to imply that the main decision criterion was to increase the value of buildings, after renewal, through the realisation of increased rents.

No original research was uncovered in the literature search on building renewal decision making. There exists, however, numerous theoretical frameworks, the majority of which originates from the public sector. The frameworks described in this chapter are therefore mostly public sector creations. They are however included in the review because:

1. no established framework could be found specifically for decisions on private commercial properties. The fact that formulas developed by the public sector have been applied to some private commercial property renewal decisions probably attest to this. For instance, Pugh (1991) used a variation of the 'Needleman' formula (to be discussed in due course) in assessing commercial office building renewal options in Leeds in the north of England.
2. the public sector has long been involved in building renewal and therefore the arguments involved have matured over the years. This provides important lessons to the private sector. Furthermore, some of the issues involved, which may be relevant to private sector decisions, may be highlighted by including these public sector frameworks in the review.

The chapter begins with a historical review of public sector renewal strategies with the emphasis mainly placed on housing renewal. This is only incidental to the property type which forms the subject of this current research, but as already mentioned, the issues involved can apply to other property types.

The historical review is followed by discussion of a sample of formulas and frameworks. At the end of these discussions, the appropriateness of the frameworks for making decisions on private commercial properties are examined. A new decision framework is then proposed in the light of any shortcomings. The chapter continues with a brief introduction to the theory underlying the proposed framework. Previous applications of the theory to the building renewal problem is examined and the refinements which this current research seeks to add are stated.

2.2 Historical Review of Public Sector Renewal Strategies

In the immediate aftermath of the second world war, the main aim of public sector building development was to provide new houses to satisfy pent-up demand and the clearance and redevelopment of houses damaged through the war. Building renewal policies then therefore placed considerable emphasis on clearance and redevelopment of slum areas. Rehabilitation was an option available on a very much lesser scale (the 1949 UK Housing Act did allow Local Authorities to make discretionary improvement grants).

In the USA, the 1949 National Housing Act was primarily focused on redevelopment. Its aim was to enable private sector involvement in renewal (Wingo, 1966) by removing obstacles which were perceived to be neighbourhood effects, site assembly limitations and demolition costs.

This policy of comprehensive clearance and redevelopment came under attack due to what came to be viewed as its adverse economic and social impacts. In the USA, these concerns culminated in a book by Martin Anderson (Anderson, 1964) which, together with other critical commentaries, was instrumental in getting policy makers to shift their attention from redevelopment as the only means of urban renewal.

The major criticisms of renewal through clearance and redevelopment were (Rothenburg, 1967; Kirwan and Martin, 1972):

- the private sector could do the job better relying on the dictates of the market place;
- in terms of public expenditure, the subsidy on renewal was too large;
- redevelopment programmes were too slow to make significant inroads into slum clearance; and
- the poor (especially slum dwellers), the intended beneficiaries, were being hurt rather than helped by redevelopment programs.

The concerns with renewal through clearance and redevelopment were addressed towards the second half of the 1950s. The USA 1954 Housing Act unveiled a raft of policies whose aim could be summed up as (Wingo, 1966):

– to eliminate the worst housing:

- to rehabilitate the declining ones; and
- to stabilise and restore the good ones.

In the UK, the 1959 Housing Act gave a boost to rehabilitation by introducing the standards grant for the five basic amenities (Kirwan and Martin, 1972). Despite these developments, Kirby (1978) writes that it was not until the 1960's that significant emphasis was placed on rehabilitation in both the US and Britain.

The 1960s therefore saw concerted efforts to present rehabilitation as a serious alternative means of achieving urban renewal. Rehabilitation was viewed as being less expensive and quicker than redevelopment. Further it was viewed as being less socially disruptive. Based on costs alone, without considering the standards of the end product, some reports and articles started appearing generalising about how always good economics it was to rehabilitate a building than knocking it down and rebuilding (Lean, 1971).

Needleman(1965) is recognised as being among the first to make a conscious attempt to derive a rule to guide building renewal decisions. His formula, whose limitations Needleman himself accepted, became the basis of several amendments (see Table 2.1).

These days, property is accepted as an investment asset and the range of issues to be considered are much more complex with several interests at stake. Concerns about the environment, the rapid change of technology and the sectors of the economy served by buildings (eg. offices, retail, residential, industrial, etc.) have all combined to make renewal intervals shorter. At the same time public sector involvement in building development has also declined. Renewal decisions are now more governed by commercial factors. However, the emergence of conservation and amenity groups and regulation by Local Authorities are ensuring that any possible adverse effects of development such as pollution and congestion are kept to the minimum.

As already mentioned, there is not much in the historical literature by way of private sector renewal decision frameworks. One can only assume that this may be due to the fact that private sector requirements and motivations tend to be so varied that no attempts have been made to come up with a general framework. Each individual owner may have his/her own decision criteria. During discussions at a conference (The Re-use of redundant Buildings, Manchester, 11th May, 1994) contributions from some participants seemed to suggest that some private companies have cut-off cost in terms of the cost of rebuilding beyond which they would not contemplate rehabilitation.

2.3 The 'Needleman' Formula

In 1965, Dr. Lionel Needleman, came out with a book on housing entitled '*The economics of housing'.* In the last few pages of the book (pp.199 - 204), he compared the economics of demolition and rebuilding to rehabilitation. In it, he argued that from a purely economic viewpoint:

"modernisation is worthwhile if the cost of rebuilding exceeds the sum of the cost of modernisation, the present value of the cost of rebuilding in λ years and the present value of the difference in the annual repair costs".

Expressed algebraically, rehabilitate if:

$b > m + \frac{b}{(1+i)^{\lambda}} + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right]$, where the symbols are as defined under Table 2.1.

Expressing the annual savings in repair costs, 'r' in terms of the cost of rebuilding, 'b', Needleman produced a table showing cost cut-off points for rehabilitation below which rehabilitation is economical for various values of 'i' and 'λ'.

Table 2.1 Evolution of the Needleman Formulation

Year	Author	Formula Rehabilitate if:	Comments
1965	Needleman	$b > m + \frac{b}{(1+i)^{\lambda}} + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right]$	Basic formula
1967	Sigsworth and Wilkinson	$b > m + c + \frac{b}{(1+i)^{\lambda}} + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right]$	They introduced the term 'c' to account for the continuing investment which the existing building represents; they also criticised Needleman for not taking into account the possible future increases in building costs.
1968	Needleman	$b > m + \frac{b(1+z)^{\lambda}}{(1+i)^{\lambda}} + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right]$	Needleman rejected the inclusion of the 'c' term but amended his formulation to include the term 'z': the annual rate of increase in building costs.
1969	Schaaf	$b > m + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right] + \frac{b(1-\lambda d)}{(1+i)^{\lambda}} + \frac{D}{i}\left[1-(1+i)^{-\lambda}\right]$ (some of the symbols have been changed for consistency)	Schaaf introduced the terms 'd' representing the annual rate of depreciation of the new building and 'D' representing differences in amenity levels between a new building and a modernised one.
1970	Needleman	$b > m + \frac{b}{(1+i)^{\lambda}} + \frac{r+p}{i}\left[1-(1+i)^{-\lambda}\right]$	Needleman decided to account for changing prices by using real costs. He also introduced the term 'p' to account for differences in rent between rehabilitated and new buildings.

Table 2.1 - The Evolution of the Needleman Formula - (cont'd)

Year	Author	Formula Rehabilitate if:	Comments
1975	Brookes and Hughes	$b > m + \frac{b}{(1+i)^{\lambda}} + \chi$	They introduced the term 'χ' to cater for all that represents the difference in standards of accommodation between a new and an improved building expressed in monetary terms.

Where,

b - the cost of demolition and rebuilding

m - the cost of adequate modernisation

i - the discount rate

λ - the useful life of the modernised property, in years

r - the difference in annual repair costs

z - the expected annual rate of increase in replacement costs

d - the annual depreciation rate of the new structure

D - differences in annual rental income.

c - the capital value of the house before improvement

p - the difference in rent between new and improved building

χ - the difference in standards between new and improved building

This formula was the first attempt to apply cost-benefit analysis (CBA) to the housing renewal problem (Merrett, 1979). It did not however follow the tradition of CBA which would have required the comparison of the separate cost-benefit ratios for each option. The formula rather appears to have viewed rehabilitation as a postponement of rebuilding.

As to be expected from being the first to introduce some structure into the rebuild/rehabilitate question, Needleman's formula attracted a lot of responses. Some of these responses were critical, others suggested 'corrections' and yet others examined the wider implications of the formula. Table 2.1 shows the evolution of the Needleman formula due to these responses. Some of them are examined below.

The first reaction to the 'Needleman' formula came from Sigsworth and Wilkinson (1968). In a joint paper, they criticised Needleman in rather strong terms which is perhaps indicative of the intense debate raging at the time. Sigsworth and Wilkinson examined Needleman's formula under the three headings of economic, social and organisational and administrative factors. It was however under the economic factors that they sought to amend Needleman's formula. Their main criticisms were:

a. that the Needleman formula failed to consider the investment value of the existing building. They proposed a 'correction' to the right hand side of the formula by introducing the term 'c' representing the capital value of the existing building before improvement. Thus the formula became: rehabilitate if:

$$b > m + c + \frac{b}{(1+i)^{\lambda}} + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right], \text{ and}$$

b. that the 'Needleman' formula did not allow for the possible future increases in building costs.

Needleman mounted a vigorous defence of his formula and the assumptions he had made in deriving it. He disagreed with the inclusion of the capital value of the unimproved building in the formula. He calculated that the value of the unimproved building had no bearing on the decision in choosing a renewal option. He reckoned that once the decision had been made to improve the existing building, the value of the unimproved building ceases to exist (Needleman, 1968).

On the criticism that his formula failed to allow for the possible future increases in building costs, Needleman did acknowledge that he had assumed constant prices. He suggested a correction by introducing the term 'z' representing the annual rate of increase in replacement costs. The formula was thus amended to (*ibid*):

rehabilitate if:

$$b > m + \frac{b(1+z)^{\lambda}}{(1+i)^{\lambda}} + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right].$$

Another reaction to Needleman's decision formula came from Schaaf, a Professor of Business Administration at the University of California at Berkeley. Schaaf thought there were some 'shortcomings' in the 'Needleman' formula that he sought to 'rectify'. These 'shortcomings' were (Schaaf, 1969):

1. Schaaf thought the term $\frac{b}{(1+i)^{\lambda}}$ in the basic 'Needleman' formula was an 'error'. He reckoned the formula should have compared the rehabilitated structure to a depreciated new structure in λ years time. The basis of his argument was that if the owner chooses to replace now, in λ years time he will have a building which is λ years old and hence worth ($b-\lambda d$), after allowing for annual depreciation, 'd'. On the other hand if the owner chooses to rehabilitate now and invest the amount $\frac{b}{(1+i)^{\lambda}}$, he will have an amount equal to the cost of a new structure in λ years.

2. Schaaf also noted that the use of the term 'b' implied assessment of the renewal options was over one period only. He thought the model could be made more general to include the possiblity of successive future rehabilitation investments. In this case, it would then not be necessary to use the discounted 'b' term but rather the 'most feasible' cost in λ years (or series of them).

3. The 'Needleman' formula ignored the fact that there could be different renewal standards. According to Schaaf, using single values of 'm' and 'b' implied there was only one renewal standard. He thought that different standards of renewal were possible and could be represented by different values of 'm' and 'b' resulting in different values of 'r' and 'λ'.

4. Finally, the 'Needleman' formula failed to give consideration to the possibility that a new structure may provide a higher level of shelter amenities than a rehabilitated one. Schaaf did acknowledge though that it would be difficult to measure the differences in amenities. However, linking higher rents to higher levels of amenities, he proposed rent as a proxy measure for level of amenity. He therefore introduced the term 'D' into the Needleman formula, where 'D' is the differences in annual rental income between the new and the rehabilitated building.

With the comments above, Schaaf amended the basic 'Needleman' formula to (Schaaf, 1969): rehabilitate if:

$$b > m + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right] + \frac{b(1-\lambda d)}{(1+i)^{\lambda}} + \frac{D}{i}\left[1-(1+i)^{-\lambda}\right]$$

To be able to use the formula to determine the optimum renewal standard, he went on to translate the amended formula into a determinant, 'Y', given by (*ibid*):

$$Y = b - \left[m + \frac{r}{i}\left[1-(1+i)^{-\lambda}\right] + \frac{b(1-\lambda d)}{(1+i)^{\lambda}} + \frac{D}{i}\left[1-(1+i)^{-\lambda}\right]\right]$$

By using this determinant, the optimum renewal standard would be that which maximises 'Y'.

In 1970, Needleman came out with an extended formula to give a more comprehensive treatment to the factors influencing the rehabilitation versus rebuilding decision (Needleman, 1970).

He derived two formulas: one covering single building renewal decisions, and the other, renewal of an area of buildings. The relevant formula in the context of the current research is the one covering single building renewal decisions.

In the new formula, Needleman stated his decision rule as (*ibid*) as:

> *" Ignoring the effects of subsidies, rehabilitation will be a cheaper way of providing accommodation than replacement if the cost of rehabilitation, plus the present value of the cost of rebuilding in λ years' time, plus the present value of the difference in annual running costs and rents for λ years, is less than the present cost of rebuilding, all measured in real terms."*

Written compactly, the extended formula was: rehabilitate if:

$b > m + \frac{b}{(1+i)^{\lambda}} + \frac{r+p}{i}\left[1-(1+i)^{-\lambda}\right]$, where the new terms are as defined under Table 2.1.

The extended 'Needleman' formula gained an official endorsement when it was incorporated in the then MHLG (Ministry of Housing and Local Government) circular 65/69. It was not, however, an unqualified endorsement for the circular did imply that the formula did not cater adequately for the differences in the standards of accommodation between a new and an improved building. Therefore when Brookes and Hughes embarked on an exercise to examine the practical value of the 'Needleman' formula, they gave as their principal aim, the exploration of alternative methods of quantifying the differences in accommodation (Brookes and Hughes, 1975).

Brookes and Hughes (1975) reckoned that differences in standards of accommodation are determined by the physical characteristics of buildings. They grouped these physical characteristics into:

- differences in space and service standards, and
- differences in the condition of the physical fabric.

They then quantified the differences in these physical characteristics by estimating the additional capital outlay required to close the gap between the improved and new property. They then denoted the additional capital outlay by 'χ'. This was incorporated into the basic Needleman formula thus:

rehabilitate if: $b > m + \frac{b}{(1+i)^{\lambda}} + \chi$.

2.4 Structured Housing Renewal Frameworks

The frameworks described in this section are described as structured because they assess the renewal options within some form of framework. In this regard, they do not rely on the almost mechanical substitution of values into a formula like the 'Needleman' approach. These frameworks introduced some logic and some degree of consistency into the decision making process.

The models discussed in this section require the explicit statement of the standards to be achieved, recognition of the constraints imposed by limited resources and the consideration of the social disruption caused to people. They range in degrees of sophistication from simple models that build upon past models to systematic models that require answers to stagewise problems till the final solution is arrived at. Two of these type of frameworks described below are the frameworks by Lean (1971) and Bell (1981).

2.4.1 The 'Lean' Economic Models

In a paper entitled: '*Housing rehabilitation or redevelopment: the economic assessment*', Lean (1971) challenged the then emerging view that rehabilitation was always generally better, in terms of cost, than redevelopment. In the case of the UK, Lean thought most of these generalisations were flawed for they relied on very few instances and were not representative. As he put it then (*ibid*):

> *"It is seldom desirable to assess rehabilitation and redevelopment on the basis of cost alone for the lower cost solution may result in a far inferior product as compared with the higher cost solution. It may be that redevelopment costs more, but when the product is compared to the product of rehabilitation, it is worthwhile in economic terms to incur the extra costs; the better accommodation and better environment more than offset the increase in costs".*

He therefore made some proposals which he claimed would make the least cost approach valid. These can be summarised in the following steps (*ibid*):

i. take the standards of housing and environment that will be created on redevelopment and list all the characteristics;
ii. determine the cost of giving the house and its environment the same characteristics by rehabilitation; and
iii. finally, compare the costs of rehabilitation and the costs of redevelopment.

According to Lean, the economical option is the one with the least cost. He however acknowledged that there may be some potential problems with this approach. He thought that in some instances, the existing building layout and the spatial arrangement of the site may make it impracticable to achieve the same standards and environment as a new building through rehabilitation.

Lean went on to advance two possible economic models which took the motivations of the building owner into consideration (Lean, 1971). Where the building was held as an investment, he proposed a method based on the rate of return on investment and when it was owner-occupied, he proposed a method based on capital values after renewal. These two methods are described below.

2.4.1.1 The 'Lean' Rate of Return Method

The basis of this method could be found in the following assumptions:

i. housing is an investment: a sum of money is paid out to build or acquire it and in return an income is expected over time.
ii. if housing is being considered as an investment asset, then there is the important fact that for the building to hold its investment value, it has to be repaired and maintained. Otherwise it will physically deteriorate.
iii. despite carrying out maintenance and repair activities, the value of a building is likely to fall over time due to obsolescence. In order to find out what the true rate of return would be, a building owner would have to calculate what sum of money to deduct from his income to offset this fall in value.

From the assumptions above, Lean proposed a rate of return formula based on a sinking fund calculation given by (*ibid*):

$r = \frac{nr - sf}{C} x100$, where,

r = rate of return

C= the cost of rehabilitation or redevelopment (including cost of improvement to the environment).

nr = increase in net rent

sf= amount annually that will accumulate to C at 5% ed for the term of years.

The option with the greater rate of return compared to the cost of finance and the returns on other comparable investments would be the economically optimal option. According to Lean, in cases where an option other than the optimum is chosen, the above analysis would show the subsidy or sacrifice made.

2.4.1.2 The 'Lean' Capital Values Method

According to Lean (1971), in many cases, it might be very difficult to make realistic calculations of market rent especially for owner-occupied properties. To carry out economic assessments for such properties, it was necessary to compare the costs of rehabilitation and the differences in capital values before and after rehabilitation to the costs of redevelopment and the differences in capital values before and after redevelopment. Written mathematically, to determine the optimal renewal option, compare the ratio, $\frac{C}{V_2 - V_1}$, for each option,

where,

C - cost of rehabilitation or rebuilding.

V_2 - capital value of building after rehabilitation or rebuilding, and

V_1 - capital value of the unimproved property.

According to this model, the option with the least ratio is the optimal option.

2.4.2 The 'Bell' Housing Renewal Framework

This model was presented in a paper by Bell (1981) based on methods developed during a review of the housing renewal policy of the Bolton Metropolitan Borough area in the north west of England.

Bell observed that the physical conditions of older properties were not so poor these days like they used to be in the past. Local Authorities were therefore being faced by decision problems of increasing complexity as many decisions were impossible to make on the grounds of statutory unfitness alone. Bell's view was that economic, social and environmental issues must be considered in making what he thought was often a very delicate judgement.

In connection with the value judgements required, Bell (1981) thought the formulas by Needleman and the Ministry of Housing and Local Government were largely economic in character and did not go very far in the decision process. The intention of Bell's approach was to use the economic models as starting points for the consideration of what he termed 'other more practical issues'. The aim therefore was to make the many value judgements required during the decision making process as explicit as possible. This, said Bell, was to 'avoid spurious accuracy by over quantification and the misapplication of mathematical functions'.

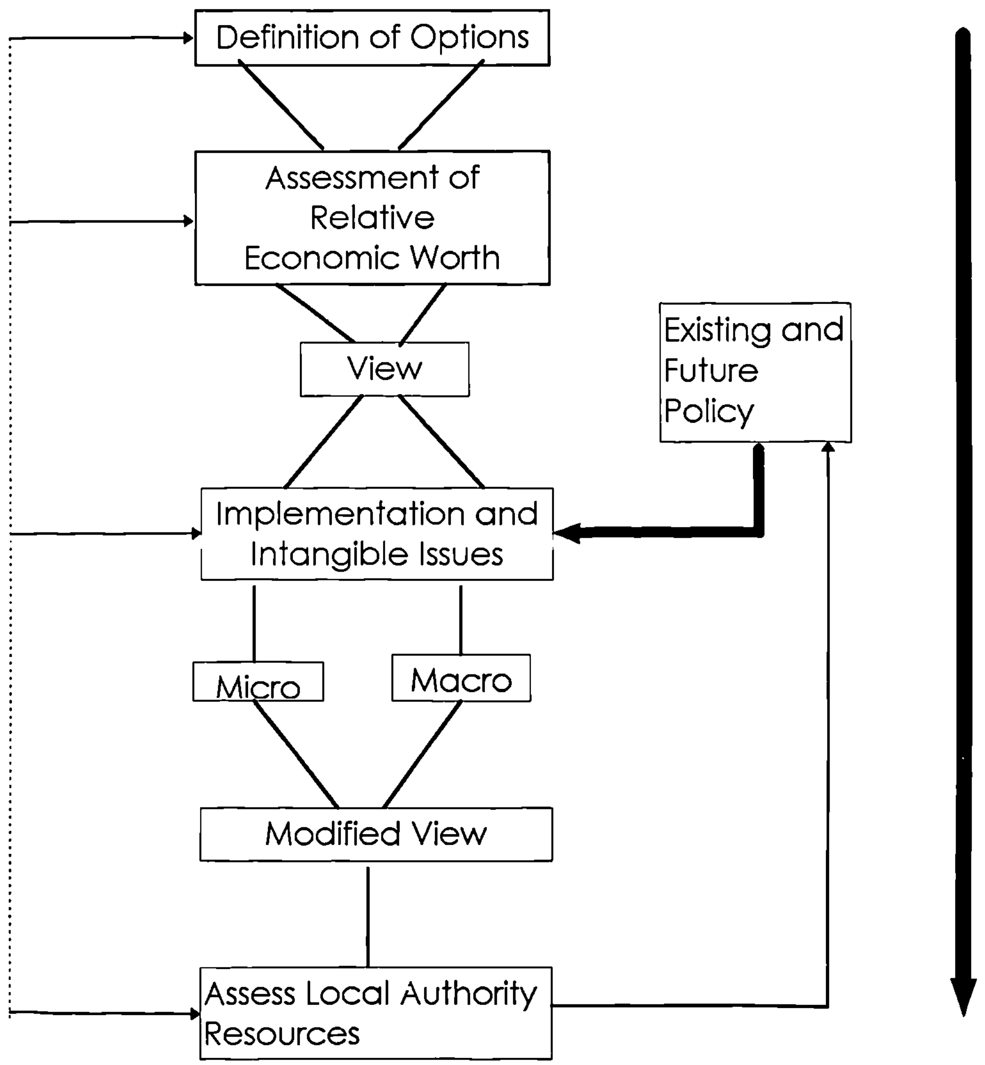


Figure 2.1: The 'Bell' Housing Renewal Model
Source: Bell, M (1981)

Bell's model consisted of a number of broad systematic issues arranged in sequential steps such that each succeeding step questioned and defined the step before it. The model is shown in figure 2.1.

The 'Bell' model worked by first assessing the options available for the property under consideration. In this case the options tested were limited to redevelopment, full rehabilitation and rehabilitation to some intermediate standard. The redevelopment option was used as the norm against which the other options were compared.

The option definition stage was followed by an assessment of the relative economic worth of the options. This assessment was carried out along two lines: a quantitative comparison of costs and benefits and a qualitative assessment of benefits. These were all to be measured against the redevelopment norm. In the Bolton case, the norm was redevelopment to Parker-Morris standards at a specified density (Bell, 1981).

The quantitative comparison was based on a method suggested by Isaacson (1976) in which the amount worth spending on an option was determined by the ratio of the benefits of that option to the benefits of the norm. The benefits were measured by combining two factors: the number of people housed and the time taken to produce that housing. Thus if on this measure, a tested option is found to be 75% of the norm, then it was economical to spend up to 75% of the cost of the norm on that particular option.

The next step was to determine the subjective housing quality afforded by the tested option. Three indicators were used to define this subjective quality:

- house quality based on spaces, layout and view;
- environmental quality based on external spaces, landscaping, noise etc.; and

- local amenities such as shops, play spaces and community facilities.

The quantitative and qualitative assessments described above were to be combined to form a single view of the situation. In forming this view, questions were to be asked regarding the tradeoffs to be made in cases where the quantitative cost limit was exceeded.

The next step in the model was described as the consideration of intangibles and implementation issues. These covered the situation - specific issues which varies from case to case. The assessment under this heading started with the consideration of issues at the individual house level and then extends to cover area-wide, district and local authority issues. These issues were divided into micro and macro issues.

According to the 'Bell' model (Bell, 1981), the micro issues involve the question of practicality in achieving the option under consideration. It involved the assessment of the likelihood of a particular owner/occupier carrying out the necessary works or of any changes of tenure affecting the achievement of the option under test. On the other hand, the macro issues were concerned with the relationship between the area, its surroundings, other local, regional or national policies and with social and spatial issues within the area itself. Such issues could include the existence of a commnity within the area and viability of the area, given external uses such as industries and the effects of any changes on such things as local shopping.

The views formed after the identification of the intangibles and the practicalities were to be combined with the initial view formed from the previous step to define each option clearly (*ibid*).

According to the author, at the end of the whole process, a clearer and somewhat ideal picture of the area would emerge within the constraints posed by economic, intangibles and other practical issues (Bell, 1981).

The last step in the model was to adopt the final view, give it an implementation resource and then set it against the availability of resources over time. What was actually done was determined to a large extent by the availability of resources, in this specific case it was the consideration of the Local Authority resources (*ibid*).

In accordance with the model, the implications of the resource reality must be fed back into the earlier steps to establish a further range of actions with different resource profiles. The actions would then be matched to the resource level after several cycles of iterations.

2.5 The 'Boon-Robertson' Market Driven Framework

This framework created by Boon and Robertson (1989) is the only one found in the literature search which addressed renewal decision of commercial properties. It was born out of the necessity to address the problems posed by empty 1960s and 1970s office buildings in Auckland, New Zealand, where one of the authors was a Development Manager for a financial institution. The buildings involved were thought to be generally tired and out of date with respect to both appearance and condition and age of services. As a result, tenants were being lost and the lack of demand in the short term meant falling capital values.

The framework worked by a process of analysis and categorisation which enabled the relationship of the buildings to the market place to be established. Alternative courses of actions were then recommended depending on the determined relationship,. The model itself is shown in figure 2.2 below.

The model started from the point where the question as to why the buildings had reached the crisis point was asked. From the answer, each of the buildings were placed in one of four categories indicating its relationship to the market (figure 2.2). Using the market categorisation, one of these courses of action: refurbishment, conversion, abandonment and redevelopment was recommended.

The causes of the crisis were grouped under five general internal and external factors which affect the performance of buildings. These were listed as macro and micro market factors, technical factors as well as social and fiscal pressures (Boon and Robertson, 1989).

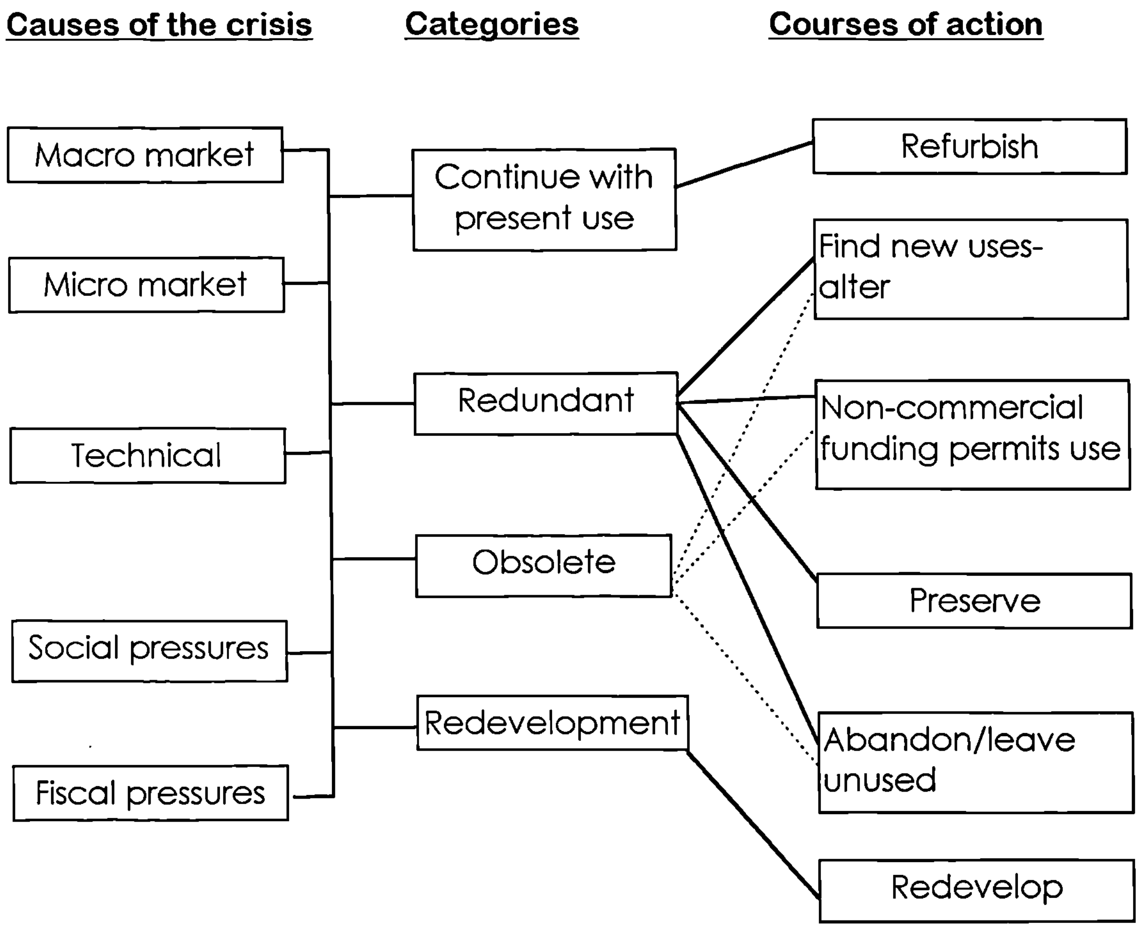


Figure 2.2: The 'Boon-Robertson' market-driven framework
Source: Boon, J and Robertson, G (1990)

The macro factors referred to the factors that affect the property market in general. They are the factors that can cause a shift in the balance of the supply and demand equation. The macro market factors identified by the authors included the following:

- growth or decline in the economy;
- industrial shifts;
- demographic shifts;
- urban decay; and
- changing levels of building development.

The micro market factors referred to factors that were specific to the building under consideration rather than the property market in general. According to Boon and Robertson (1989), these factors may include:

- changing locational factors as a result of either redevelopment or modernisation in the locality or due to the onset of urban decay or changes in urban patterns;
- changes within the industry for which the building was designed. These include decline, changing working methods, a shift in the location of the industry and changes in the accommodation standards required; and
- competition from newer buildings.

The technical factors included structural and configurational factors that highlight the opportunities afforded by the existing building. Also to be considered were any restrictions imposed by the existing fabric, layout and internal sub-divisions. The technical factors the authors considered were the following (Boon and Robertson,1989):

- wear and tear;
- structural condition;
- configuration;
- state and condition of services;

- health issues, eg. asbestos and sick building syndrome;
- compliance with current codes of practice;
- existing building density compared to current permitted density;
- cost and time requirements to achieve the accommodation required; and
- historical and architectural significance of the existing building - are there any conservation or preservation orders on the building?

The social pressures referred to the factors that were considered socially important but could not be based on market evaluation. The following factors were considerd by the authors under social pressures (*ibid*):

- resource conservation arguments;
- the relationship of the building to the community; and
- aesthetics.

The fiscal pressures referred to the taxation tools available to both central and local governments to encourage or discourage different types of development activities at different times at different locations. According to the authors, these can include land tax, depreciation, tax bonuses and grants (Boon and Robertson, 1989).

The four market categories into which the buildings were placed after the cause analysis were given as (*ibid*):

1. continuing with the present use;
2. deciding that the building was either redundant or obsolete, or
3. deciding that it was a candidate for redevelopment;

If on analysis, it was found that there was still a demand for the existing building in its current use and location, the model recommended that the building be refurbished. A building was classified as redundant if on analysis it was found to be still suitable for its original use but surplus to requirements. If on the other hand the analysis showed a mismatch between what was required and what the building could offer, the building concerned was classified as obsolete. The mismatch mentioned above may be in terms of physical decay, functional inadequacies or both.

In the case of redundancy or obsolescence, the model recommended three possible solutions:

- conversion to a new use;
- abandonment; or
- restoration and preservation if non-commercial funding is available.

The model classified a building as a candidate for redevelopment if the analysis showed the economic benefits of redevelopment as strongly outweighing the benefits of restoration. The key to this decision was market demand. As put by Boon and Robertson (1989):

> *"the mere fact that a building is so dilapidated that it cannot be restored to its previous use does not necessarily make it a candidate for redevelopment".*

2.6 Comments on the Frameworks Described

The frameworks described so far have highlighted the issues of concern and the complexities involved in choosing a renewal option. However most of them, originating from the public sector, are pre-occupied with the desire to minimise cost. Therefore other pertinent issues concerning physical and functional requirements were not given the deserved attention. This is to be expected as the public sector operates with scarce resources and is always under pressure to demonstrate value-for money in almost all its dealings.

The 'Needleman' formula in particualr is not suited to private sector decisions. This is because private sector decisions do consider a lot of factors including investment returns, functional flexibility and location which the formula does not cater for. Even though subsequent extensions of the formula (eg. Schaaf, 1969, Needleman, 1970, Brookes and Hughes, 1975) sought to introduce other factors like standards of accommodation, the choice of rent and running costs as proxies for standard of accommodation was not considered to be adequate.

Brookes' and Hughes' recognition of standards of accommodation as determined by physical characteristics was certainly an improvement but the indicators of these physical characteristics were not stated for measurement. Being a theoretical framework, not backed by any studies, the authors could only talk about generalities.

There are two fundamental impressions created by the 'Needleman' formulae which can be challenged:

1. the implied assumption that new buildings have superior physical characteristics than older ones is not always true. There are instances where some older buildings can boast of far grander architecture and more solid structures than new buildings (Sidwell, 1984).
2. the use of a formula gave the impression of the existence of a single 'correct' answer. This is practically not the case for the particular problem situation and the standards of renewal being chased all affect the choice of action.

The model by Lean (1971) is simple and allowed the incorporation of the motivation of the building owner, be it investment or occupation, into the decision making process. It also required the pre-specification of the standards to be achieved before the economic assessments are made. Here too, indicators of the standards were not stated which is an undesirable characteristic of theoretical models. Further work would be required to define both the standards and the indicators of their achievement. The rate of return method of Lean (1971) theoretically assumed that funds would be put aside to be compounded at a fixed rate to replace a building at the end of its life. This does not occur in practice.

Bell's model attempted to introduce some structure into the decision making process (Bell, 1981). Most of the prescriptions however were not sufficiently defined to be useful to anyone outside his organisation. For instance, no indicators were given to assess the quantitative benefits and how they were to be measured. It is also not clear how the qualititative indicators were measured. The case may be that within his organisation (ie. Bolton Metropolitan Council), these factors were sufficiently defined to aid the renewal decisions. Bell's model, as presented in the paper did not demonstrate clearly how an option was to be chosen. It is not clear if the choice of an option was based on the outcome of the resource requirement versus availability assessment or the standards that could be achieved.

The 'Boon-Robertson' market-driven framework, the only one originating from the private commercial sector, covered a wide range of factors. The framework in which the factors reside was however too loose and leaves the decision maker still to take in a lot in reaching a decision. The model did not show explicitly any causal relationship between the causes of the crisis and the four market categories. Neither did it give guidance on how to decide on a course of action where more than one had been recommended. To be fair, the authors did point out how subjective the judgements required were.

Despite the 'shortcomings' of the models discussed above when applied to private commercial properties, each one of them makes important contributions to the resolution of the building renewal decision problem. They highlight important considerations which, if pooled together in a simple but comprehensive framework, can go a long way to make the decision making process better. In the search for such a framework, the decision context is examined critically for a clear understanding of the problem that decision makers face. This is then followed by statements of facts and assumptions concerning the reality of the problem. This then leads to the proposal of a new generic framework which the current research will help to create.

2.7 The Nature of the Decision Environment

A characteristic of buildings that came out clearly in the background review in chapter one was that buildings serve different functions to different people, depending on their interest. The value objectives of the different interests impacted by building development were briefly touched upon as well in chapter one. From those brief discussions, it became apparent that the dilemma over whether to rehabilitate or rebuild an existing building poses a decision problem because the decision maker has to consider not only his own interests but also those of affected others.

The background examination and the past frameworks just reviewed highlight the issues that characterise the decision environment. These issues are:

- multiple conflicting value criteria;
- difficulty in generating unique value criteria;
- subjective criteria (intangibles);
- uncertainty; and
- incommensurable units.

The issues are examined individually below.

2.7.1 Multiple conflicting value criteria

Deciding on a renewal option for an existing building is complicated by the fact that at times none of the available options (ie. rehabilitation or redevelopment) can fully satisfy all the value aspects of buildings. This is due to the following which have already been discussed:

- building development affects different interest groups which can broadly be classifieds as owners, occupiers and non-occupiers. In any development, some of these interest groups gain whilst others left to bear the social costs, lose.

- buildings, by their nature, are required to serve different functions to different people at the same time.

The interaction of these two factors means that some of the criteria for evaluating the value of buildings are often in conflict. This implies that doing well on one criteria may require doing poorly on another. Edwards (1996), for instance, writes of the conflict that exists between occupiers and investors in the property industry. He observed that:

> *"At the root of the property industry's problems is the conflict of interest between occupier and investor. An investor looks at property primarily as a financial asset whereas the occupier sees it as a factor of production"*
>
> *"Investors require inflexibility from their leases and security of income, high rents and high returns. Occupiers want flexibility and low cost so that they are able to generate high revenues from their facilities."*
>
> *"These objectives are incompatible today and the property industry needs to reconcile them if it is to move forward."*

Generally, land use planning and building development in particular involves different evaluations of the relative priorities to be awarded to the different interests and values within different contexts (Healey et al, 1988). To determine the optimal action, one has to understand the complex processes involved. The sociology of the problem has to be considered very carefully. For instance, whose values and interests are to be emphasised and who ultimately benefit or lose? An optimal action may call for the making of painful and often controversial interpersonal and intergroup tradeoffs.

2.7.2 Difficulty in generating unique value criteria

It is clear that different organisations or individuals engage in property development (including rehabilitation and refurbishment) for different and varied reasons and with different motivations. These motivations define the objectives they want to achieve by the developments they engage in. Buildings therefore have to serve a multiplicity of functions at the same time as a response to these objectives (see section 1.7).

The problem with choosing an option in the building repair-replace decision space is that no unique set of criteria exists that can completely indicate the value of buildings. Each situation can be different. Due to this, the value criteria in each case will depend as very much on who the decision maker is, as on the use and attributes of the building in question.

2.7.3 Subjective criteria (intangibles)

A building can function as a container of activities, shelter, a cultural symbol, environmental filter and as a social and economic investment among others (refer to section 1.7). The criteria for evaluating these functions include subjective ones that can not be universally quantified. For instance how do you measure architectural or historical significance, aesthetics or amenity? In these cases, what may be one observer's grand architecture may be another's monstrosity.

It is usually impossible to obtain universal agreement on the evaluation of subjective factors. They are therefore usually defined in the context of the decision at hand. Where attempts are made at quantification, they usually require delicate and searching psychological scaling derived from good practice and the best expertise available. Such scales do not usually lend themselves to everyday application.

The difficulties involved in trying to evaluate building subjective factors is appropriately captured by Carver (1977) when he wrote that:

> *"....attempts have been made to cost the subjective aspects of our requirements from buildings, but as yet there are no fixed rules by which designers can incorporate subjective data within investment appraisals".*
>
> *"...this is probably the first major difficulty encountered when trying to optimise the complete system".*

The difficulties with making subjective evaluations mean that most commentaries on building development appraisal tend to concentrate heavilly on the economic criteria usually measured in monetary terms. But buildings are so different from ordinary market commodities that they should not be treated as such. The fact that buildings can serve more than one purpose at a time to different groups of people means that a proper evaluation can only be done if all criteria both subjective and objective are included in any analysis. At the very least, subjective criteria should not be left to the judgement of only one interested party, for such judgements have the potential to lead to bias.

The fact that subjective evaluations might not be universally accepted should not deter decision makers from taking them into consideration. It is better for the issues involved to be highlighted than to ignore them. Ignoring subjective issues in an analysis could increase the risk of yielding sub-optimal solutions.

2.7.4 Uncertainty

Building performance is affected by uncertainty due to the fact that whilst the determinants of building performance change with time, the buildings themselves are fixed to particular locations to serve the needs of particular times.

Buildings are developed in response to prevailing requirements that are influenced by social tastes and perceptions, level of technological advancement and economic conditions. The performance of a building is therefore trapped within a certain functional, social and economic framework, whose future trend the owner or occupier has little or no control over (Byrne and Cadman, 1984). The modern response to this has been to construct buildings that are flexible and easily adaptable. But even this approach can only solve problems internal to the building in question but not all those imposed by external factors and conditions.

The main sources of uncertainty in building development are:

- the effect of time on issues affecting performance and requirements such as social tastes, working practices and economic conditions; and
- lack of sufficient detailed information in the appropriate form for use by developers, investors and others involved in development.

Against this background of uncertainty, the decision on whether to rehabilitate an existing building or demolish and rebuild does not only involve predicting what future requirements are going to be. It is also involved with predicting future economic performance as they affect development costs, operating and maintenance costs, space take up and hence rental income.

The effect of changes in economic performance, level of technological advancement, social tastes and planning standards as well as the environment is to change building user requirements over time. Eley and Worthington (1984), in their book about the conversion of old buildings for re-use by small firms, wrote that:

> *"as the organisation of work and technology changes, so do its locational, servicing and special demands. The result is that different building types are continuously becoming redundant as markets, cultural values and technology shift"*

Thus the effect of these changes may be to make a building redundant even though it might still be structurally sound.

2.7.5 Incommensurable units

Building requirements and performance criteria are not evaluated in one single unit, even if they can be quantified at all. The unit of attributes like development cost and rent may be in monetary terms whereas that of ceiling height may be in feet or metres. A major source of problem is how to combine all these attributes, measured in different units, to arrive at one scalar quantity reflecting relative values of competing options.

Techniques such as cost-benefit and cost-effectiveness analyses quantify the value criteria by 'collapsing' them into monetary units. Whilst these techniques are useful in decision making, there is the risk that reducing attributes measured in different units into monetary units might distort the relative importance of the individual attributes in the evaluation exercise (Powell and Brandon, 1984). Because the factors are not weighted in these methods, there is the implicit assumption that they are all equally important which may not be right. Furthermore, these techniques place much power in the hands of the professional adviser who has to decide the money equivalents of the non-monetary factors (Cohon, 1978). If the adviser does not belong to the building owner's organisation, there may be little or no input from the owner or client apart from the statement of general requirements.

2.8 The Problem Reality and the Proposed Framework

From highlighting the characteristics of the problem environment, certain facts and assumptions can now be stated regarding the 'real world' of the building renewal problem. Further analysis can then proceed on the bases of these facts and assumptions. These assumptions and facts are stated as follows:

1. it is assumed that every building is commissioned for a purpose or purposes. These purposes are in accord with the value objectives of the owner; the occupier, in terms of fuctionality; and non-occupiers, who are concerned with the social effects. In response, buildings possess certain attributes (tangible and intangible) that enable them to satisfy these objectives. The utility of any building and hence its life span is therefore determined by the extent to which it satisfies the value objectives of the impacted groups mentioned above.

2. the value objectives of buiding owners, occupiers and non-occupiers can differ. Thus for a building to be useful to each interest group, it must serve several functions at the same time. The building renewal

problem is thus a multi-objective problem involving not only economic issues but also issues to do with functionality, the environment as well as structural and physical integrity.

3. there are no two buildings which are the same. If this is considered together with the fact that the value objectives of the different groups impacted by building development do differ, it would be difficult to come up with a unique set of factors that will determine building renewal action in all situations. There may be the existence of core or principal criteria but there would also be situation-specific factors in each case.

4. the problem environment is uncertain. Not only that, the resolution of the renewal problem also involves the evaluation of a mixture of subjective and objective criteria measured in incommensurable units.

The main inference that can be made from the facts and assumptions stated above is that economic imperatives alone are not sufficient to arrive at an optimal decision action in the building renewal problem. With this premise, what then is the way forward?

Studying the literature on decision analysis (eg. Keeney and Raiffa, 1976, von Winterfeldt and Edwards, 1986) the kind of model that permits the evaluation of conflicting values is based on Utility theory. This kind of model also allow the incorporation of subjective factors as well as the pooling of factors measured in different units.

By employing the principles of utility theory, value or utlity curves can be constructed for all decision criteria in any decision context. The points on the curves reflect the underlying preference of the decision maker for different levels of the criteria concerned. For a decision problem that is determined by more than one criteria, the theory is referred to as multi criteria or multi attribute utility theory or MAUT for short. The theory and some of the techniques for constructing the value and utility curves are presented in the next chapter.

Utility theory has been used extensively on real world problems including:

- the appraisal of alternatives to improve Mexico City's airport facilities (de Neufville and Keeney, 1972; Keeney and Raiffa, 1976);
- the setting of ambient air quality standards for carbon monoxide by the United States' Environment Protection Agency (Keeney, Sarin and Winkler, 1984);
- analysis of sites for pumped storage facility in New Mexico (Keeney, 1979).
- setting of standards for oil production platforms in the North Sea (von Winterfeldt, 1982).

The particular advantages of multiattribute utility techniques that make it appropriate to resolving the building renewal problem are (Edwards and von Winterfeldt, 1986; Keeney and Raiffa, 1976):

1. they help in the identification and formulation of feasible options.
2. by focusing on generating measurable decision criteria, they help in the clear definition of objectives.
3. by following the procedures involved, the bases of decisions can be made more explicit and can be used for advocating for a particular course of action.
4. the model that they lead to is flexible enough to accommodate value objectives from different perspectives.
5. they convert variables measured in different units to a common basis without obscuring the relative importance of the individual attributes in the decision context.

Formal decision analysis procedures have been applied previously to the building renewal problem. This framework was created to resolve building renewal problems of the United States Army. This framework is now reviewed and following on from it, the task of the current research is defined.

2.9 The 'USA-CERL' Building Renewal Model

The model described here was constructed at the United States Army Construction Engineering Research Laboratory (USA-CERL) by Osman Coskunoglu and Alan Moore (1990). It was created to solve housing renewal problems for the US Army.

The model was based on the premise that: in general, three major criteria interact to establish the service life of a building. These three criteria were given as (*ibid*): physical (material) condition, functional effectiveness and economics. The building renewal problem was therefore viewed as a multi-objective problem and recourse was made to formal decison analysis to resolve the problem.

As an initial step, the problem was defined in terms of three components (Coskunoglu and Moore, 1990):

- initial (ie. existing, current) state.
- the goal state, and
- operators to transform the initial state to the goal state.

According to the authors, if the current state is not the same as the goal state, then a problem exists. The solution of the problem then involves finding the operators that can reduce the gap between the existing and the goal states.

The problem definition above was applied to the building renewal problem as follows:

Initial state: the current physical and functional conditions of the existing building under consideration.

Goal state: the desirable physical and functional condition of a building at some future time.

Operators: the actions that should be taken in order to bridge the gap between the current desirable physical and functional conditions.

Coskunoglu and Moore (1990) were of the view that to change the existing conditions the decision maker has to spend money to modify the conditions. The actions required, they wrote, include maintenance and repairs (M&R), rehabilitation and redevelopment. It was however left to the decision maker to operationally define what constitutes M&R and rehabilitaion. They thought this could be based on the extent of the improvements and the capital outlay.

After the problem definition stage, the solution to the building renewal problem was seen as comprising the following tasks (*ibid*, 1990):

i. evaluation of the present physical and functional conditions of an existing building.
ii. determining the building dynamics (ie. how does the physical and functional conditions evolve over time?) as a function of:
   - its age, structure, location and use; and
   - M & R and renewal activities.
iii. determining the goal physical and functional conditions.
iv. determining the level of M & R and renewal activities to eliminate any differences between the existing and goal conditions.

Coskunoglu and Moore (1990) classified the tasks under steps (i) and (ii) as structural, mechanical and architectural. Discussing various ways of viewing the tasks under steps (iii) and (iv), they favoured the use of formal decision models in conjunction with human judgement to define the goal physical and functional conditions. The building renewal problem was therefore restated thus:

Given variables to evaluate the physical condition of a building (π) and the functional condition (ϕ) and a function (F) characterising the building dynamics:

a. determine the optimal M & R and renewal expenditures every year for a given planning horizon (T), and

b. determine the subjectively optimal goal conditions for the same planning horizon (π_T , ϕ_T) which maximises the value function of the individual or organisation owning the building (V), whilst recognising the constraints imposed by:

- the annual budget for the M & R and renewal each year (β_t), and
- the maintenannce of a minimum defined acceptable conditions of the building each year (Ω_t).

Mathematically expressed, $\begin{bmatrix}\pi_{t+1} \\ \phi_{t+1}\end{bmatrix} = F(\pi_t, \phi_t, \beta_t, x_t, y_t)$, where,

π_t, ϕ_t - physical and functional conditions of a building at a given year.

π_{t+1}, ϕ_{t+1} - physical and functional conditions of a building in the subsequent year.

x_t - M & R expenditure in the given year.

y_t - Renewal expenditure in the given year.

Coskunoglu and Moore (1990) proposed a two-step solution to the problem defined above:

- a cost minimisation stage: this involved the determination of the optimal M & R and renewal expenditures over the planning horizon for any possible goal conditions.
- a value maximisation stage: this involved the assessment of the tradeoffs to be made between costs and the conditions to determine optimal goal conditions.

The cost minimisation stage should lead to the solution of the following problem (*ibid*):

Determine $\{(x_t, y_t) : t = 1, ..., T\}$, for every possible (π_t, ϕ_t) combination so as to minimise $\sum_{t=1}^{T}(x_t + y_t) * \alpha_t$, where,

(π_1, ϕ_1) - the given initial physical and functional conditions, and

α_t - a discounting factor.

The authors postulated that the solution to the cost minimisation problem would be a function of (π_T, ϕ_T). That is, it would yield the optimal conditions given by (Coskunoglu and Moore, 1990):

$\left[x_T^*(\pi_T, \phi_T), y_T^*(\pi_T, \phi_T) \text{ for } t = 1, \ldots, T\right]$ and an optimal cost function given by: $C(\pi_T, \phi_T) = \sum_{t=1}^{T}\left[x_t^*(\pi_T, \phi_T), y_t^*(\pi_T, \phi_T)\right] * \alpha_t$, where the (*) superscript applied to x_T and y_T denotes optimal levels.

According to them, if the goal conditions (π_T, ϕ_T) were known, the solution to the above problem would specify how much to spend on M & R or renewal each year to minimise the total cost, $C(\pi_T, \phi_T)$, over the planning horizon.

Before going on to the value maximisation stage, Coskunoglo and Moore (1990) first investigated the behaviour of the cost function $C(\pi_T, \phi_T)$ as derived above.

The properties of the cost function were found to be (*ibid*):

i. for a fixed physical condition, π_T, the higher the functional condition, ϕ_T, the higher will the cost, $C(\pi_T, \phi_T)$ be.
ii. for a fixed functional condition, ϕ_T, the higher the physical condition, π_T, the higher will the cost, $C(\pi_T, \phi_T)$ be.
iii. for a fixed cost, $C(\pi_T, \phi_T) = k$,
   a) increasing π_T is possible only by decreasing ϕ_T.
   b) increasing ϕ_T is possible only by decreasing π_T.

Using these characteristics, they plotted series of curves they dubbed iso-cost curves such that any combination of (π_T, ϕ_T) along each of them costs the same (figure 2.3).

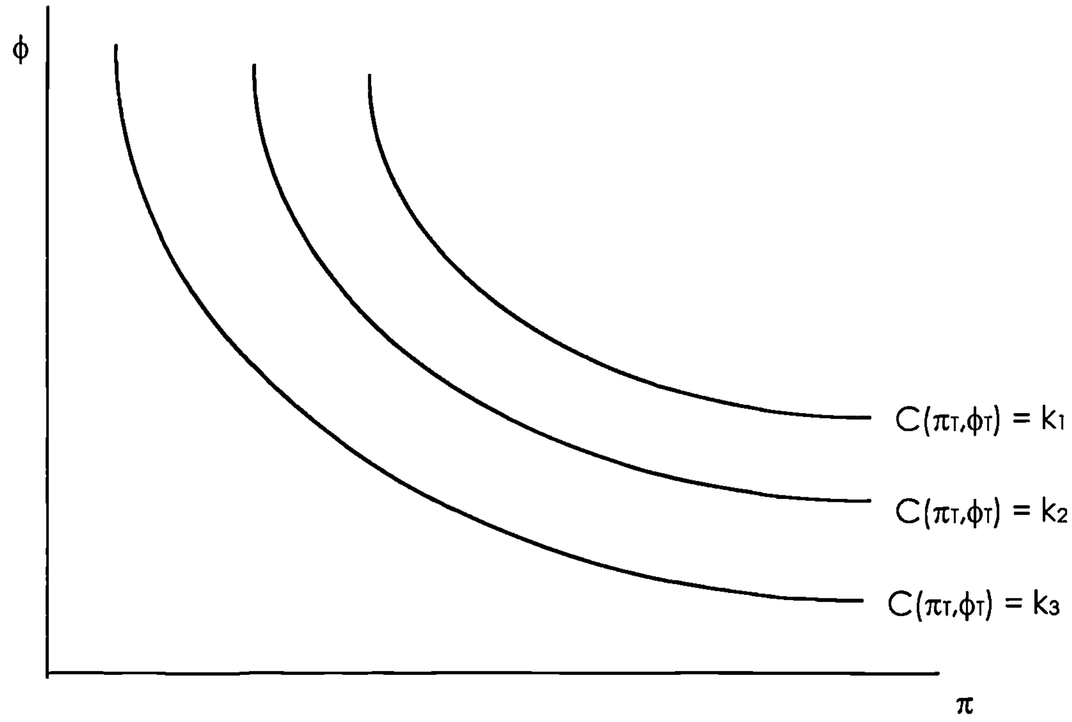


Figure 2.3: Contours of constant cost (Iso-cost curves)
Source: Coskunoglu, O and Moore, A (1990)

The value maximisation process involved the resolution of the tradeoffs between the three attributes shown in figure 2.3 : k, π_T, ϕ_T such that the value function V[k, π_T, ϕ_T] is maximised.

Departing from the seemingly complicated mathematical derivations presented earlier, Coskunoglu and Moore (1990) summarised their model with the flow chart in figure 2.4.

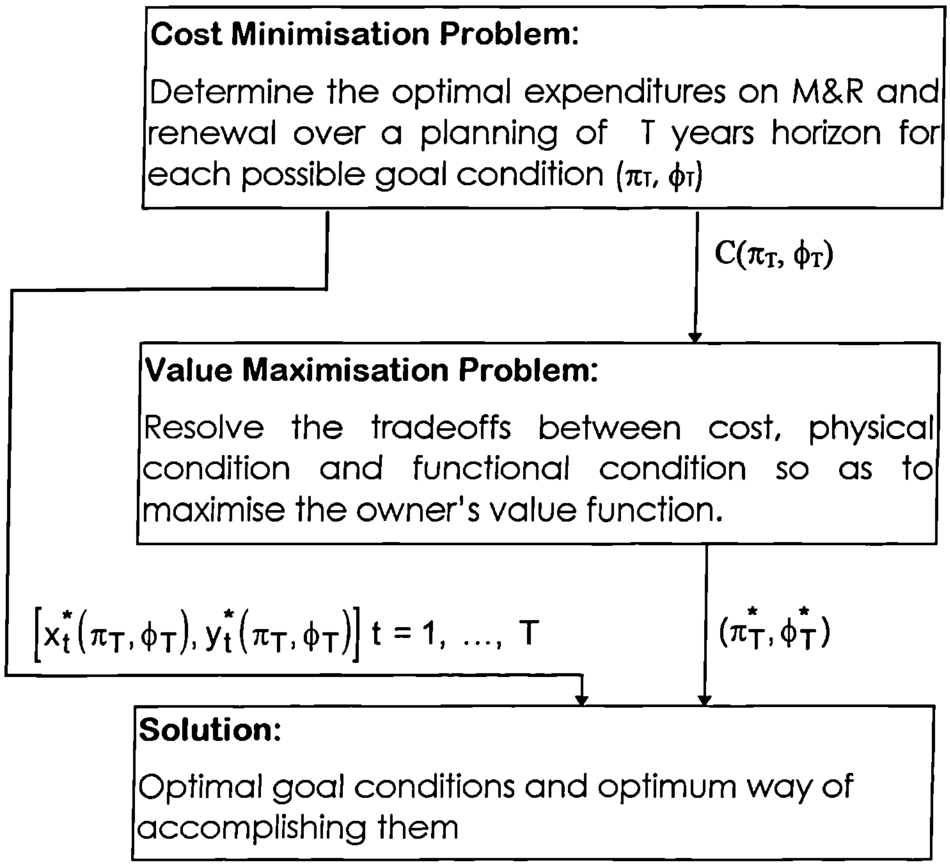


Figure 2.4: The 'USA-CERL' building renewal framework
Source: Coskunoglu and Moore (1990)

2.10 Comments on the 'USA-CERL' Model and the Current Research

The main drawback of the 'USA-CERL' renewal model is that it failed to adequately spell out the attributes that indicated the physical and functional conditions mentioned. The authors themselves admitted that the internal US Army indicators they used as proxies were less than adequate. The seemingly complex mathematical derivations involved could make the model less user friendly to less numerate decision makers. It can however be said that the mathematical expressions make it more suitable for computerisation.

The decision alternatives the model was being used to evaluate were not clear. The model appeared to be more suited to determining the level of M & R expenditure and element renewal investments rather than the replacement of whole buildings.

The model just presented does apply decision theory to the building renewal problem. It operationalised the building renewal problem into a value maximisation and cost minimisation problem in which multiple attributes indicate the degree of achievement. In this regard, it offers a useful platform to build upon.

The approach of the current research is to initially determine the goal objectives that Coskunoglu and Moore (1990) talked about. Then using the value judgements of the main groups impacted by building development, a generic decision framework based on utility theory is created to resolve this problem. The next chapter presents the theoretical background to utility theory in general and value-focused thinking in particular and how it can be applied to the building renewal problem.

CHAPTER THREE

THEORETICAL BACKGROUND TO PROPOSED FRAMEWORK

3.1 Introduction

In the last chapter, some of the past theoretical formulas and decision frameworks created by various individuals and organisations to guide building renewal decisions were reviewed. The review concluded that these formulas and frameworks were inadequate for the problem they were intended to solve. These inadequacies were in terms of either lack of logic or the lack of indicators to measure the achievement of the desired outcomes.

Of the frameworks reviewed, the 'USA-CERL' model by Coskunoglu and Moore (1990), based on formal decision analysis, was considered as offering the best basis for proceeding to solve the building renewal problem. The proposal was therefore made to employ the techniques of Multiattribute utility theory (MAUT) to refine this model. A MAUT model was proposed because it is flexible to allow multiple and often conflicting objectives from different viewpoints to be incorporated into a single framework. This chapter mainly describes the theoretical background to the proposed framework.

Decision models in general are created from the objectives of decision makers in any decision context. One of the means of generating objectives in a given decision context is through value-focused thinking as expounded by Keeney (1992). This chapter therefore describes the concept of value and utility as well as value-focused thinking.

After reviewing the theoretical background, the chapter goes on to define its application to the building renewal decision problem. The chapter ends by describing some of the techniques for constructing value/utility functions and for determining attribute weights.

3.2 The concept of Value and Utility

It was mentioned in the last section that value-focused thinking would be used to identify the criteria to assess building renewal options. It is perhaps appropriate to explore what is implied by value as used in this context ?

Value is a measure or an indicator of the relative importance or desirability of an object or action. It derives basically from some need or desire which the object of evaluation has the potential to fulfil (Sinden and Worrell, 1979). The greater of this potential an object or action possesses, the greater is its value.

Values are usually determined to aid decisions. In any decision making situation, value forms the basis for assessing the desirability of actual or potential consequences of proposed alternatives.

The most obvious evidence of people's relative valuation is their willingness to pay for an object : what they are willing to give up in order to acquire that object. Value can therefore be simplistically defined as (*ibid*) :

$V_i = WTP_i - OC_i$, where,

V_i = Value of an object or action, i

WTP_i = willingness to pay for the object or action, and

OC_i = opportunity cost of acquiring the object or action.

Stated in words, the value of an object or action is the net effect of the willingness to pay for it set against the benefits from the choices foregone in order to acquire the object or to carry out the chosen action.

Value as used in the context described above should be distinguished from market or exchange value for two basic reasons:

1. even though some objects have value, they cannot be priced in the market. An example is the air we breathe to stay alive. It is probably the most essential commodity to life and yet it is absolutely free till nature intervenes !
2. exchange value may bear a close relationship to value used in the context of this study but they are not the same. Exchange values or market values are subject to competition laws that potentially can distort valuations.

Value as a property of an object is not fixed, but rather a variable whose magnitude depends on factors external to the object itself. These factors include (Sinden and Worrell, 1979):

- the context within which it is assessed:- values are always determined to aid decisions. The aims of decision lead to the generation of value relevant desiderata. By evaluating competing alternatives in terms of these desiderata, it is possible to assess relative values of competing alternatives. Therefore the decision context has a bearing on values.
- the assessor and the influences he has been or is expected to be exposed to:- the value of an object or action may be different to different people under different sets of circumstances.
- the person or group of persons on whose behalf the assessor is acting:- many of the difficult real world decisions do not affect only the decision maker but also other people. To be able to make a proper evaluation, the social, economic and environmental background of those impacted by the decision should be understood.

The inference from the brief discussions above is that it is not always adequate to measure values in terms of money. For some objects, monetary valuation is not even possible. Value as defined by the equation above leaves the impression of monetary valuation and may not be applicable to all situations.

The general way therefore to evaluate objects or actions is to assess their capacity to make a favourable difference to the status quo. This capacity to make a favourable difference is referred to as utility (Sinden and Worrell, 1979). Utility is thus the ultimate criterion for appraising the value of an action or object. When a decision has to be made, each alternative action in the decision space is evaluated in terms of both its utility (U) and its opportunity cost or disutility (DU). Thus the value equation can be redefined as :

$$V_i = U_i - DU_i$$

By applying this new equation to the consequences of alternative decision actions, their comparative values can be determined.

3.3 The Conceptual Basis of Value/Utility Theory

The basis of Utility theory is that rational decisions are guided by the preferences and the strength of preferences for decision outcomes. These preferences are derived from the value or utility that decision makers attach to the consequences of the alternative chosen. Thus to choose between alternatives in a decision space, the ultimate aim would be to choose the option that maximises psychological and economic benefits (ie. value or utility).

If the foregoing premise is accepted, it can be seen that the single most important input into decision making is value judgement. The application of this value judgement is illustrated by a conceptual example (after Goicoechea, Hansen and Duckstein, 1982):

If an individual is presented with two objects, A and B, it is a generally accepted fact that, that person can say whether:

- he prefers A to B;
- B to A; or
- is indifferent between the two.

Relying on this cognitive ability, human beings are capable of rank-ordering their preferences for objects presented to them (*ibid*).

Extending this observation further, people are not only capable of rank-ordering their preferences, but can also, with some amount of thinking, meaningfully communicate about the strength of their preferences. As a result, when people are presented with options in a decision space, they can state how much more they prefer one option over another in a ratio sense (Goicoechea et al, 1982).

Individual cognitive judgements do not only reflect ordinal rankings of and strength of preferences for sure objects. They can also reflect preferences for lotteries (gambles) involving these objects (*ibid*).

The values of gambles formed the main work by von Neumann and Morgenstern (1947) on which modern day utility theory is founded. They concluded from their work that :

> *"If A and B are gambles, and if certain technical axioms required to make expressions of preferences valid were satisfied, then such preferences are enough to make it possible to represent the underlying value structure as a cardinal utility function".*

Source: Goicoechea, Hansen and Duckstein, (1982)

The technical axioms mentioned above relate to choices among both certain and uncertain outcomes of decision actions. Essentially, these axioms maintain that people are rational and consistent in choosing among risky alternatives, if all the information pertaining to the decision is available and properly structured.

The axioms are, (Markowitz, 1959):

1. for two alternatives, A and B in a decision space, one of the following must be true: an individual prefers either A to B or B to A or is indifferent between them.

2. an individual's evaluation of alternatives is transitive: if she prefers A to B and B to another option, say C, then she prefers A to C.
3. Assuming that A is preferred to B and B to C, there then exists some probability 'p': $0 < p < 1$, that the individual is indifferent between object B with certainty or getting A with probability p and C with probability (1-p). Simply stated, there exists a certainty equivalent to every gamble.
4. Assuming an individual is indifferent between two choices A and B, and if C is any third alternative in the decision space, then she will be indifferent between the following two gambles: Gamble 1 offers a probability p of receiving A and a probability (1-p) of receiving C, and Gamble 2 offers a probability p of receiving B and a probability (1-p) of receiving C.

With these technical axioms, it is possible to employ some elicitation techniques to encode preferences for objects and gambles in terms of utility numbers. These utility numbers are such that if A and B are the only options in a decision space then:

$U(A) > U(B)$, if and only if, A is preferred to B, where,

U(A)and U(B), are utility numbers for options A and B respectfully.

3.4 Decision Making in the Context of Value-focused Thinking

The usual procedure for solving decision problems is to find all the alternatives available, and from their individual consequences, choose the optimal from amongst them. This approach dubbed 'alternative-focused thinking' by Keeney (Keeney, 1992) is considered as flawed because it does not really address the ultimate reason why the listed alternatives are important. If the ultimate aims were to be addressed, more alternatives and perhaps opportunities could be identified (*ibid*).

The 'flaw' in 'alternative-focused thinking' led to Keeney to propose an alternative approach to problem solving which he referred to as 'value-focused thinking' (Keeney, 1992). In this approach, the decision maker selects alternatives in a decision situation based on the ability of the alternatives to satisfy his or her prespecified value objectives. According to Keeney, for creative decision making, the 'first port of call' should be the end values that one hopes to achieve by the decision (*ibid*).

The justification for value-focused thinking can be found in the fact that by concentrating on what is really important in a decision situation: values, objectives can be more concisely and explicitly stated. This could then lead to the identification of better as well as an extensive range of alternatives. Besides, articulating value objectives could lead to careful and consistent evaluation of the desirability of the identified decision alternatives (Keeney, 1992).

Value-focused thinking consists of two activities: first deciding what is required; based on values, and then determining the optimal means of achieving it. The procedure for assessing decision alternatives through value-focused thinking is summed up in the following steps (*ibid*):

- structuring the problem in terms of values;
- identifying value-based objectives;
- structuring these objectives;
- evaluating the achievement of the objectives;
- quantifying the objectives with a value model; and finally,
- choosing the best or optimal alternative.

Each step is described in the next few sections.

3.5 Problem Structuring

The aim of structuring a decision problem is to render it operational to facilitate evaluation. This involves the definition of the problem and the understanding of the problem environment including the identification of the decision maker, the people on whose behalf he is acting and the values that these people would like to maximise.

In most problem situations, the nature of the problem itself, the options available to address it and the decision objectives are not known at the outset of the evaluation. The indication of any problem may only be the feeling of something being wrong. In such a scenario, an exploratory study is required to define the actual problem and its ramifications. The exploratory study must address the following questions among others (von Winterfeldt and Edwards, 1986):

- what is the nature of the problem and its environment?
- what is the purpose of the analysis?
- who is the decision maker?
- who is impacted by the decision?
- what are the decision maker's objectives?

At the end of this structuring exercise, a set of value relevant objectives may emerge.

3.6 Identification of Objectives

Values that are of concern in a decision situation are made explicit by the identification of objectives. Objectives are therefore statements about what one desires in a decision context. They are characterised by decision contexts, objects of evaluation and directions of preferences (Keeney, 1992: p. 34).

What objectives do in a decision situation is to provide the needed guidance for making choices. They also provide the bases for any quantitative modelling or analysis that may follow the qualitative articulation of values (*ibid*). The relative value of each alternative is then determined by the levels of objectives achieved by each alternative.

Objectives are to be distinguished from goals or targets in that whereas objectives indicate the preferred direction of improvement, goals or targets refer to specific levels of improvement (Keeney and Raiffa, 1976). As far as objectives are concerned, any improvement in the preferred direction is recognised, albeit to varying degrees depending on the levels of the objectives achieved. On the other hand, any improvement that is below a target or goal is strictly not recognised at all even if it is better than the status quo. An example of an objective for a company may be "increase turnover for the coming financial year" but the goal for the same company may be "achieve a 50% increase in turnover for the coming financial year".

There are no unique set of rules for identifying objectives in a given decision situation. It is only in few cases where the objectives for a study are given prior to the evaluation. Keeney (1992) suggested the following as being among the general approaches for generating objectives:

- examination of the relevant literature to find out what has been reported as pertinent objectives in similar decision situations;
- observing people to see how they are presently making decisions relevant to the problem and trying to understand the rationale behind such decisions;
- by asking those impacted by the decision to think of objectives from their own perspectives;
- by probing into the shortcomings of the present situation to specify what is desired;
- using goals and constraints to identify what is desired or what has to be avoided; and

- by classifying the consequences of decisions into generic categories such as economic, political, environmental etc. Objectives relevant to the problem can then be generated by finding the aspects of the generic categories that are of concern.

3.7 Structuring of Objectives

In most decision contexts, the generated objectives are usually a mixture of ends and means objectives. To be able to understand the decision context better and to establish the relationships between objectives, it is necessary to separate these two kinds of objectives. This is the essence of the objective structuring exercise.

The ends objectives, also known as fundamental objectives, are the essential reasons for interest in the decision (Keeney, 1992). In other words, they derive from the value judgements of the decision maker(s). They therefore provide the bases for creating a value model to assess the alternatives in the decision context.

The means objectives concern how best the fundamental objectives can be achieved. They link the alternatives in the decision context to their consequences in terms of the ends objectives (see figure 3.1).

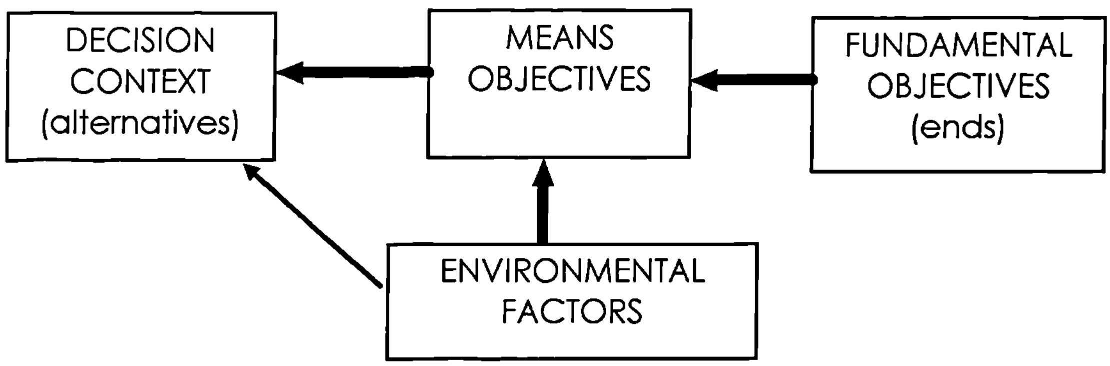


Figure 3.1: Generic decision model based on value-focused thinking
Source: adapted fron Bodily, S E (1985)

Using the value-focused thinking approach, the generic decision model first shown in chapter one (figure 1.2) is modified as shown in figure 3.1. From the modified model, it can be seen that two main types of relationships can be identified between objectives: an ends objectives hierarchy and a means-ends objectives network (Keeney, 1992).

In the ends objectives hierarchy, the relationship between an adjacent higher-level and lower-level objectives are hierachical. This is to say that: the lower-level objective either defines and explains the higher level objectives linked to it or it indicates the aspects of the higher-level objectives that are of concern. The end objectives hierarchy starts from the end objectives or generic classification of the impacts of the decision and ends when suitable lower-level objectives which exclusively and exhaustively describe the end objectives are reached (*ibid*).

The means-ends objectives network presents the best means to the end objectives. The relationships between adjacent higher-level and lower-level objectives are causal. The network starts from the lower-level objectives in the end objectives hierarchy and ends in the identification of either alternatives or classes of alternatives (Keeney, 1992). In the means-ends network, one means objective can affect several end objectives or several means objectives can affect one end objective.

The discussions above indicate that two kinds of judgements are required to model the decision frame: judgements about values and judgements about factual knowledge. The data required to build the end objectives hierarchy comes from the value judgements of the decision maker(s). On the other hand the data required to build the means-ends objectives network is from judgements about factual knowledge or information on how best to achieve the value-based end objectives.

3.8 Measuring the Achievement of Objectives

To assess the degree to which objectives are achieved in a decision situation, there ought to be some means of assessing them. This is done in two stages: first by the specification of attributes or indicators followed by the selection or construction of value-relevant scales to evaluate the attributes.

3.8.1 Specification of Attributes

Attributes are low level abstractions derived from the end objectives. They are required for each lowest-level objective in an end objectives hierarchy to indicate the extent to which each objective is achieved. Attributes also help explain what is meant by the higher-level objectives and the value judgements associated with them (Keeney, 1988).

As an example, consider the objective "improve the quality of life". One of the attributes which might help explain this objective could be "provide affordable health care to all". This might not be the only attribute under the higher objective but it partially explains what aspect of the objective is of concern. The relationship between an attribute and an objective is directed and hierachical.

Attribute generation is the result of the level by level disaggregation of higher level objectives till the level where further disaggregation will produce no further explication of the decision maker's values. At this stage, the attributes should be measurable and judgementally, easy to assess.

For an attribute to be value-relevant, it should be understandable to the decision maker and it should be possible to make meaningful expressions of preference for different levels of it. In other words it should be possible to discriminate between competing alternatives on the basis of that attribute (von Winterfeldt and Edwards, 1986).

The following criteria is recommended by Edwards and von Winterfeldt (1986) for examining attributes:

- completeness:- which requires that all relevant values be included in the evaluation and that the attributes completely define the higher level objectives;
- operationability:- which requires that it should be possible to assess the attributes in a meaningful way;
- decomposability:- which requires that it should be possible to analyse one or two attributes at a time independent of other attribute levels;
- absence of redundancy:- which requires that no two attributes mean the same; and
- minimum size:- which refers to the necessity of keeping the number of attributes small enough to manage or to work with.

3.8.2 Selection and/or Construction of Scales

Scales are required to measure the levels of attributes. The choice of such scales requires careful judgement to ensure that they are simple and understandable to the decision maker. Furthermore, the chosen or constructed scale for an attribute ought to be relevant to it. It should also enable the decision maker to meaningfully express varying degrees of preferences for points on the scale within the context of the decision at hand.

Measurement scales can be categorised according to whether they directly or indirectly indicate achievement of an attribute. They can also be categorised into natural or constructed scales (Keeney, 1981).

3.8.2.1 Direct and indirect (proxy) measures

Direct and indirect scales can perhaps be defined appropriately by the following illustration below (after Keeney, 1981):

Suppose there is a set of alternatives: $A_1,\dots,A_i,\dots A_J$ in a decision space and suppose each alternative is to be evaluated as to their achievements on objectives: $O_1,\dots,O_i,\dots O_n$. Suppose for each objective, O_i, there is an attribute which indicates the level of achievement. For simplicity sake, let this attribute and its scale be denoted as X_i, even though strictly speaking, the two can be different.

If X_i directly measure the objective O_i, the scale is said to be a direct scale. For instance, suppose one of the objectives in deciding whether to repair or replace a building is "minimise development cost", an attribute for such an objective could be "development costs" and the direct scale could be "cost in thousands of Pounds".

In many evaluation problems however, the X_i's as defined above cannot be easily quantified. For instance, what scale can be used to judge the artistic merit of a painting? In such cases, a different attribute which bears a relationship to artistic merit could be used to indirectly measure it. For instance the "amount of wear of carpeting" in front of paintings exhibited in a gallery can be used to assess the relative values of the paintings. This would be valid if it can shown that a relationship exists between the popularity of a painting among visitors and the amount of wear of carpeting in front of the painting. In this instance, the amount of wear of carpeting is an indirect measure of value and popularity of the painting is a proxy attribute for the value of the painting.

3.8.2.2 Natural and constructed scales

There are basically two major types of scales that can be used to measure both direct and indirect attributes. These are natural and constructed (subjective) scales (Keeney, 1981).

Natural scales refer to long established scales which enjoy common and almost universal usage and interpretation. Examples are distances in kilometres and weights in tonnes. Natural scales tend to have relevance to several problem contexts and are not problem-specific.

Constructed scales, on the other hand, are developed specifically for a problem at hand. There is no universal scale for aesthetic delight for instance. Any attempt to quantify this requires the construction of a scale. This may entail the use of verbal descriptions and pictorial representations of different degrees of aesthetic delight. Due to the fact that constructed scales are problem-specific, they must have certain key defined points on them to convey their meanings to people other than those who constructed them.

3.8.3 Dominance Analysis

At the end of the structuring exercise, ideally a set of desired objectives: $O_1, O_2, ..., O_n$ would be produced. It would also yield a set of feasible options $A_1, A_2, ..., A_m$ that satisfies these objectives. Each objective would be described by an attribute $X_1, X_2, ..., X_n$ respectfully and that each can be assessed on a value-relevant scale. If the specific levels of these attributes on the scales are represented by $x_1, x_2, ..., x_n$ respectively, the decision problem can be reduced to a pay-off matrix as shown in figure 3.2.

	Decision Options						
Attributes	**A_1**	**A_2**	**...**	**A_j**	**...**	**...**	**A_m**
X_1	x_{11}	x_{12}	...	x_{1j}	...	...	x_{1m}
X_2	x_{21}	x_{22}	...	x_{2j}	...	...	x_{2m}
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
X_n	x_{n1}	x_{n2}	...	x_{nj}	...	...	x_{nm}

Figure 3.2: Pay-off Matrix

After the construction of the pay-off matrix, all the totally dominated options can be eliminated. A dominated option refer to the option which is equally desirable as its nearest better rival on all attributes, but less desirable over at least one attribute.

The dominance analysis involves eliminating from the least valuable option upwards till a set of non-dominated options is obtained. In some problem situations, this would yield only one non-dominated option in which case the problem is solved and no further analysis would then be required. If this is not the case, then further analysis in line with the procedures listed in section 3.4 would be required.

3.9 Building Multiattribute Value/Utility Models

After the objectives structuring stage comes the assessment of the desirability for the outcome of each option in terms of the attributes. This measure of desirability is captured by the construction of value and utility functions, $V(X_i)$ and $U(X_i)$, over each attribute X_i. They are created by arbitrarily assigning real numbers to describe the preferences for different levels of objects in a decision space.

The consequences of most decisions cannot be adequately described by only one attribute. In reality they may be described by a number of measures or criteria and this forms the basis of multiattribute evaluation. In such a situation, the single attribute functions are combined into a multiattribute model with which the options are evaluated. The two steps are described below.

3.9.1 Single Attribute Utility/ Value Functions

Value and utility functions assign real numbers $v(x_i)$ and $u(x_i)$ to every possible outcome of attributes (Keeney, 1981). Their basic property is that options whose outcomes have higher v's and u's are preferred to those with lower ones.

In decision analysis, it is conventional to distinguish between value and utility functions (von Winterfeldt and Edwards, 1986). Value functions are created over attributes with certain outcomes. Here, the decision maker assigns higher numbers to preferred consequences. Utility functions on the other hand are constructed over attributes with uncertain outcomes. The decision maker is asked to assign utility numbers in accordance with his perception of risk. Utility functions therefore do not only indicate preferences, but also give indications of the risk behaviour of decision makers.

Techniques for constructing value and utility functions are just sets of conditionalities and rules for assigning real numbers to valuable objects to reflect their underlying values within a specific decision context. It involves the elicitation of responses to stimuli presented to decision makers according to a chosen or constructed value scale (*ibid*).

Table 3.1: Array of Value/Utility Measurement Techniques

Type of Judgement	Stimuli	
	certain outcomes	uncertain outcomes
Numerical Estimation Methods	Direct rating Category estimation Ratio estimation Curve drawing	N/A
Indifference Methods	Difference standard sequence Bisection	Variable probability method Variable certainty equivalent method

Source: Edwards & von Winterfeldt (1986)

The techniques for measuring values or utilities are categorised by the type of stimuli presented and the response judgements required of decision makers (Table 3.1). The stimuli can be based on either certain or uncertain outcomes of decision consequences, as the case may be. As already explained, it is conventional to term measurements based on certain outcomes as value measurement and those based on gambles as utility measurement. Thus in table 3.1 methods falling under certain outcomes are used in the construction of value functions. Similarly, those placed under uncertain outcomes yield utility functions.

The response judgement required to be made on the stimuli presented to decision makers are either indifference or direct value judgements on some numerical scale. Some of the methods listed in Table 3.1 are described in sections 3.11 and 3.12.

3.9.2 Multi-Attribute Value/ Utility Models

The building of multiattribute value or utility model involves the following:

- the construction of single-attribute value or utility functions over the various attributes (covered in the last section); and
- determining the form of the formal model to aggregate the individual single-attribute value and utility functions into a single multi-attribute utility model.

How to construct single-attribute value/utility functions has just been described in the last sub-section. The common multi-attribute utility/value models together with the conditions under which each is applicable are described below.

In general a multi-attribute utility model is of the functional form (von Winterfeldt and Edwards, 1986):

$V(X) = F\{v_1(x_1), v_2(x_2), \ldots, v_n(x_n)\}$, where,

$V(X)$ - the multi-attribute utility or value function, and

$v_1(x_1), v_2(x_2), \ldots, v_n(x_n)$ - are the single-attribute value or utility functions over the attributes $X_1, X_2, \ldots, X_n$.

There are a variety of multiattribute models but the most popular are the additive and the multiplicative models.

The additive model is of the form: $V(X) = \sum_{i=1}^{n} w_i v_i(x_i)$, where,

X - is the evaluation object.

x_i - is its measurement on attribute X_i.

v_i - is the single-attribute value or utility function over attribute X_i.

w_i - is the scalar constant or importance weight of attribute X_i, and

n - is the number of attributes.

The basic multiplicative model is of the form:

$$V(X) = \sum_{i=1}^{n} w_i v_i(x_i) + \sum_{i<j} w w_i w_j v_i(x_i) v_j(x_j) + \sum_{i<j<k} w^2 w_i w_j w_k v_i(x_i) v_j(x_j) v_k(x_k) + \ldots$$

$$+ w^{n-1} \prod_{i=1}^{n} w_i v_i(x_i)$$

The first term of the right hand side of the multiplicative equation is the additive model. The rest of the terms depend on only one parameter, 'w' that models the interaction between the attributes. If there are no interactions, w = 0 and the equation reduces to the additive model.

A more compact form of the multiplicative model proposed by Keeney and Raiffa (1976) appears to be the most popular multiplicative model among decision analysts and have been used extensively on 'real-world' problems.

It is of the form: $1 + wV(X) = \prod_{i=1}^{n} [1 + w w_i v_i(x_i)]$

where $w \neq 0$ and all the variables are as defined previously.

If each of the models above is scaled from 0 to 1.0 and the individual component functions are also scaled from 0 to 1.0, in the additive model, the sum of the individual attribute weights, w_i, is equal to 1.0. This is however not the case for the multiplicative model.

There are independence rules that indicate the form of the MAUT model to use. These independence rules are a source of considerable confusion and detract from the attractiveness of MAUT procedures (von Wnterfeldt and Edwards, 1986). Stated quite simply, if there are no strong interactions between attributes, and if each attribute can be assessed independent of the others, the additive model applies. Otherwise the multiplicative model is the most appropriate.

Some Analysts (eg. Edwards, 1977) demonstrated the robustness of the additive model by ignoring the independence conditions. Therefore rather than go into the intricacies of the independence conditions, the additive model is adopted in this research for creating the building renewal decision model.

3.10 Some Techniques for Constructing Value Functions

Some of the techniques for constructing single-attribute value and utility functions listed in Table 3.1 are described below.

3.10.1 Numerical estimation methods

In the numerical estimation methods decision makers are required to make quantitative judgements about stimuli, or relations between stimuli, presented to them. Using this method, respondents are presented with scales with anchored minimum and maximum points. They are then asked to numerically estimate the attractiveness of presented stimuli relative to these anchors. The main versions of the numerical estimation methods are: direct rating, category estimation, ratio estimation and curve fitting techniques. Some of these techniques are described below.

3.10.1.1 Direct rating techniques

In the direct rating method, the end points are usually labelled "bad" or "least preferred"; a stimulus that is arbitrarily assigned a value of 0, and a "good" or "most preferred"; assigned a value of 100. Respondents are then asked to rate competing objects between these end points.

To illustrate this method, suppose an organisation is seeking to site its headquarters in one of five northern UK cities, say Manchester, Leeds, Liverpool, Preston and Sheffield. The Board wishes to base its decision on customer catchment area, level of local business rates and availability of skilled labour. Although there is more than one reason for preferring one city over another, the Board thinks it can 'pool' all together to rate the cities in order of preference.

First the Board would be asked to select two UK cities it considers the worst and the best for siting its headquarters. The worst city is arbitrarily assigned the value of 0 and the best city is assigned a value of 100. Next the Board is asked to rate the competing cities between the end points.

A curvilinear representation of value can be constructed if a natural numerical scale exists for the object being assessed. An example is, say, the rating of the value of office floorplate sizes. First, the worst and the best levels of the scale (say, square footage) are identified and arbitrarily assigned the values of 0 and 100 respectively. The square footage of all other offices are rated in between.

An example of value responses to square footages of offices may be as given below:

v(1000) = 0 ....(arbitrarily assigned)

v(1500) = 40 ....(judgement relative to end points)

v(1800) = 60 ....(judgement relative to end points)

v(2100) = 80 ....(judgement relative to end points)

v(2500) = 100 ......(arbitrarily assigned)

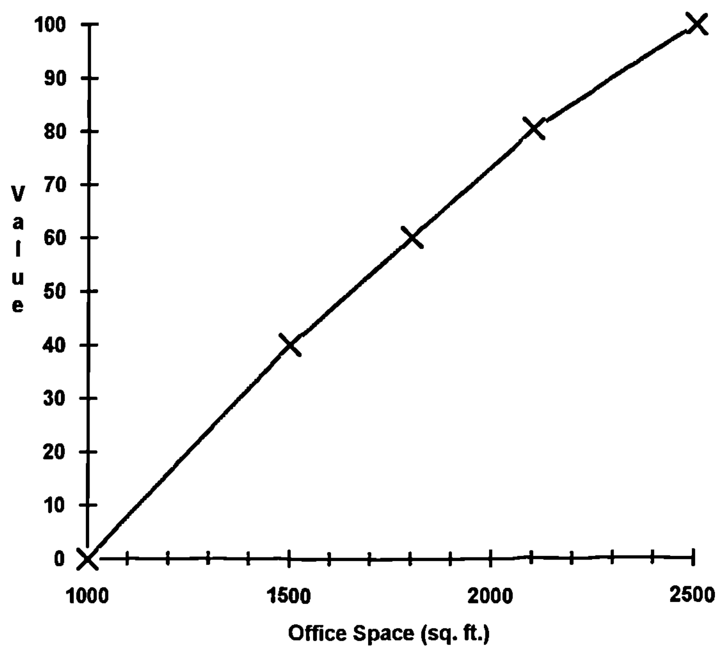


Figure 3.3: Value Curve for Office Space

A curve can then be fitted to these responses as shown in figure 3.3. Intermediate values can then be read off. In this example, the chosen end points could be either the actual lowest and highest floor areas in the set presented or floorplate sizes within practically acceptable range if the evaluation is not associated with any particular office space.

3.10.1.2 Category Estimation Techniques

In this technique, possible responses of the decision maker are reduced into a finite number of categories. These categories are defined such that adjacent categories are deemed to be equally spaced in value or preference. The evaluation task is then for the decision maker to place presented objects under the category that best describes them. Using the headquarters location example discussed earlier, the decision maker may be presented with the following category scale:

very bad	__	__	__	__	__	__	__	**very good**
location	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**location**

To be effective, the characteristics of cities falling under the categories above should be defined concisely. The decision maker would then be asked to place each of Manchester, Leeds, Sheffield, Preston and Liverpool under the category that best describes each of them.

Even though categorisation scale is simpler to use, achieving fine distinctions between objects is difficult unless expert knowledge is employed (von Winterfeldt and Edwards, 1986).

3.10.2 Indifference methods

Indifference methods require respondents to match two stimuli or pairs of stimuli to meet a specified indifference relation. In other words, pairs of valuable objects are varied in their attractiveness until their respective strengths of preference are matched.

The main versions of riskless indifference methods listed in Table 3.1 are the difference standard sequence and the bisection methods. They are described and illustrated below.

3.10.2.1 Difference standard sequence

In the difference standard sequence method, a decision maker is asked to identify a sequence of stimulus that is equally spaced in value. For instance stimulus X_0, X_1, X_2, X_3,..., X_i, ... is found such that the strength of preference of X_0 over X_1 is equal to the strength of preference of X_1 over X_2, which in turn is equal to the strength of preference of X_2 over X_3 and so on. Steps for constructing such a sequence can be summarised as follows:

1. The decision maker picks a starting point and a unit stimulus ie. zero stimulus X_0 and the unit stimulus X_1.
2. The decision maker is then asked to find a sequence of X_i's such that (X_0, X_1) is indifferent to (X_i,X_{i+1}) for all X_i.

The value function is defined as:

$$V(X_0) = 0$$

$$V(X_1) = 1$$

$$V(X_i) = i$$

If X is a numerical measure, $V(X_i)$ can be plotted as a function of X_i and intermediate values can be read off the resulting curve. However if X is not a numerical measure, the V values for the standard sequence can just be listed and the intermediate values can be located by finding their closest X_i's in the sequence.

3.10.2.2 Bisection method

In the bisection method, the decision maker is asked to determine the lower and upper bounds of a scale which spans the entire value range of the evaluation object. He is then asked to find the point on the scale which is halfway in value between the predefined end points. The value function is refined by further sub-division of the scale. The following example is used to illustrate the bisection method.

Suppose a young Graduate has been offered a job in Manchester and he is looking for a suburb in which he can rent an accommodation. His mother has given him her old battered car in which he can travel to and from work. Due to the daily traffic jams on the roads leading to the city centre during the morning rush hours, he has a limit on how far away from the city centre he is prepared to consider.

In considering the choice of a suburb, let us assume other factors such as noise, crime level, rent levels, council tax levels etc. have been used to produce a shortlist of suburbs.

The value relevant attribute in this example is not distance of a suburb from the city centre as the traffic situation is not the same from all suburbs to the city centre. It would seem the appropriate attribute is travel time since he wants to arrive at work each day on time without necessarily having to wake up very early in the morning.

In trying to construct a value function for travel time in say minutes, the young graduate is asked to state the maximum time he is prepared to travel each day. Let us assume for this example that he says 60 minutes. Of course his wish is not to even spend a minute in travelling to work. He therefore arbitrarily assigns the following values to the limits:

v(0) = 100 and v(60) = 0, ie. the value of zero travel time is 100 and that for 60 minutes travel time is 0.

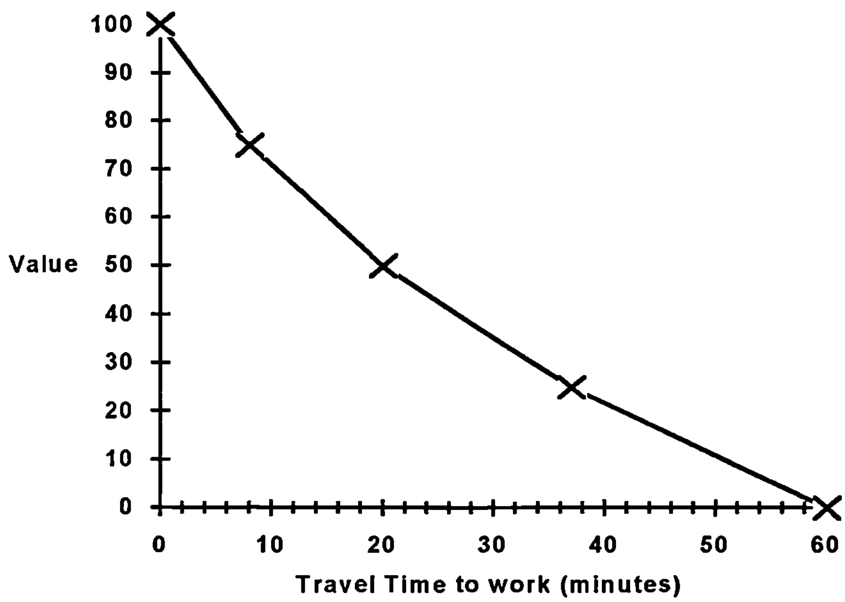


Figure 3.4: Value curve of travel time to work for a young graduate

Next the graduate is asked what will cause him the more displeasure: the first 30 minutes of driving or the second 30 minutes? Thinking about how difficult it would be for him to get up early in the morning to prepare to go to work, he might consider that if he had been driving for 30 minutes already, an extra driving time would not be as 'hard' as when he actually set off. He might therefore decide that the first 30 minutes would be much more of a bother than the second 30 minutes. Let us assume for this example that he chooses the first 20 minutes of driving as causing as much displeasure as the remaining 40 minutes. Thus the value of 20 minutes travel time is halfway between the values of 0 and 60 minutes of travel. The procedure is repeated to bisect the 0 and 20 minutes as well as 20 and 60 minutes to determine the quarter-value and three-quarter value points respectively.

Let us assume the following answers:

$v(0) = 100$

$v(8) = 75$

$v(20) = 50$

$v(37) = 25$

$v(60) = 0$

The values, as determined above, can be plotted against travel time to represent the graduate's value function for travel time to work. This is as drawn in figure 3.4 above.

3.11 Some Techniques for Constructing Utility Functions

From Table 3.1, indifference methods can be applied to both riskless (value measurement) and risky (utility measurement) decision outcomes. The main versions of gamble-based indifference methods from Table 3.1 are the variable certainty equivalent and variable probability methods. The procedures for the two methods are summarised below (after von Winterfeldt and Edwards, 1986).

3.11.1 Variable certainty equivalent method

The steps involved are as follows:

1. First the set of evaluation objects, X is defined (ie. a value relevant scale is selected or constructed).
2. The decision maker is then asked to select the maximum and minimum limits which span the value range of the attribute being measured. In

other words, the most preferred and least preferred elements of the set is determined and designated as X_{max} and X_{min} respectively.

3. Next a 50-50 gamble of winning X_{max} or X_{min} is constructed in which variable elements of the scale between X_{max} and X_{min} are chosen to determine if:
   (a) they are indifferent to the gamble;
   (b) they are preferred to the gamble; or
   (c) the gamble is preferred to them.
4. As a result of the exercise in step (3), the largest X at which the decision maker definitely prefers the gamble is determined. Similarly, the smallest X at which the sure thing is preferred to the gamble is also determined.
5. Establish as precisely as possible, $X_{1/2}$, the point where the sure thing is indifferent to the gamble.

The utility of $X_{1/2}$ is derived from the arbitrarily defined utilities of the end points: $u(X_{max}) = 1$ and $u(X_{min}) = 0$. From expected utility assumptions:

$u(X_{1/2}) = 0.5u(X_{max}) + 0.5u(X_{min}) = 0.50.$

The same procedure is repeated to sub-divide the utility scale into equal intervals. Where a natural numerical scale exists, three or five points are usually sufficient to permit the smoothing of a curve through the points.

3.11. 2 Variable probability method

This method involve the following steps:

1. Define the set of evaluation objects, X.
2. Select X_{max} and X_{min} as defined under the variable certainty equivalent method.
3. Next, construct a gamble with an unspecified probability, 'p' of winning X_{max} and (1-p) of winning X_{min}.

4. Choose any element in X, say X_i between X_{max} and X_{min} and compare for various p's if:

   a. X_i is indifferent to the gamble;

   b. X_i is preferred to the gamble; and

   c. the gamble is preferred to X_i.

5. As a result of the exercise in step (4), the largest probability, 'p' at which the decision maker definitely prefers X_i to the gamble is determined. Similarly, the smallest 'p' such that the decision maker prefers the gamble to X_i is also determined.

6. The value p_x such that an indifference relation is established between X_i and the gamble is elicited as precisely as possible,.

7. The utility of X_i is derived from the arbitrary definitions of the utilities of the end points: $u(X_{max}) = 1$ and $u(X_{min}) = 0$. From expected utility theory:

   $u(X_i) = p_x u(X_{max}) + (1-p_x)u(X_{min}) = p_x$

The variable probability method can be applied to any scale, whether they form dense scales or consist of only a few elements and whether they are natural or constructed (von Winterfeldt and Edwards, 1986). If the attribute has a natural scale and enough points are determined, a smooth curve can be run through them.

3.12 Some Techniques for Determining Attribute Weights

The multiattribute models discussed in section 3.9.2 contain parameters $w_1, w_2, \ldots, w_i, \ldots, w_n$. These were described as attribute importance weights. In this section, some of the methods for determining these importance weights are described.

There are a variety of methods for determining attribute weights which depend on the type of model: whether the attribute function measures value or utility. Some of these methods and the circumstances where they may be applicable are listed in Table 3.2 below.

Table 3.2: Array of Attribute Weighting Methods

Technique	Value Measurement	Utility Measurement
Numerical Estimation Methods	Ranking Direct rating Ratio estimation Swing weighting	(usually not applicable but has been known to be used)
Indifference Methods	Cross-attribute indifference Cross-attribute strength of preference	Variable probability method Variable certainty equivalent method

Source: von Winterfeldt & Edwards, (1986)

The direct numerical methods are described first followed by two indifference methods, one each under value and utility measurement.

3.12.1 Numerical estimation methods

Numerical estimation methods are usually based on the notion of attribute importance in the overall evaluation of value or utility. The two common methods described under this heading are the direct rating and ratio estimation methods.

A typical direct rating procedure may involve asking the decision maker to share say 100 points over the attributes in a manner that reflects their relative importance in the evaluation exercise. Some authors (von Winterfeldt and Edwards, 1986) believe this method tends to produce flatter attribute weight distribution especially where the number of attributes is large.

The ratio estimation method is believed to be an improvement on the direct rating method. In this method, the decision maker is asked to estimate how much more important an attribute is relative to the least important one. The method can be summarised in the following steps:

i. The decision maker is asked to rank the attributes from the most important to the least important in that order. He is then asked to assign a ranking weight of say 10 to the least important attribute.
ii. Next he is asked to judge for the remaining attributes how much more important each is relative to the least one. This should be consistent with the rank order in step (i).
iii. The individual rank weights 'w_{ir}' determined from step (ii) are then normalised to obtain the actual attribute importance weights 'w_i' which goes into the additive MAU or MAV model. Since $\sum w_i = 1$, the actual weights are given by:

$$w_i = \frac{w_{ir}}{\sum w_{ir}}$$, where w_i and w_{ir} are as defined above.

As said earlier, the two methods discussed above rely on the idea of attribute importance. This notion has been criticised by some authors (Keeney and Raiffa, 1976), who prefer to consider the parameters w_1, w_2, etc. as rescaling parameters. Keeney and Raiffa consider the attribute weights as parameters that are required to match the various units of the individual single-attribute functions that make up the composite model.

3.12.2 Indifference methods for attribute weights in value functions

The two main techniques for determining attribute weights in Multiattribute Value (MAV) functions are cross-attribute strength of preference and cross-attribute indifference methods.

In the cross-attribute strength of preference method, the Decision maker is asked to determine attribute relative weights by systematically matching the strength of preference in one attribute to the strength of preference in another.

In the cross-attribute indifference method, the analyst systematically varies the attractiveness of two attributes at a time to establish indifference relations between all attribute pairs. These are then used to generate indifference equations that can then be solved for the attribute weights.

It is cognitively difficult and rather more subjective to implement the strength of preference procedures. Therefore the cross-attribute indifference method is discussed here as a check on the direct rating techniques. The procedure is summarised in the following steps:

i. The Decision maker is asked to rank the attributes $X_1, X_2, \ldots, X_i, X_j, \ldots, X_n$ in order of importance.

ii. Next the Decision maker is asked to consider two attributes say X_i and X_j at a time. Let x_i^M and x_j^M be the best levels of attributes X_i and X_j respectfully. Also let x_i^L and x_j^L be the worst levels of attribute X_i and X_j respectfully. From the theory, let us define $v_i\left(x_i^M\right) = v_j\left(x_j^M\right) = 1.0$ and $v_i\left(x_i^L\right) = v_j\left(x_j^L\right) = 0$. Assuming $w_j > w_i$, the decision maker is asked to find the level of X_j, say x_j', at which he is indifferent between these two alternatives: (x_i^L, x_j') and (x_i^M, x_j^L) with all other attributes at their worst levels. At this level of X_j, $V(x_i^L, x_j') = V(x_i^M, x_j^L)$.

iii. Using the additive model and the value of the end points already defined,

$$w_i v_i(x_i^L) + w_j v_j(x_j') = w_i v_i(x_i^M) + w_j v_j(x_j^L)$$

$$w_j v_j(x_j') = w_i \quad \Rightarrow \quad w_i - w_j v_j(x_j') = 0 \text{ or } \frac{w_i}{w_j} = v_j(x_j')$$

Since $v_j(x_j')_{max} = 1$, for the procedure to work, $w_j \geq w_i$, hence the importance of first ranking the attributes as given in step 1.

D. von Winterfeldt and Edwards (1986) suggested that all the relative attribute weights could be derived in terms of one attribute, the least important one, say w_n. Then for n attributes, (n-1) equations can be established of the form:

$$w_i = \frac{w_n}{v_i(x_i')}$$

For the additive model, these (n-1) equations together with the restriction that the sum of the weights, Σw_i, is equal to 1, are sufficient to solve for the actual weights. Consistency checks, however, will require that more than (n-1) equations, not all involving w_n, are created.

3.12.3 Indifference methods for attribute weights in utility functions

Methods for determining attribute weights in Multiattribute Utility (MAU) models are hybrids of the indifference methods just discussed. The difference here is that instead of creating relations between sure things, these methods rely on indifference relations between sure things and lotteries. The two main methods are the variable probability and the variable certainty equivalent methods. The variable probability method is discussed below as a check on the weights derived by the direct rating techniques.

The variable probability method can be summarised in the following steps:

i. First the Decision maker (DM) is asked to rank the attributes $X_1, X_2, \ldots, X_i, \ldots, X_n$ in order of importance.
ii. Then for all pairs of attributes, say X_i and X_j ($w_j > w_i$), the DM is asked to find the probability 'p' such that he is indifferent between receiving a sure thing and a lottery all involving different levels of X_i and X_j, with all other attributes at their worst levels.

Mathematically expressed, the decision maker is asked to determine the probability 'p_j', such that:

$$\left(x_i^M, x_j^L\right) \sim \quad \begin{cases} p_j & (x_i^L\ ,\ x_j^M) \\ (1\text{-}p_j) & (x_i^L\ ,\ x_i^L) \end{cases}$$

where, $x_i^M, x_i^L, x_j^M, x_j^L$ are as defined above and $u_i\left(x_i^M\right) = u_j\left(x_j^M\right) = 1$ and $u_i\left(x_i^L\right) = u_j\left(x_j^L\right) = 0$.

At the indifference point,. $u\left(x_i^M, x_j^L\right) = p_j u(x_i^L\ ,\ x_j^M) + (1\text{-}p_j)\ (x_i^L\ ,\ x_j^L)$.

Using the additive model and the defined utility of the end points,

$$u_i\left(x_i^M\right) = p_j u_j\left(x_j^M\right) \;\Rightarrow\; w_i = p_j w_j \;\Rightarrow\; w_j = \frac{w_i}{p_j}$$

Using the least important attribute, say w_n, as a standard on the left hand side of the indifference equation above, (n-1) indifference equations can be created for the remaining attributes in terms of w_n of the form:

$w_i = \dfrac{w_n}{p_i}$. These n-1 equations together with the restriction that for the additive model, the sum of the weights equals 1 are sufficient to solve for the individual weights.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

In chapter three (also refer to chapter one: section 1.5) it was stated that the fundamental data required to create decision models are decision objectives. This chapter presents the methods adopted and the procedures followed to obtain the relevant data for the creation of the building renewal model which this research is about.

The chapter begins by sketching the outline of the renewal decision model in terms of the value-focused thinking procedures described in the last chapter. The research task is then to:

- identify the data on which the model can be based;
- determine the sources from which these data can be obtained;
- determine the means through which the data can be collected;
- create the building renewal decision model from the data collected;
- demonstrate the use of the model by applying it to a hypothetical case study; and
- finally draw conclusions and make recommendations.

The tasks above constituted the research methodology. What is reported in this chapter is how each task was executed for this study.

4.2 Application of Value-focused Thinking to the Renewal Problem

In this study, the building renewal decision is represented by the generic model shown in figure 4.1. This is in accordance with the principles of value-focused thinking described in chapter three. The model shows a link between building requirements and renewal options via operational variables, all subject to internal and external factors.

The requirements, which translate into decision objectives may be associated with the motivations of the building owner, the functional requirements of existing or potential users and the values championed by non-users.

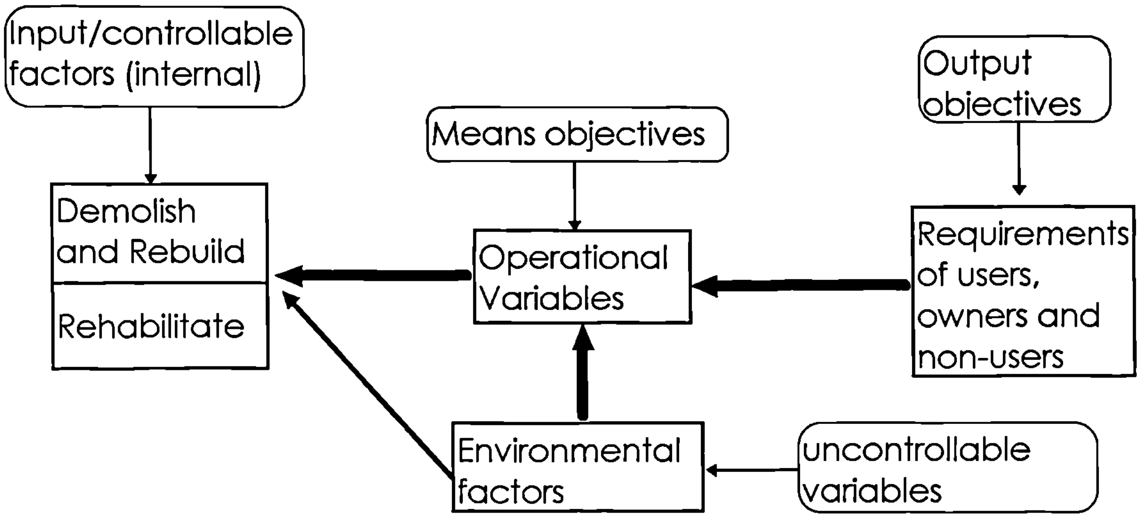


Figure 4.1: Generic building renewal model
Source: Adapted from Bodily, S E (1985)

A prerequisite for this model is to identify the value objectives linked to the requirements, the variables that indicate the achievement of these objectives and the factors (both internal and external) that affect the achievement of these objectives. This brings to mind the research questions generated in chapter one:

1. What are the value objectives of the main actors involved in building development?
2. What variables indicate the achievement of these objectives?
3. What external factors affect the achievement of these objectives, and
4. What is the appropriate aggregation rule for combining the levels of the objectives into a scalar quantity to reflect relative values?

For any building under consideration, it is envisaged that the initiator, or in this case, the decision maker knows the requirements he wants the building to satisfy based on the intended use. It is assumed that he would be able to identify viable options under both rehabilitation and redevelopment that would satisfy these requirements within the constraints of resources available and planning laws. In practice, it is possible that several options with different standards can satisfy the requirements. For the purposes of illustration, it is assumed that there is only one rehabilitation option and one redevelopment option. The model building exercise is summarised in the following steps:

1. List the requirements and hence the objectives which are of concern. These may be in relation to the motivation of the building owners, the requirements of potential and existing users and non-occupational interests.
2. Determine the variables or attributes: X_1, X_2, X_3, ..., X_n, which indicate the achievement of each requirement.
3. Choose or construct a scale for evaluating each attribute.
4. Considering the requirements of potential users and planners and the level of resources, state realistic maximum and minimum levels of these attributes (ie. the range). The maximum levels may be what can be achieved if there were no constraints.
5. Again, Taking the level of resources and the requirements of users and planners into consideration, state the preferred or enforced goal levels of these attributes which could be achieved with a new building. Cost the option chosen. If the total cost is found to be above the resources available, adjust the attribute levels untill a match is established between resources and goal attribute levels.
6. Determine the position of the existing building in relation to the maximum and minimum anchors of the attributes. Also compare the

existing building's attribute levels to the preferred goal levels, and finally,

7. Determine the improvements possible in the attribute levels for the existing building by paying attention to physical constraints imposed by the existing structure and configuration. Next check the resources required. If found to be above the resources available adjust the improved attribute levels till a match is established between resources and attribute levels.
8. Finally, compare the benefits of the rehabilitation option to the redevelopment option and make a decision.

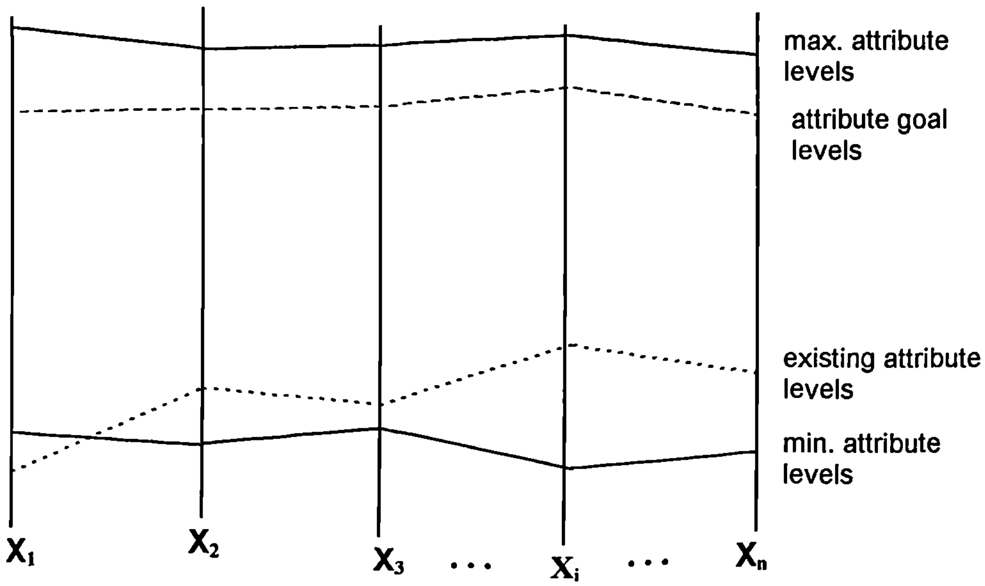


Figure 4.2: Existing Building attribute levels in relation to defined minimum and maximum anchors as well as goal attribute levels (for llustrative purposes).

The reason why the maximum attribute levels have been shown to be different from the goal levels is to allow for the possibility that some existing buildings would be superior to new build in some aspects. For instance an existing building may enjoy a higher plot ratio than permitted under current planning controls for new build.

The results of steps 1 to 7 can be graphically shown as in the attribute ordinate diagram shown in figure 4.2. It shows the relation of the attribute levels in the existing building to the minimum and maximum as well as to the goal levels.

Step 8 involves exploring the best means of achieving the goal attribute levels: whether through rehabilitation or new build. For the rehabilitation option, this means closing the gap between the existing attribute levels and the goal levels as shown in figure 4.2. For the new build option it will mean starting from a zero base to achieve the goal levels. For each option the activities required to reach the desired attribute levels are identified and costed.

Figure 4.3: Pay-off matrix of improved attribute levels.

Attributes	Decision Options	
	Rehabilitation (R)	**New Build (N)**
X_1	X_{1R}	X_{1N}
X_2	X_{2R}	X_{2N}
.	.	.
.	.	.
.	.	.
X_i	X_{iR}	X_{iN}
.	.	.
.	.	.
.	.	.
X_n	X_{nR}	X_{nN}

Where,

X_{iR} , X_{iN} - the improved level of attribute X_i for the rehabilitated and the new build options respectively.

The improved attribute levels and the cost for each option are entered into a pay-off matrix as shown in figure 4.3. After entering the improved attribute levels for each option into the pay-off matrix, if one option totally dominates the other, the problem is solved and that option is the optimum. A dominated option refers to an option that is at most equally desirable as its nearest rival over all attributes but inferior over at least one attribute.

If no single option totally dominates the others, then the next step is to construct single attribute value/utility functions for each attribute as described in chapter three. The utility or value corresponding to each attribute level is read off the relevant utility curve, for each option. After weighting each attribute, the overall value of each option is given by the additive rule as: $U(\mathbf{X}) = \sum w_i u_i(x_i)$. The decision criterion then would be to choose the option that maximises the utility or value of the decision maker.

4.3 Information Requirements

It can be seen from the sketch in the last section that the major inputs needed to complete the decision model are the value objectives and their attributes. The data collection stage of this research was therefore concerned with the generation of the building decision objectives and the critical variables that determine their achievement. To determine the information needs of the research, sub-questions were generated under each main research question followed by the identification of the sources of information to satisfy these questions. Presented below are the questions generated.

4.3.1 Main research question 1

<u>What are the value objectives of the main actors involved in building development?</u>

The sub-questions that the research sought to answer under this main research question were:

1. who constitute the main groups or interests impacted by building development?
2. what is the nature of the impacts of building development on these groups; is it beneficial or adverse?
3. what are the values of the impacted interests as far as buildings are concerned?
4. why are buildings renewed?
5. can the reasons and impacts identified in steps 1 to 3 be grouped under some generic objectives?
6. what is the relative importance of each generic objective in making building development decisions?
7. are there any differences between the impacted interests in terms of the objectives and the degree of emphasis placed on each?

4.3.2 Main research question 2

<u>What variables indicate the achievement of the objectives mentioned in main question 1?</u>

The questions answered under this main research question were:

1. what is meant by the objectives identified under main research question 1?
2. what aspects of the generic objectives are of concern?
3. how does one know that the objectives have been achieved?

4. what variables can be derived to evaluate achievement of the objectives?
5. how critical are these variables to the objectives?
6. what scale of measurement can be used to assess these variables?
7. what are the differences between the interest groups on the criticality of the variables identified?

4.3.3 Main research question 3

What external factors affect the achievement of the objectives?

The research questions generated under this main research question were:

1. through what process are the objectives achieved?
2. what are the internal and external constraints on the process of achieving the objectives?
3. what factors affect the stages of the process?
4. which of the factors are under the control of the building owner and which are outside?
5. are there any differences between the interest groups in the effect of these factors?

4.3.4 Main research question 4

What is the appropriate aggregation rule for combining the levels of the objectives into a scalar quantity to reflect the relative values?

The generic aggregation rule has already been covered in the last chapter and in the introduction to this chapter. The task that was left was the weighting of attributes and the construction of utility functions. This stage of the research process depends on the individual decision makers and the specific situations. The sub-questions that were investigated under this main research question were restricted to the structuring of the objectives and attributes uncoverd at the data collection stage. These sub-questions were:

1. which of the variables uncovered are means to an end and which are ends in themselves?
2. what is the relationship between each of the uncovered attributes and the objectives?; are they hierarchical or causal?

4.3.5 Sources of information

During the research, data were collected from two main sources to satisfy the information requirements defined by the research questions above. These were secondary and primary sources.

Secondary data refer to existing relevant data in the research area. They included data collected to satisfy the needs of some research other than this one which were relevant to the current research . The sources for the secondary data included textbooks, professional and trade journals, periodicals, newspapers and magazines as well as computer on line databases. These are adequately referenced throughout the thesis.

The primary research refers to the collection of first hand data to satisfy the information needs of the current research. It involved some kind of interaction with the subject population of the study which is described subsequently.

The rest of the chapter is devoted to describing the means of data collection and how they were analysed and used in the creation of the decision model.

4.4 The Research Design

The research process can be considered as the means of finding valid answers to the following questions (Weirs, 1988):

1. what problem or decision are we faced with?

2. how can this problem or decision be defined in terms of information already available and/or can be collected at reasonable cost?, and
3. what strategies and procedures can be employed to obtain the necessary information?

Without giving the impression that the exercise was tidy and orderly, the questions above were answered within the context of this research by the flow diagram shown in figure 4.2 below. It shows the main research stages and the activities carried out during each stage.

The research was carried out in four stages:

- the intial collection of background information;
- main data collection stage;
- model creation; and
- conclusions and recommendations.

Each earlier stage provided information for the next stage. The activities that were carried out in each stage are described first followed by the detailed presentation of the data collection procedures.

4.4.1 Initial collection of background information

The initial exercise of collecting background information enabled the building renewal problem to be defined and operationalised for research investigation. It also enabled the data needs to be identified. The result of this exercise is reported mainly in chapter one and to some extent expanded upon in chapters two and three.

The aim of the background study was to gain an insight into the problem and to capture the 'language' of the subject area. For this, general literature on built property and the property market were consulted. Some face to face interviews were also held with some few property and building professionals.

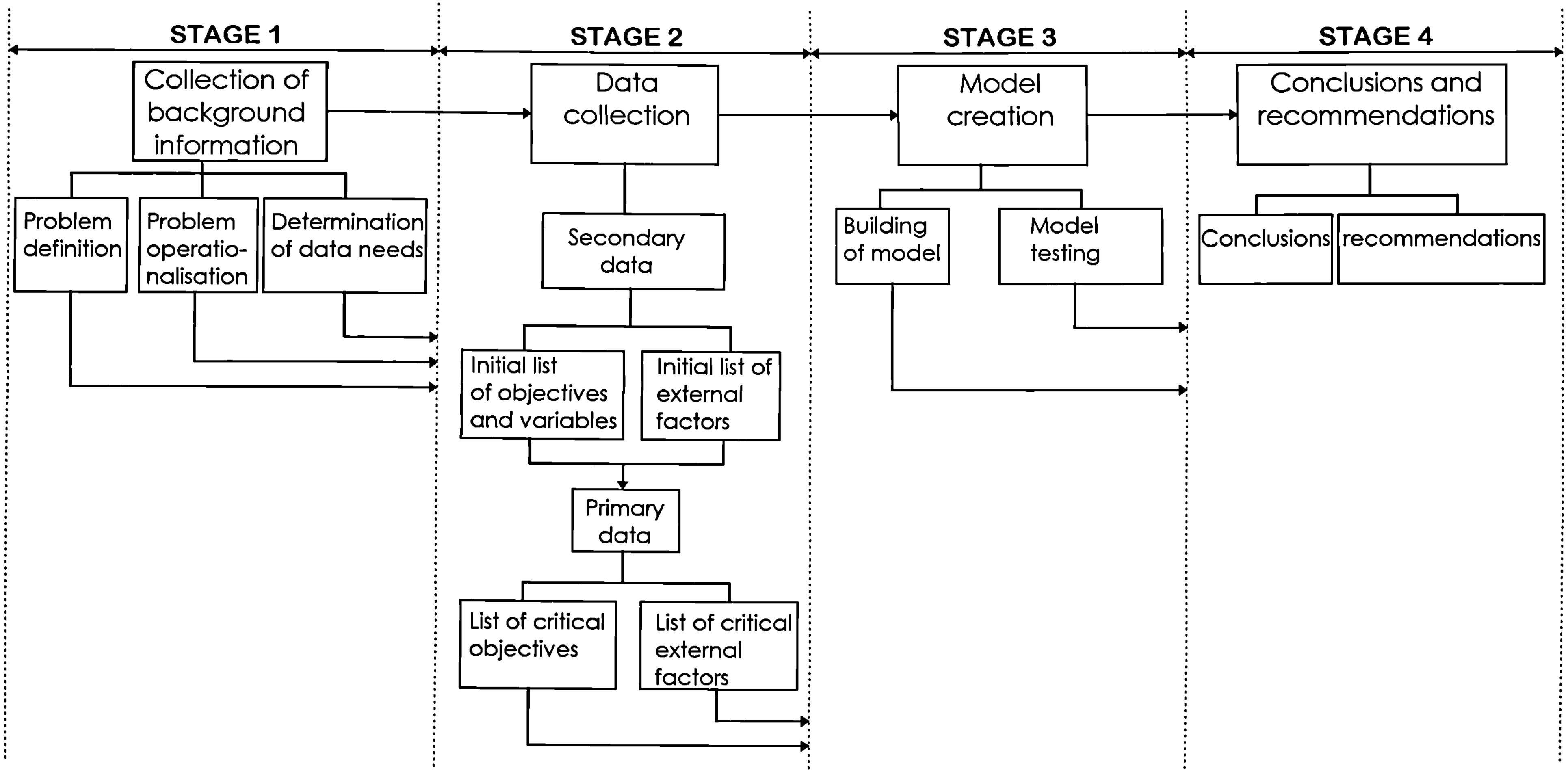


Figure 4.4: Flow chart of the research process

This exercise yielded information on the nature of the evaluation object: buildings and the main actors involved in building development. It also produced useful information on the nature of the environment in which buildings exist and in which the actors operate.

Some theoretical building renewal frameworks were reviewed as part of this exercise to determine any inadequacies which the proposed new model should cater for. Also, by studying generic decision models and the procedures for solving problems of the kind being researched, it was possible to operationalise this problem leading to the identification of the data needs.

4.4.2 Main data collection

The main aim of the data collection exercise was to satisfy the information needs identified in the last section. This means that the object of this stage of the research was to obtain a list of decision objectives for the building renewal model. A further aim was to produce a list of critical variables that indicate achievement of the objectives. Also determined were critical external factors that affect achievement of the objectives identified.

As mentioned previously, two main data collection methods were employed in obtaining the data to satisfy the research needs: secondary data search followed and augmented by collection of primary data.

The secondary data search was carried out to produce an initial list of objectives, variables and external factors of the nature described above. Effort was concentrated in the following areas to generate these data:

1. the objectives of building development, investment and occupation:- the main interests in property derive from development, investment and occupation. To generate the value objectives of the main actors

involved in the property industry and their indicating variables, the motivations of these actors (ie. developers, investors and occupiers) were studied. Further, factors outside the control of these actors, that affect the achievement of their objectives were noted.

2. the rehabilitation decision process:- the data search was focused on finding reasons why buildings are rehabilitated and what the inputs and outputs and the constraints on the process are. From these some objectives and their indicating variables were identified.

The secondary data search described above provided information on the objectives of building development, investment and occupation which were tested in the primary research. It also provided information on the indicators of these objectives and the external factors that affect their achievement.

The primary data collection was through mail questionnaire survey. The justification for this method is discussed subsequently in the chapter. The object of the primary survey was to:

- refine the list of objectives, indicators and external factors determined from the secondary search by finding out those critical to the building renewal decision.
- uncover additional indicators and factors.
- investigate any differences between the population sub-groups in either the criticality of the indicators and factors or in the degree of emphasis placed on the objectives in decision making.

The primary research yielded a list of critical variables and external factors which formed the bases of the renewal decision model. The external factors themselves did not go into the model. Rather they provided indications of the main sources of uncertainty and risk which ought to be addressed to achieve the performance desired.

4.4.3 Model building

After obtaining the list of the critical objectives and variables, the model building proper began. The first step taken was to structure these objectives and variables by exploring relationships based on factual knowledge. This involved establishing and examining the dependencies between related variables.

At the end of the structuring exercise, the final list of lower-level variables on which the model is to be based was obtained. The resulting model was then inspected to ensure that it performed as intended. These checks included the following:

1. checking the assumptions made in building the model for their logic;
2. checking the dependencies that were established between related variables for their effects;
3. checking the performance of the overall model by testing it on some hypothetical case study. This was done by applying the model to a case study built from actual cases that have been disguised.

4.4.4 Conclusions and recommendations

After building the model and testing it on a hypothetical case study, conclusions were drawn on the research findings. The conclusions mainly addressed the research findings in terms of the research objectives and the main research questions. Comments were then made on the research itself, any limitations and any effects these shortcomings might have had on the findings.

The usefulness and the potential of the new decision model was also commented on in the conclusions. Recommendations were then made on the application of the model and the type of database that needed to be established to aid the use of the model. Finally, further research work required to enhance the model was also suggested.

4.5 Secondary Data Search

One of the main reasons why the secondary data search was carried out before the primary data survey was that it afforded both time and cost economies. In other words it could be done relatively cheaply and quickly too.

As mentioned earlier, the sources for the secondary data were mainly from published material found in textbooks, conference proceedings and articles in journals, newspapers, periodicals and magazines.

The obvious starting point was the library. Extensive use was made of library resources to locate the relevant references for review. This started with the drawing up of keywords and phrases in the research area that were used to search library on line databases for possible references. Use was also made of the global computer network otherwise known as the Internet.

The list of references from the initial library search were assessed for their availability. The bibliographic references in the located references in turn yielded additional references to pursue. This process proceeded until there was only marginal benefit from further search for additional secondary data.

The keywords used in the data search included phrases such as: ***built property; building (re)development; building modernisation; building rehabilitation*** and ***building refurbishment***. Others keywords were ***built asset management; property (re)development; property management; building renewal; building conservation; building maintenance; property investment; economic life; investment value; real estate development*** and a lot lot more.

Despite the cost and time economies achieved with secondary data, there were certain drawbacks which did not make the data the sole source of information. The major drawback was that a number of the references located were not relevant to the problem being researched.

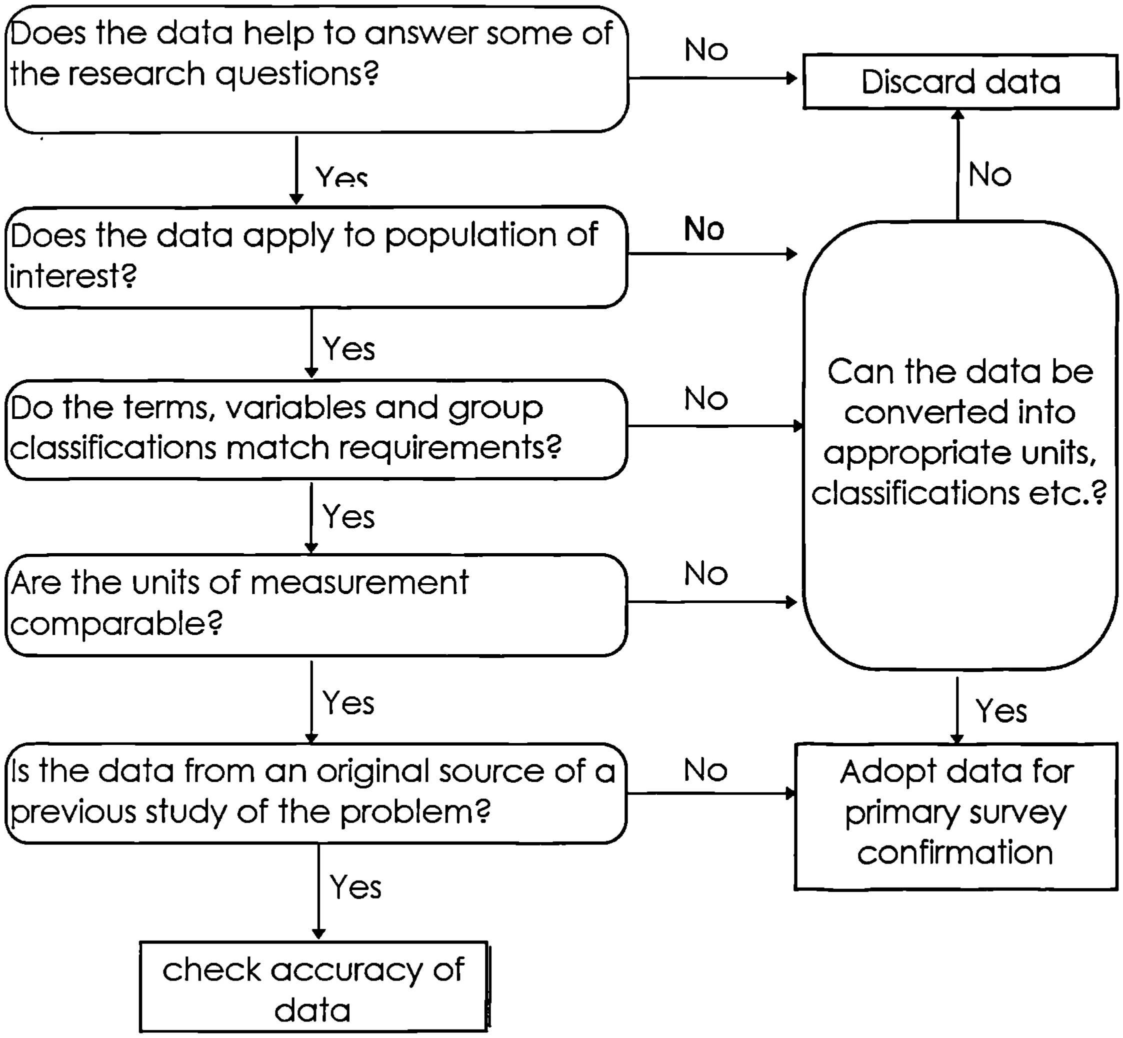


Figure 4.5: Framework used to assess the relevancy of the secondary data

Source: Adapted from Joselyn, R W (1977)

Because the secondary data was not collected specifically for this research, they could not satisfy fully all the data needs. As a result each located reference was assessed for its relevance to the problem at hand. The following questions were asked of every secondary data located (after Tull and Hawkins, 1990 & Zikmund, 1991):

1. how pertinent is the data?
2. is the subject matter consistent with the problem under investigation?
3. does it apply to the population of interest?
4. is the time period consistent with the needs of the current research?

5. does it appear in the correct units of measurement?, and
6. does it cover the subject of interest in adequate detail?

These questions were formalised into a vetting framework (after Joselyn, 1977) which was applied to each located reference. This framework is shown in figure 4.5.

4.6 Primary Data Survey

After the secondary data search, the collected data were assessed to determine what information was missing and what information needed to be confirmed. As expected the collected secondary data did not satisfy all the data requirements of the research. Primary data was therefore needed to meet some of the requirements of the study.

The procedures that were followed are described under the following sub-headings for ease of presentation:

- Data collection method
- Sampling
- Design of instrument of data collection, and
- Fieldwork

4.6.1 Primary Data collection method

There are two main means of obtaining primary data: by observing the population of interest or by communicating with them (Churchill, 1987). Observation involves the monitoring of the situations or subjects of interest and recording the relevant facts, actions, events or behaviours. The communication method however involves the securing of responses to questions presented to target subjects.

The main objective of this research was to discover the underlying values that guide the building renewal decision making process. These values were required for incorporation into a logical and consistent decision framework. The creation of the decision framework therefore required the identification of the performance objectives that decision makers want to achieve. Since this is a thought process, the only viable means of securing the required information was through communication with the target population. Hence a communication method by way of questionnaire survey was chosen for the collection of the primary data.

Survey methods themselves are classified according to the means of communication: mail surveys, face-to-face interviews and telephone interviews. Each method has strengths and also weaknesses. Refer to Table 4.1for some of these strengths and weaknesses (adapted from Zikmund, 1991; Czaja and Blair, 1996). The most appropriate method to use in any event depends on the circumstances of the research.

This was an academic research which had the seemingly conflicting objectives of wishing to collect data from a sample covering the whole of the UK but at minimum cost. Time to collect and analyse the data was not considered to be much of a determining factor in this situation because of the relatively long duration of the degree programme. Besides, the results were neither required to solve an immediate management problem nor would they have become outdated in the time it would take to present the findings.

Using the criteria of minimum cost and wider geographical coverage in a situation where speed of data collection was not a major factor, the most appropriate survey method was mail survey (see Table 4.1).

Table 4.1 shows that mail surveys have certain weaknesses which must be minimised to improve the quality of the research. For instance:

- there is no control over who fills out the questionnaire. An ineligble subject could therefore complete the questionnaire.
- since respondents can read the entire questionnaire before deciding to answer, they could decide not to respond at all if they find that the time and effort required of them are too much.

Table 4.1: Strengths and Weaknesses of the Basic Survey Methods

Criteria	Mail Survey	Telephone Survey	Face-to-face Interview
1. Speed of data collection	no control over return or questionnaire; can be slow	very fast	moderate to fast
2. Cost	lowest	low to moderate	highest
3. Geographical coverage	may be wide	may be wide	limited to moderate
4. Versatility of questioning	highly standardised	moderate	quite versatile
5. Questionnaire length	short to medium	medium to long	can be long
6. Respondent co-operation	moderate	good	excellent
7. Item non-response	high	medium	low
8. Interviewer bias	none	moderate	high
9. Anonymity of respondent	high	moderate	low
10.Possibility of respondent misunderstanding questions	high	average	lowest
11.Use of visual aids	good	usually not possible	very good
12.Quality of recorded responses	fair to good	very good	very good

Source: Adapted from Zikmund (1991) and Czaja & Blair (1996)

- since there is no interviewer present to probe for more information or clarification, the quality of responses could be poor.
- there is no control over when the questionnaires are completed and returned.
- there is usually no way of knowing if subjects have either changed addresses or moved away. Thus research resources could be wasted on subjects who cannot be contacted.

Notwithstanding these drawbacks, mail survey was chosen. Precautions were, however, taken in the data collection and the subsequent analysis to minimise the effects of these drawbacks.

4.6.2 Sampling

The next step considered after choosing the data collection method was the selection of subjects for the study: the sampling process. The sampling exercise that was carried out considered the issues of:

- defining the population of interest;
- the availability of sources where elements of the population are listed (the sampling frame);
- the size of the sample; and
- the means by which the sample is selected.

From the research objectives, the intended subjects of the study were property owners, users and non-users. To be able to find a sampling frame which lists property owners, users and non-users the population specification was defined further. The population was redefined as individuals whose job responsibilities involve making decisions on property development and investment. The justification for this population was that these are the people who sanction and influence what is built and where. They also do interact with occupiers, financiers, planners and local communities. It was felt that for a successful property development or investment they must be aware of the issues that concern their clients who are the primary population of interest. Thus property development and investment decision makers were used as 'surrogate' owners, users and non-users in the search for the research data.

To locate the individuals specified above, property development and investment companies in the UK were targeted. The formal population specification for the study was therefore restated as: decision makers located in UK development and investment companies.

One of the major problems encountered in this study was how to find a suitable sampling frame that listed property developers and investors After much searching and writing to a number of organisations, the *UK Directory of Property Developers, Investors and Financiers,* (Building Economics Bureau, 1994), 7th edition, was chosen as the best frame to select the survey sample from. This directory contains listings of UK property development and investment companies, pension funds, building societies, banks, finance houses, insurance companies and property unit trusts all in different and distinct sections. After adjusting for multiple listings, the property development and investment section of the directory contained 1, 962 elements.

The directory was published in 1994 and at the time of the survey in June, 1996, it was two years old. Calls to the publishers could not elicit any responses as to the currency and hence the reliability of the listings contained in it. A 'crude' method was employed to assess the currency of the information using a small random sample of 30 companies from the directory. This was done by calling BT (British Telecom) directory inquiries for phone numbers of these companies. Any company which was not listed in the BT directory was judged to be potentially not contactable. By this crude method, it was estimated that about 55% of the listed companies were potential non-contacts. This was allowed for in the determination of the sample size.

There was concern about the potential high level of non-contacts. It was therefore decided to use a back up sampling frame from a different and independent source. A supplementary frame was therefore constructed from the listings of property development and investment companies in the April, May and June, 1996 *Directory* supplements to the *Estates Gazette*. The currency of this information was not in doubt. After adjusting for multiple listings and for those already listed in the main sampling frame, the constructed frame contained 235 elements.

The aim of the study was to be able to generalise the findings beyond the sample to the population of interest. Consistent with this, simple probability sampling techniques, where each element had an equal chance of selection, was therefore adopted. Based on cost and the fact that non-contacts would have to be allowed for, a total number of 100 completed questionnaires was deemed to be adequate for the analysis required.

It was arbitrarily decided to have a 2:1 ratio between the number of completed questionnaires from the main and supplementary frames. This worked out to be 67 completed questionnaires for the main frame and 33 from the supplementary frame. Assuming a 50% response rate and allowing for the 55% potential non-contacts, 300 elements were selected from the main frame. In the same way, allowing for a 50 % response rate, 66 elements were required from the supplementary frame. In fact, as will be explained later, 104 elements were eventually selected from the supplementary frame. This resulted in unequal probabilities of selection from the two sample frames. This was corrected for by weighting the categorical responses from the two samples in the data analysis. This is explained later.

For the element selection, all the elements in each sample frame were numbered sequentially. Then using the "***RAND*()***" command in Microsoft Excel, which generates random numbers (Microsoft Corporation, 1994), 300 random numbers were generated for the primary frame and 104 for the supplementary frame. The companies whose numbers matched these random numbers in each case were selected to form the elements of the survey samples.

4.6.3 Questionnaire design

As mentioned earlier, the primary data required to satisfy the information needs of this research was collected by means of a questionnaire. A good questionnaire must be able to (Czaja and Blair, 1996):

1. validly measure the factors of interest;
2. induce respondents to cooperate with the study; and
3. elicit acceptably accurate information from respondents.

In designing the questionnaire for this study, consideration was given to these criteria. From the literature, there is no one set of formal guidelines to follow in the design of questionnaires. The steps followed, which were not sequential as shown, are presented in the following order for ease of discussion (after Tull and Hawkins, 1990):

- the question content of the questionnaire;
- question framing;
- the response format;
- the question sequence;
- the questionnaire layout; and
- pretesting and revision.

4.6.3.1 Question Content

The questions in the questionnaire were intended to satisfy three basic conditions:

1. they were to ensure that the data was collected from the intended subjects: decision makers in private UK property development and investment companies. The questionnaire therefore contained three screening questions (refer Appendix A) which enabled the eligibility of the respondents to be determined. There was also a single screening question to ensure that the companies surveyed were from the private sector.
2. they were to ensure that the information collected was sufficient and did satisfy fully the information needs of each main research question. The questions asked therefore matched the sub-questions generated under each main research question.
3. they were to ensure that any possible variation of the measured factors with the population sub-groups were investigated. To achieve this objective, the questionnaire contained questions that enabled the responses to be classified according to the survey population sub-groups, in this case, property developers and investors.

4.6.3.2 Framing of questions

The determination of the desired question content was followed by the consideration of how to translate them into word expressions to elicit the intended responses. Czaja and Blair (1996) describe the process survey respondents go through to respond to questions as:

- the initial reading of the question;
- the attempt to understand and interpret the question;
- depending on the nature of the question, recalling of past information or the formation of a judgement; and

- finally, the provision of a response consistent with the recollection or the judgement made.

Each questionnaire item was framed to make each stage of the process described above as easy as possible. This was not only that accurate responses to the questions would be obtained, but more importantly, to induce respondents to complete the questionnaire.

Simple words were used in framing the questions to avoid ambiguity and unclear questions. This was to minimise the risk of misinterpretation of questionnaire items and also to make the task of respondents less difficult. Whilst ensuring that bias was not introduced, careful hints were given on the questionnaire to guide repondents. Also, where from the secondary data, some data have been established as near fact, they were introduced into the questionnaire as statements rather than as questions. For instance, it was established in the secondary data search that generic building performance objectives could be classified as economic, functional, physical/ structural and environmental. Rather than ask for confirmation, these were adopted and respondents were asked to confirm the variables which indicated their achievement.

4.6.3.3 Response format

The next issue that was considered, after framing the questions, was the form of the responses to the questions. For each questionnaire item, this depended on the question and the amount of information already available from the secondary data search. Careful consideration was given to the fact that the questionnaires were to be self-administered in deciding the response format.

The aim of the primary data survey was partially given as confirmation of the factors identified in the secondary data search and the uncovering of additional factors that were not found in the secondary data search. These circumstances meant a highly structured questionnaire consisting of mostly closed-ended questions. This was however balanced by making provisions for respondents to add more information in an open-ended format.

4.6.3.4 Question sequence

The next essential issue considered was the sequence of the questions in the questionnaire. The prime objective of the question sequence was the securing of maximum cooperation from respondents. Another objective was to avoid biasing later responses by questions that had been asked earlier. This required a logical flow to the request for information. The following guidelines were therefore adopted (after Churchill, 1987):

- the questionnaire opened with simple questions about job titles, job responsibilities and decision capacities of respondents.
- questions about one topic were completed before moving on to the next.
- questions about company ownership: whether in the private or public sector were asked last. This was to ensure that should a respondent refuse to disclose information on the ownership of his/her company, the responses provided to the earlier questions would still be available.

4.6.3.5 Questionnaire layout.

The final issue that was addressed was how the questions were to be laid out in the questionnaire. To minimise confusion, each of the different topics in the questionnaire were clearly demarcated into distinct sections. Each section was preceded by a brief commentary on the frame of reference and the general purpose of the questions in that section. Instructions were also given where it was considered necessary.

Attention was given to such physical characteristics of the questionnaire as line and character spacing. Adequate space was provided between lines, multiple-choice tick boxes and the different sections to prevent the eye from tiring (see questionnaire in Appendix A). Adequate space was also provided for responses to the open-ended questions.

Finally, within the limited budget of an academic research, the questionnaires were printed on good quality paper with laser quality printing. The cover to the questionnaires stated boldly the title of the survey and had a graphical symbol of a collection of buildings. This was to give the impression of a professional looking document to increase respondent interest.

4.6.3.6 Pretest and Revision

The questionnaire design was carried out on the basis that respondents would understand the questions and know what was required of them. Pretesting of the questionnaire therefore became essential to test the validity of the assumptions made on how respondents would understand and answer the questions. Pretesting was also critical to determining whether the questionnaire would collect all the data required to satisfy the research objectives.

The pretest exercise was carried out in two stages. The first stage used a sample of Architect colleagues to check respondents' comprehension of the questions. The second stage was carried out on a small sample of individuals who were considered to be similar to the target population.

To sum up, the pretesting was carried out to check:

- whether the 'language' of the research area had been captured properly;
- if the questionnaire was capable of collecting the required data to satisfy the research objectives;
- the difficulty respondents would face in answering the questions; and
- if there were other responses that had been omitted for the multiple-choice questions in the initial draft.

The pretesting was very useful and it led to some useful changes in the number of questions, the wording of some of the questions and the sequence of questions. Refer to Appendix A for the final draft of the questionnaire which went out to respondents.

4.6.4 Fieldwork

The questionnaires were sent by mail, with covering letters, to the sampled companies. The companies were requested in turn to return the completed questionnaires by post.

The cover letter was written to induce maximum cooperation. It stated the institution conducting the survey, the purpose of the survey, and who should complete the questionnaire. Perhaps most importantly, the cover letter also contained an assurance of confidentiality should any of the companies find some of the information sought to be either sensitive or confidential. As a further bid to maximise return of the questionnaires, a self-addressed envelope was enclosed with each questionnaire posted.

To be able to monitor the progress of the survey, each sample element was given a unique number. These numbers were then used to mark the corresponding questionnaires before mailing. A spreadsheet table was created to monitor the progress of returns. The table had columns fields for "*respondent number*", "*company name*", "*date questionnaire posted*", "*date questionnaire returned*", "*date of follow-up*" and the "*date questionnaire returned after follow-up*". It also had a "*comments*" column which commented on whether a particular survey was successful, a non-contact, a refusal or a non-response.

The first batch of questionnaires was mailed by first class post to the elements of the primary sample only. It was decided to use the supplementary sample only when the reponse rate for the primary sample is poor.

A period of six weeks was allowed for the return of the completed questionnaires. By the end of this period, the returns had already tailed off and stopped completely. The total number of questionnaires returned then was 53. Of these, 15 had been returned by the Post Office as "addressee unknown".

A follow up of the unreturned questionnaires from the primary sample was undertaken to increase response. Due to the high number of non-contacts, it was decided to carry out this exercise on only those companies whose existence or contact address could be confirmed. This was to avoid wasting resources on companies who could not be contacted. The confirmation was carried out by scanning through property journals including the *Estates Gazzette* and the *Property Week* to see if any of these companies had been referred to in either articles or adverts. The internet was also used in this exercise. Through this exercise, 30 companies were confirmed as being existent, some of them with changed addresses.

In the follow up, copies of the questionnaire were sent again together with a second covering letter. The second covering letter mentioned how important the particular company's involvement and the return of the questionnaire were to reaching valid conclusions. The follow up yielded 6 additional responses. After four weeks, when no more questionnaires were being returned, the primary survey was terminated.

Due to the low response from the primary sample, it was decided to send out questionnaires to elements of the supplementary sample. Instead of the initial projected 66 questionnaires, 104 were eventually sent out due to the poor response to the primary survey. After another four weeks, the secondary survey yielded 25 responses. No follow up was carried out and the decision was made to terminate the survey.

4.7 Data Reduction and Analyses

The final stage in the data collection process was to analyse and interpret the data collected. The data analysis involved the reduction and presentation of the collected data into a format that permitted meaningful conclusions to be drawn with respect to the objectives of the research.

The data reduction for this study consisted of the initial 'sanitisation' of the collected data followed by the creation of tables and graphical representations. The subsequent data analysis involved the calculation of sample statistics followed by estimation of population parameters. The analysis ended with the hypothesis testing of the differences between survey sub-groups (ie. developers and investors).

The steps followed are described under the following headings:

- Validation and editing of questionnaires;
- Coding and data entry;
- Tabulation and graphical representation of data;
- Calculation of descriptive statistics; and
- Estimation and hypothesis testing.

4.7.1 Validation and editing of questionnaires

Each completed questionnaire was validated and edited before the data was entered into the analysis. The validation and editing exercise included the checking of the eligibility of both the companies and the respondents as well as the completeness of the questionnaires.

The first eligibility check was to determine if the respondents' companies belonged to the population of interest according to the population definiton. The target population in this case was private UK development and investment companies. The second eligibility check was of the respondents themselves: whether they are decision makers or not.

Next, the completeness of each questionnaire was inspected to see if any question items had been left unanswered or had been answered incorrectly. The only problem detected was limited to the question on objective importance weights (refer Appendix A: Q. 8 of questionnaire). In this question, respondents were asked to share 100 points over the generic performance objectives to reflect their relative importance in decision making. They were to do this with the most important objective receiving the greatest share and following on in descending order.

There were two respondents who did not supply these weights at all with the explanation that they considered all of the performance objectives important and could not sensibly rank them. For these questionnaires, the 100 points were shared equally over the four objectives in the analysis.

One other exercise carried out was to check the internal consistency of the responses. Here again the problem was limited to questionnaire item 8 on importance weights. Two types of errors were detected in the sharing of the 100 points among the objectives. These were:

1. the sum of the scores was either less or more than 100, and
2. respondents ranked the objectives rather than shared the 100 points among them to reflect these rankings.

There were 7 questionnaires where the sum of the objective weights was less than 100. For these questionnaires, the weights were adjusted upwards whilst maintaining the same weight ratios among the objectives as originally intended by the respondents concerned. There was a single questionnaire where the sum of the weights was more than 100. In a similar manner, the weights were adjusted downwards, whilst maintaining the original ratios between the objectives.

In two questionnaires, the 100 points were not shared at all. Rather the objectives were ranked in order of importance (ie. 1, 2, 3, 4 in decreasing importance). For these, the objective weights were derived by sharing the 100 points according to the ratios of the reciprocal of the ranks.

4.7.2 Data coding and entry

The next step was to reduce the 'sanitised' data for analyses. The first step was to code the responses before entering them into coding tables. The coding exercise started by establishing codes for the range of responses for each questionnaire item. For each question, the response categories were represented by alphabetical letters. Alphabetical codes were used to allow data counting by Microsoft Excel version 5.0 spreadsheet package. For the objective weights however, the actual weights were entered without any coding.

The questionnaire was highly structured where most of the response categories had already been established during the questionnaire design stage. The only remaining task was to specify the codes for the response categories.

It can be seen that the questionnaire (Appendix A) did contain some open-ended questions which required respondents to supply responses in their own words. For these questions, the response categories were established after the return of the completed questionnaires. For each of these questions, the coding categories were only established after the consideration of the range of responses. Refer to the coding notes in Appendix B for the codes used.

The coding exercise was followed by the entry of the codes into basic data arrays for all the questions for all respondents (Appendix B). Due to the large number of variables and the fact that two survey samples were used, there were separate data arrays for each performance objective as well as for the external factors, for each sample. The primary sample is labelled A whilst the supplementary sample is labelled B.

4.7.3 Tabulation and graphical presentation of data

The construction of the basic data arrays mentioned above was the first step in data tabulation. The coded tables were however too raw to permit any meaningful conclusions to be drawn with respect to the research objectives. Further data reduction was therefore required to make the findings meaningful. These refinements were in the form of cross tabulations and graphs.

The data collected through the questionnaire were of three types:

1. data on the characteristics of respondents including sub-groups, job titles, job responsibilities and decision making capacities. These were measured on a nominal scale.
2. data on respondents' responses for presented variables and factors. These were measured on a categorical scale, and
3. data on the importance weights of the generic building performance objectives. These were measured on a ratio scale.

Each of these different types of data was treated differently in the tabulation and graphing which followed.

The nominal data on the respondent characteristics were converted into frequency tables showing the number of occurrences. These were also augmented with graphical representations, details of which are given in chapter seven.

For the categorical data on respondents' responses, the first step was to construct, for each indicating variable, frequency tables for the response categories. The frequency tables were constructed for each population sub-group for each survey sample. The individual frequency tables were then converted into percentage relative frequency tables. Refer to Appendices C and E for the relative frequency tables for the generic performance objectives and the external factors that could affect the objectives.

Since the survey used two samples, the individual relative frequency tables for each sample were combined into single relative frequency tables for each sub-group. To obtain the combined entries, Sample A frequencies were weighted up whilst Sample B frequencies were weighted down. This is due to the unequal probability of selection of the sample elements. The weights used were proportional to the inverse of the probablity of selection of each sample's elements. For each reponse category and for each variable, the combined relative frequency was therefore given by:

$f_{icombined} = [p_B f_{Ai} + p_A f_{Bi}] / [p_A + p_B]$, where,

$p_B =$ probability of selection of Sample B elements; (104/235).

$p_A =$ probability of selection of Sample A elements; (300/1962).

$f_{Ai} =$ relative frequency for variable i in sample A.

$f_{Bi} =$ relative frequency for variable i in sample B.

The combined relative frequency tables were further augmented with horizontal stack bar charts showing frequencies for each response category for each variable. For data on external factors (questionnaire item 9) however, the horizontal bar charts only show the proportion of each sub-group who thought presented factors could affect property performance.

The only ratio data were the relative importance weights of the generic performance objectives. The raw weights for each objective were listed in the coding tables for all respondents from the two samples. From the raw weight tables, frequency tables were constructed giving the number of weight occurrences within defined weight classes were. To be able to better visualise and describe the distributions, histograms were also constructed from the frequencies (see chapter seven).

4.7.4 Descriptive statistics

To make the collected data even more meaningful for some of the data types, descriptive sample statistics were calculated for each sub-group and sample. The type of statistic calculated however depended on the nature of the data: whether nominal, categorical or ratio.

The nominal data collected on respondent characteristics needed no further analysis beyond the frequency tabulation described in the last sub-section.

Further analysis was carried out on the categorical data on the response distributions for the performance indicating variables. This was to convert them into ordinal data using the relative frequencies for each variable for each response category. A major aim of the research was to isolate variables critical to the assessment of the identified generic property performances. These critical variables were determined by converting the relative frequencies for each response category into a composite index for each variable. This index, referred to as a criticality index (CRI) in this thesis, was calculated using rules defined in chapter seven. The CRI score for each variable reflected how important or critical that variable was to assessing the achievement of the generic property performance objectives. By defining a cut-off CRI score, the indicating variables for each performance objective were categorised into primary and secondary indicating variables. The primary variables for each objective went into the decision model.

No further analysis was carried out on the data collected on the external factors that affect property performance. The relative frequencies calculated were used to assess how important those factors were among decision makers from the two survey population sub-groups. The importance of each external factor was in terms of the percentage of respondents who thought each particular factor could affect property performance.

The bulk of the descriptive sample statistics calculated was on the ratio data collected on the relative importance of the generic performance objectives in terms of importance weights. The descriptive statistics calculated included measures of central tendency (ie. means, modes and medians) and measures of dispersion such as the range, variance and standard deviations. These were calculated for each sub-group on data pooled from the two survey samples. An apparent advantage of this is that pooling data from more than one independent sample of the of the same population increases precision by decreasing the dispersion of the data (Rice, 1995: p.216).

4.7.5 Estimation and Hypothesis Testing

The only estimation exercise involved the projection of the sample mean objective importance weights to cover the entire population. For each generic performance objective, the standard deviation of the weights and the sample size of each sub-group were used to calculate the standard error of the mean. By specifying a confidence level (95% in this case), confidence intervals were established where population mean weights were likely to be located.

Hypothesis testing was carried out to determine if detected differences between the population sub-groups were significant or not. Two types of hypothesis testing were carried out. The first was on the distribution of responses for the performance indicating variables among developers and investors. For each variable, a chi-square test was carried out on the distribution of responses (in terms of relative frequencies) for each sub-group. Refer to details in Appendix C.

Differences between developers and investors were also tested over the variances of the importance weight distribution for each objective. Possible differences in the variances were tested by F-tests before testing for differences between the mean weights. Mean weight differences were tested by t-tests due to the small size of the samples involved. All tests were carried out to 95% confidence level. Details of the F-tests and t-tests are given in Appendix D.

CHAPTER FIVE

OBJECTIVES OF PROPERTY DEVELOPMENT, OCCUPATION AND INVESTMENT

5.1 General

Property development is the result of the interaction between several actors and agents from the public and private sectors of the economy. This chapter begins the search of secondary data sources for the value objectives of private sector actors and public sector agents who act to regulate property development.

According to Roulac's 'Real Estate Body of Knowledge Framework', the participants involved in real estate markets include (Roulac, 1995):

- space users who occupy space for personal and business purposes;
- investors who commit capital to a multiplicity of real estate interests and financial positions;
- development team who are involved in creating new properties;
- services who provide professional advice and services to the other participants; and
- public interest which include government agencies, other non-profit organisations and high level concerns not necessarily represented by formal organisations.

The value objectives of these participants can be different and at times be in conflict. The aim of the proposed model to aid the rehabilitation versus redevelopment decision is to incorporate the multiple objectives of these participants. These objectives are identified by examining the literature on commercial property market in general without limiting it to rehabilitation and redevelopment. In the next chapter, the objectives uncovered in this way are then examined in the context of resolving the building renewal decision problem. What finally emerges shall become the bases of the building renewal decision model.

Before discussing the value objectives of the individual actors, the influence of the private and public sectors on property development is examined briefly.

5.2 Public and Private Sector Influence on Property Development

The influences on property development are derived from the two main sectors of the economy: the private and the public sectors. They each operate through different mechanisms with different motivations. Despite these, the public and private sectors are all locked together in a single framework that determines what is built, when and where (Adams, 1994).

The public sector used in connection with property development refers to local and central governments. It also refers to all agencies and bodies who act on their behalf in matters relating to Town and Country Planning as well as building control.

The public sector probably occupies a unique position in terms of the influence that it exerts on property development. It can assume the roles of property developer as well as facilitator and regulator of property development. It owes this unique position to the political powers vested in it by the voting public. This therefore makes them accountable to the electorate at both local and national levels. As a consequence of this, it wants to demonstrate openness and value for money in most of its dealings. It also has regard for the effects of developments on the welfare of the community that it serves (Cadman and Austin-Crowe, 1978).

The influence that the private sector exerts on property development comes from the desire to maximise direct or indirect financial gain by acting in one or more of the capacities mentioned in 5.1 above. The private sector is therefore considered to be largely responsible for changes in building styles and the built environment. This 'zeal' is however checked by the public sector in its capacity as regulator of development in particular and the economy in general.

Private sector involvement in property development is mainly to realise financial gains. The financial gain may be as a result of:

- carrying out development where the gain may come from the so called developer's profit. This is the difference between the total cost of development and the sale price or capitalised value of the completed property.
- acquiring and disposing of property (investment) where the gain may come from the stream of rental income over the period the property is held and/or from appreciation of the value of the property on disposal.
- financing property development where the gain may be in the form of interest and fees charged on loans.
- carrying out economic activities in buildings where the financial gain can also be indirect through the profits generated from the activities carried out in the property.

In line with the roles cited above, the main actors who influence private sector property development are owners, financiers and occupiers.

The owners category include developers and investors (Cadman and Austin-Crowe, 1978). Other types of ownership interest are dealers, who do not undertake developments but profit from acquisition and disposal of properties and owner-occupiers, who, as the name implies, own the properties they occupy.

According to Adams (1994), apart from the owner-occupier, there are no strict differences between developers, investors and dealers in terms of their basic objectives: making profit. He reckoned that they represent different levels of maturity in the holding of property as an investment asset. Thus a property company may start business as a dealer, maturing into a developer and eventually as an investor. This view is also shared by Cadman and Topping (1995).

For the purposes of the current research, however, strict differences are maintained between developers and investors. This is because their objectives are very much influenced by whether their outlook is long or short term. Those at the lower end of the maturity spectrum tend to have short-term view of receipts whilst those at the higher end tend to have long-term view. The value objectives of developers, investors and occupiers, which must coincide to determine when and what to build, are discussed from here on. The objectives of financiers and the public sector are also discussed for they have great influence over the main actors in deciding what is built as well as when and where to build.

5.3 Value Objectives of the Private Property Developer

Private sector property development is driven by the need to satisfy the actual, implied and anticipated needs of occupiers. The developer is the entrepreneur who :

- spots these opportunities;
- conceives the plan to develop;
- implement it; and
- finally,disposes of the completed product to the eventual owner or user.

At the lowest end, a developer may be a one-man band or at the highest-end, a national or multi-national company quoted on the stock exchange (Cadman and Topping, 1995).

The developer at times carries out development for a named user but also where it is anticipated that demand for a particular type of property at a particular location is going to pick up, he may carry out a speculative development. Speculative development is probably what Harvey (1987: p.75) associated with the developer when he defined the commercial developer as:

'an entrepreneur who provides the organisation and capital required to make buildings available in anticipation of the requirements of the market in return for profit'

Speculative and novel schemes could be riskier than conventional schemes for which there is a known user (Guy, 1994: p.38). In the UK the recession of the late 1980s and the early 1990s put many property companies out of business and has made speculative developments rather unpopular. The demise of the Olympia and York Company on the Canary Wharf development in London's Docklands is a classic example which is widely cited in recent property literature (Guy, 1994; Cadman and Topping, 1995; Ashworth, 1996).

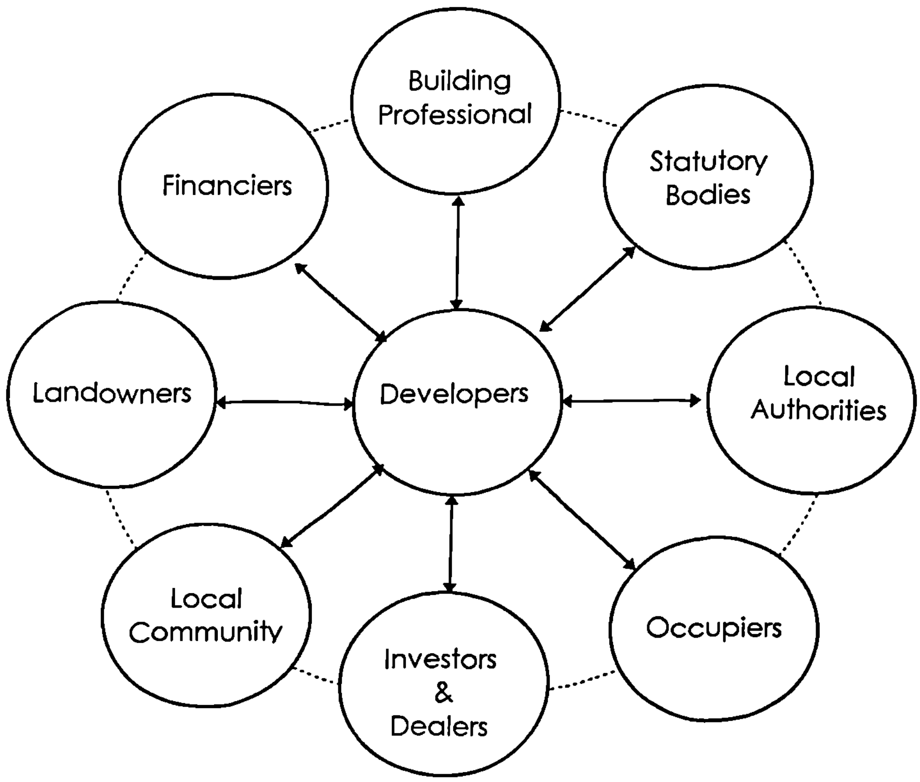


Figure 5.1: The coordinating role of the developer

The role the developer plays is essentially that of coordinating the activities of, and resolving conflicts between, different actors and agents involved in the development process (Roddewig, 1993). These actors and agents include architects, engineers, financiers, planners, regulators and occupiers, to mention a few. The developer thus acts as the pivot around which all the other actors revolve (figure 5.1).

The fundamental functions of the developer are (Krugman & Furlong, 1993; Harvey, 1987):

- identifying land with or without buildings;
- exploring its suitability for development;
- obtaining approvals from the relevant authorities for the proposed development;
- arranging finance for the development from his own and/or other sources; and
- procuring the building and disposing of the completed development through either sale or leasing.

It can be seen from the functions above that the developer assumes the risks of the development process. In return for assuming these risks he hopes to make profit. The prime value objective of the developer in undertaking development is therefore to maximise profit. Development profit is driven by the relationship between capital values of completed developments and development costs. Capital values derive from the investment market whilst development costs depend on the conditions of the wider economy (Frazer, 1996). To maximise profit, therefore, the developer aims to maximise capital values whilst at the same time minimising development costs. The range of actions that may be taken to achieve each objective and the contributing factors are summarised in figure 5.2 below.

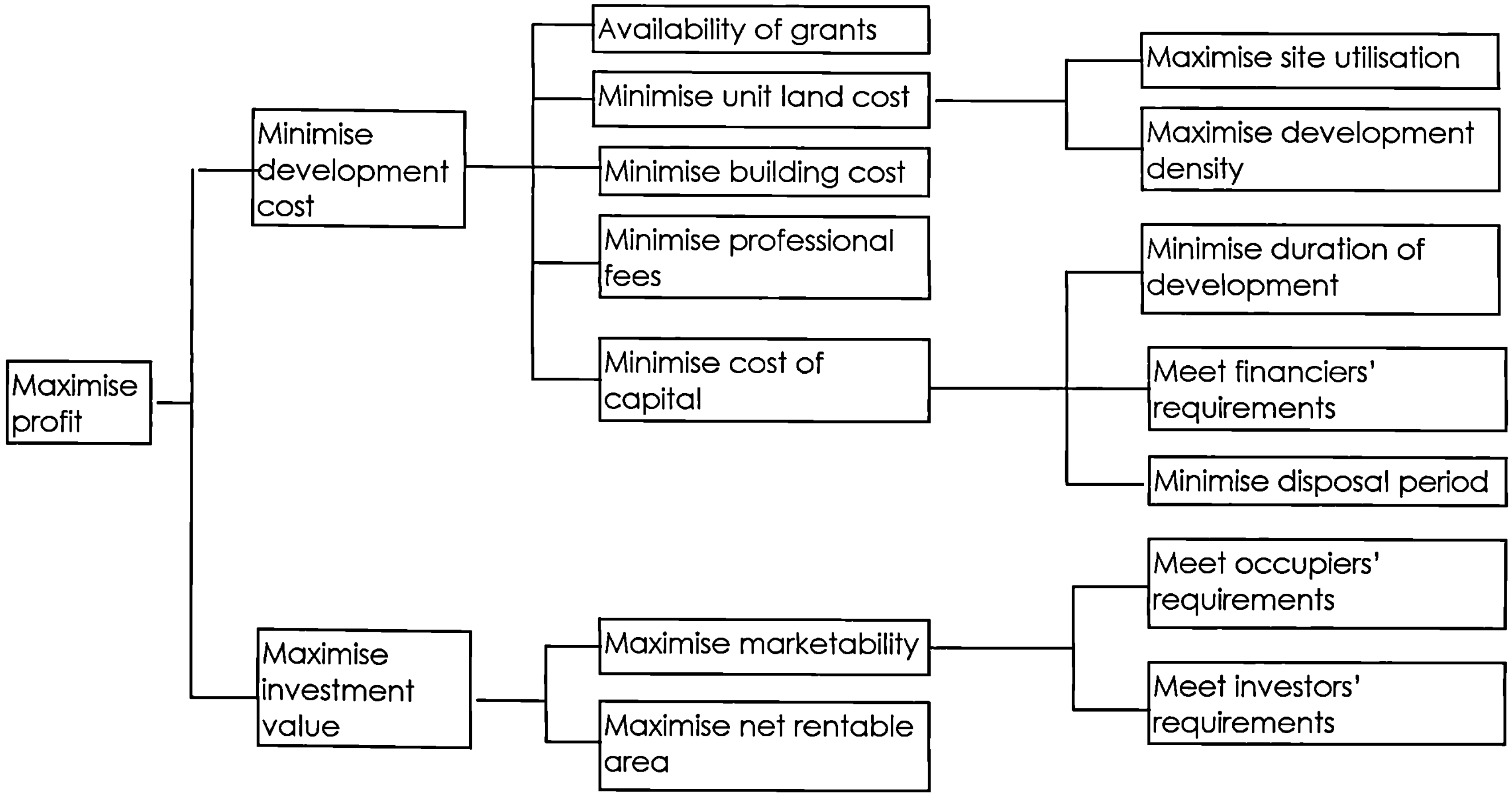


Figure 5.2: The value objective structure of the property developer

To maximise profit, the developer aims to minimise development costs and to maximise the capital value of the completed development.

Development cost can be minimised by controlling the components of development cost including:

- land costs - by minimising unit land cost. This the developer can do by maximising the utilisation of the site and/or maximising the density of the development subject to the requirements of local planners.
- minimising building cost, which depends on the building specification.
- minimising professional fees by using, for example, in-house expertise, where available, as far as it is possible before engaging external ones.
- minimising the cost of capital which depends on the rate of interest, the duration of the development period and the time taken to dispose of the completed development. To obtain a competitive rate of interest, the developer may have to satisfy the requirements of the financier(s) of the project in terms of reducing some of the risks associated with development. This may require the identification of a potential occupier before development commences (prelet).

Another way to improve the economics of development is for the developer to apply for development grants from public bodies. This is applicable in situations where the proposed development accords with some public sector objectives such as regeneration of an area or district.

Property investment value depends on the perceptions of investors and occupiers as influenced by the type of property, its specification and location. Therefore to maximise the investment value of a development, the developer would have to maximise the marketability and lettability of the completed development by becoming sensitive to the value objectives of occupiers and investors.

5.4 The Value Objectives of the Occupier

Occupiers are the ultimate consumers of the final product of building development. It is their actual or anticipated unsatisfied demand that leads to development opportunities. Occupiers include tenant lessees and owner-occupiers who may or may not have been known at the start of the development.

The tenant lessee retains the flexibility to move within the terms of the lease, to take advantage of an equal or better covenant. Another reason may be to move to a property with modern facilities appropriate for changed requirements.

An owner-occupier is an individual or organisation who assumes the sometimes conflicting role of owner and user of property. The reasons why property users would want to become property owners include the following (Goodall, 1972):

- the requirement for high specification 'tailor-made' buildings which have high use value but little or no market value. There is therefore no incentive for investors to get involved.
- the wish to undertake development to improve the use value of land and property thereby boosting company image, liquidity and asset position.
- the user realising that he could derive greater profit or satisfaction from owning rather than leasing property.

The benefits the user derives from owning the property he occupies may include security of tenancy, the ability to time repairs and maintenance to suit cash flow position and the reduction of uncertainties associated with rent reviews (*Business,* September, 1988).

Properties used to be viewed by commercial occupiers as being merely incidental to business. No strategies therefore existed in the past to assess the impact of properties on business. Two recent developments are thought to have changed this passive approach. First, the difficulties that were encountered during the recession of the early 1990s are believed to have caused occupiers to start examining their overhead costs. As a result, downward pressure has been brought to bear on occupancy costs. The second development is the impact of the growing importance of facilities management in the UK. Occupiers are now considered to be selective and sophisticated in their requirements (Harrington, 1994). These two developments are thought to have made occupiers increasingly aware of the impact of the properties they occupy on their production costs, productivity and employee morale.

In remarks attributed to Howard Bibby of UK Facilities Management Firm, Procord, property occupier requirements are nowadays more business driven with two main factors being prominent (Strohm, 1996):

- the need to drive down occupational costs. This is already having impact on how properties are managed and procured; and
- the desire to use properties to help bring about changes in working methods and business culture rather than as symptoms of change.

Occupiers are therefore concerned with occupancy costs and the functionality of the buildings they occupy. The actions available to the occupier to achieve these objectives and the factors that contribute to them are summarised in figure 5.3 below.

There are several means through which occupiers attempt to achieve reductions in occupancy costs. The core ones are achieving reductions in running and maintenance costs. For occupiers taking up new leases and even for sitting tenants, other means being pursued include negotiating flexible lease terms with break clauses.

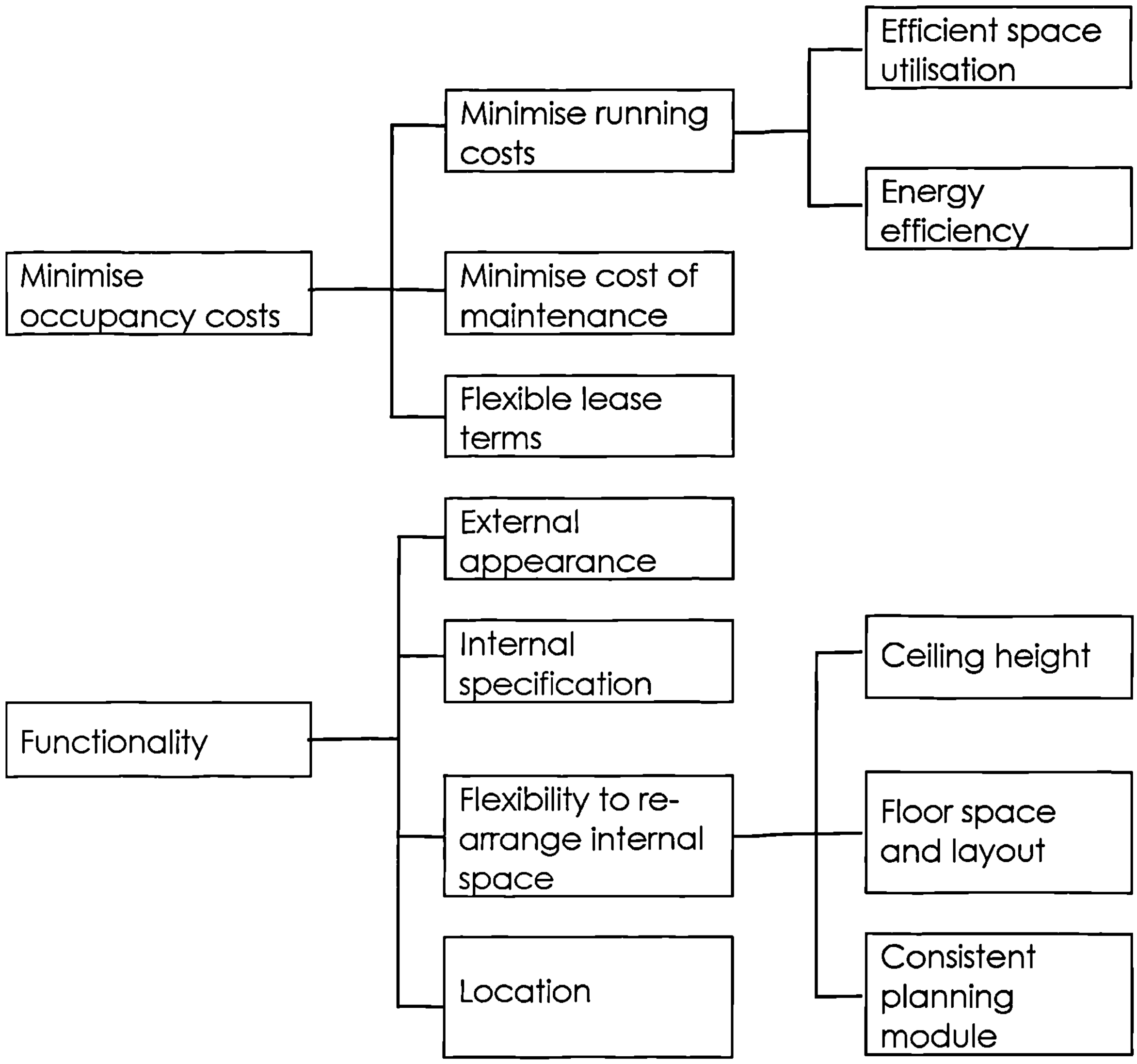


Figure 5.3: The value objectives of the property Occupier

Reductions in running costs are being realised through improvements in space utilisation and energy efficiency. A lot of UK companies have been employing facilities experts to review how effective the properties they occupy are in supporting their operations. This kind of review was carried out by Procord for IBM (UK) Limited in 1989 (Jack, 1994). In addition to the benefits of improved staff morale and productivity, this review resulted in space requirements being reduced by up to 30% through desk sharing (*ibid*).

Apart from the global benefits of energy and resource conservation the growing popularity of 'green' buildings is due to the possible energy savings they can deliver. In a survey of decision makers from 200 large property occupiers, 60% of them indicated that their future occupational requirements would include some environmental criteria (Goodman, 1994). Of the numerous environmental measures listed, the inclusion of low energy lights was chosen as the most important to occupational requirements. This is obviously due to the cost savings they afford.

It is also in the interest of occupiers to minimise maintenance costs. As such they prefer well maintained properties with respect to the structure, external envelope and internal provisions including services. With regard to the external envelope, what is innovative and aesthetically pleasing may not necessarily be useful to tenants unless it also affords savings in maintenance costs (Harrington, 1994). Occupiers therefore prefer the use of simple designs with low maintenance material which will reduce the need for regular and perhaps expensive maintenance.

The need to reduce overhead costs has also led to the demand for flexible lease terms (Harrington, 1994; Cadman and Topping, 1995). With the rapid advances in computer and telecommunications technology, occupiers are cautious not to lock themselves into long leases that will encumber them with inflexible properties (Smith, 1995). The granting of shorter leases with possible break clauses will provide them with the opportunity to respond to their short-term property needs. This objective is in conflict with the old UK 'institutional lease' whereby leases are granted for 25 years with upward-only rent review every five years. There are signs however that some institutions are granting 15 year leases (Cadman and Topping, 1995). Some have even gone to the extreme of granting one month leases. An example is Regus, a UK business-centre operator, who claims to provide one month leases in response to 'a change in the working habits of many occupiers' (Smith, 1995).

Occupiers are also concerned with functionality of the properties they occupy besides aiming to reduce occupancy costs. The emphasis here is on flexible accommodation in terms of the external appearance as well as the internal specification and configuration, both of which are the most sensitive to obsolescence.

The external appearance does not only concern the building envelope but also the entrances and reception areas. Tenants, especially office tenants, are thought to be preoccupied with first impressions. As such even in these days of belt-tightening, reception areas and entrances still continue to be one of the main areas of expenditure (South, 1994).

The intensive use of IT equipments and the associated heat loads are altering requirements of the building fabric (Harrington, 1994). The rapid development in this area has exposed the need for adequate riser provisions and knock-out panels to ensure future flexibility. The increasing use of video display units (VDUs) and associated European directives have also had impact on the type of low-glare glazing being used.

The important aspects of the internal specification are the finishes, decorations, furnishings, services and the effect they have on the internal environment. Occupiers care about the indoor environmental conditions (including safety, access, health, comfort and aesthetics) and its effect on employees' health and productivity. According to the Richard Ellis' survey: *Tomorrows's Workplace* (Smith, 1995), the vast majority of occupiers believe that a well-designed building has a positive effect on staff productivity. Almost invariably air-conditioning features somewhere in this equation. The shift now though is towards natural air-conditioning (South, 1994).

The flexibility that occupiers are seeking in relation to the internal specification is in the building plants' ability to maintain 'fresh' internal environments in the face of increased demand (Harrington, 1994). This may become necessary due to the increasing heat loads resulting from the increasing use of IT equipments and higher density of personnel resulting from space reduction reviews.

Building configuration is probably the most important attribute that determines its functional efficiency. If it is of the wrong type, it can impose restrictions which affect the occupiers flexibility to change to suit changing practices. The elements of building configuration include the total floor area, floor layout (links between spaces), floor plate sizes and ceiling height. The sort of flexibility in configuration required by occupiers include (Harrington, 1994):

- the provision of a suitable and consistent planning module to afford occupiers the flexibility in internal space planning.
- the provision of ceiling voids and raised floors to enable flexible cabling and ducting. This requires adequate floor-to-floor heights. The British Council of Offices' (BCO) recommends floor to ceiling heights of between 2600 and 2750mm with a raised floor of 150mm and a ceiling/lighting zone of 150mm for urban offices (Macrae, 1995). Where this is not possible, adequate space for perimeter trunking would be required (South, 1994).
- the inclusion of space either in the roof, or where available, in the basement for additional plant which the occupier might require to support special areas.

The final issue which the occupier is concerned with is the effect of external factors on the use of properties. Site attributes such as accessibility and the availability of local amenities are important to building functionality. Research carried out by Capital & Counties (Abel, 1994) found that among factors influencing relocation decisions were the desire for banking facilities close by and a wide range of shops within walking distance. This appears to have been borne out by another research commissioned by Connaught Group which also found out that among the key factors influencing tenants' choice of accommodation were availability of parking space and proximity to transport links (Chase, 1996).

5.5 The Value Objectives of the Private Property Investor

Investment is defined as the commitment of capital to an enterprise with the hope of receiving future benefits in the form of financial returns (Hargitay and Yu, 1993: p. 3). A property investor therefore is an individual or organisation who holds property as an investment asset with the expectation of receiving future financial returns.

Unlike the property developer, the investor takes a long term view of the financial returns. He is thus inclined to accept moderate returns in the initial stages of investment where there is the expectation that returns will grow in the future.

In the UK, an important category of property investors are the so called financial institutions. They include insurance companies, pension funds, property investment companies and property unit trusts (Guy, 1994). They get involved in properties to increase their profits to be able to discharge their future responsibilities to their members. Due to this responsibility, the financial institutions avoid risky investments. This tend to govern their entire outlook and behaviour.

Property investors realise financial gains from acquiring standing properties, holding them for a period and disposing of them when no longer required. They may also get directly involved in the development of property by providing funds for development in which they retain equity interests. This enables them to acquire properties in desirable locations that will give them adequate return on capital invested and an opportunity to see that income grows (Cadman & Austin-Crowe, 1978).

The financial institutions are thought to have considerable influence over the specification and location of properties, especially where they fund speculative development. According to Cadman and Topping (1995), this is a source of considerable conflict between the occupier and the investor. Whereas investors specify buildings which are meant to suit 'typical' occupiers, occupiers, at the individual level, find the resulting buildings not exactly matching their needs (*ibid*). There are indications that this situation is gradually changing as more and more developers and investors carry out research into occupier needs (Abel, 1994).

Property investment produces returns in two tangible ways (Baum and Crosby, 1995):

- capital appreciation, whereby the capital realised on resale is higher than the original investment; and
- income which comes from rents paid, less any management costs.

The risks associated with property investment are that the projected income or capital appreciation may not materialise. The causes of these risks are classified as specific and systematic risks (Brown, 1991). Specific risks relate to the situation of individual properties and include tenant effects, building quality, structure effects and location effects. On the other hand, systematic risks affect all properties of a particular type and include economic factors, taxation and financial changes.

It can be seen that the fundamental value objectives of the property investor are to maintain or increase income and capital growth. To achieve this, the investor seeks to minimise the effects of both specific and systematic risks as defined above. The value objective structure of the investor and the actions taken to minimise risks are shown in figure 5.4 below.

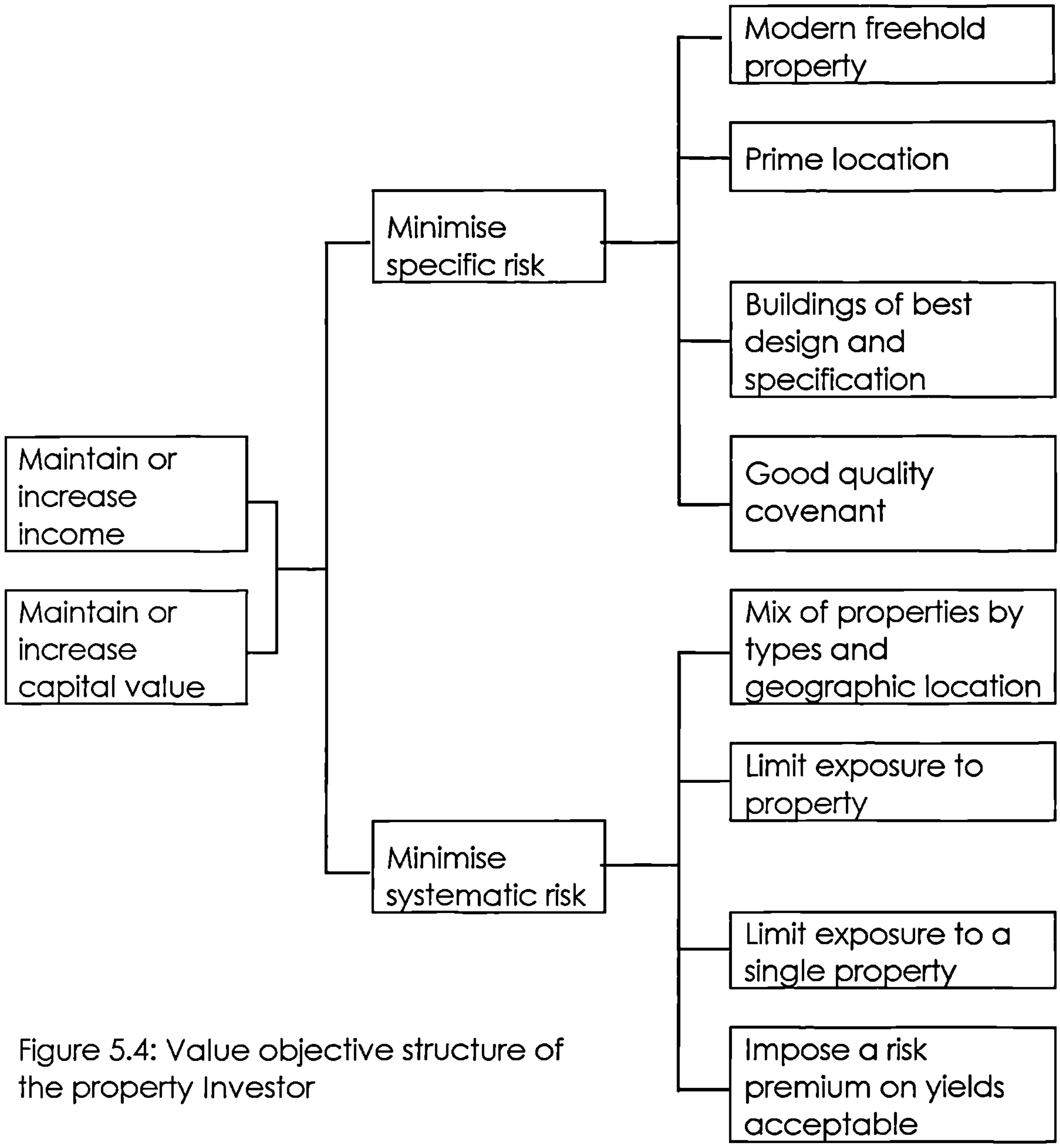


Figure 5.4: Value objective structure of the property Investor

In minimising the impacts of specific risks, the main preoccupation of the investor is to ensure the security of income over a relatively long lease period. He therefore prefer properties which by virtue of their design, specification and location will continue to attract tenants. Hence Investors apply what is considered as conservative and strict criteria to choose properties in which to invest. These criteria include (Guy, 1994):

- modern freehold or long leasehold property;
- best building in terms of design and specification;
- prime location where demand is high;
- properties with reputable sitting tenants who are unlikely to default on rent payments; and
- long lease over preferably 25 years of the full repair and insurance kind with 5-yearly upward-only rent review.

Systematic risks cannot be entirely eliminated because the causes are usually outside the control of the individual investor. The investor however can take actions to minimise their impact. This is reflected in how the property portfolio is constructed and in the yields that investors are prepared to accept before commiting capital. The actions to reduce systematic risks include (Guy,1994):

- spreading the risk over several properties in terms of property types and/or geographical locations;
- limiting the degree of exposure to the property market. Some financial institutions are thought to limit property investment to about 15% of their total investment portfolio (Guy, 1994: p.54).
- limiting the amount of capital to invest in a single property. Some investors are thought to limit the amount invested in a single property to about 10% of their total property investment (*ibid*).
- requiring a risk premium (reported to be 2% above gilts) to ensure that income receipts are higher in the initial stages to offset any possible future under-performance (Guy, 1994: p.50; Dubben and Sayce, 1991: p. 151).

5.6 The Value Objectives of Property Financiers

Property developers and investors, at times, finance their developments and acquisitions from their own sources (equity funding). This is the case for some of the large property companies. However, most of the small developers and investors, and even some of the big ones, fund their developments and investments from external sources (Dubben and Sayce, 1991; Guy, 1994; Ashworth, 1996; Cadman and Topping, 1995). The main sources of finance in the UK for private commercial property development and investment include the financial institutions, banks (clearing and merchant) and to a lesser extent building societies. A distinction has to be made between financiers who fund developments to retain equity interest and those who do not. The discussions in this section is about the latter group.

The loans that the financiers grant can be short, medium or long term. The type of loan granted depends on the experience of the financier concerned in dealing with properties, the general economic conditions and the future performance of the property market (Cadman and Topping, 1995; Ashworth, 1996). Some financial institutions have property portfolios of their own and may have built management expertise over the years. They are therefore more willing to take on risks associated with property investment by granting long-term loans (Cadman and Topping, 1995). The banks, especially the clearing ones, are considered to be the least experienced in the funding of property investments and hence tend to avoid long-term commitments (*ibid*). They may therefore restrict their lending to short-term development financing.

Property financiers lend money with the aim of making profit from the fees and interest charged. Their fundamental objective is to minimise the risks associated with lending by satisfying themselves that the principal capital can be recovered. Another important consideration is to ensure that interest payments can be met and would be current. Hazeel, in an article in the *Chartered Surveyor Monthly* (Hazeel, 1995), listed some of the criteria influencing bank property lending. These could appropriately be described as borrower-centred criteria, property-centred criteria and covenant-centred criteria. These are summarised in figure 5.5 below.

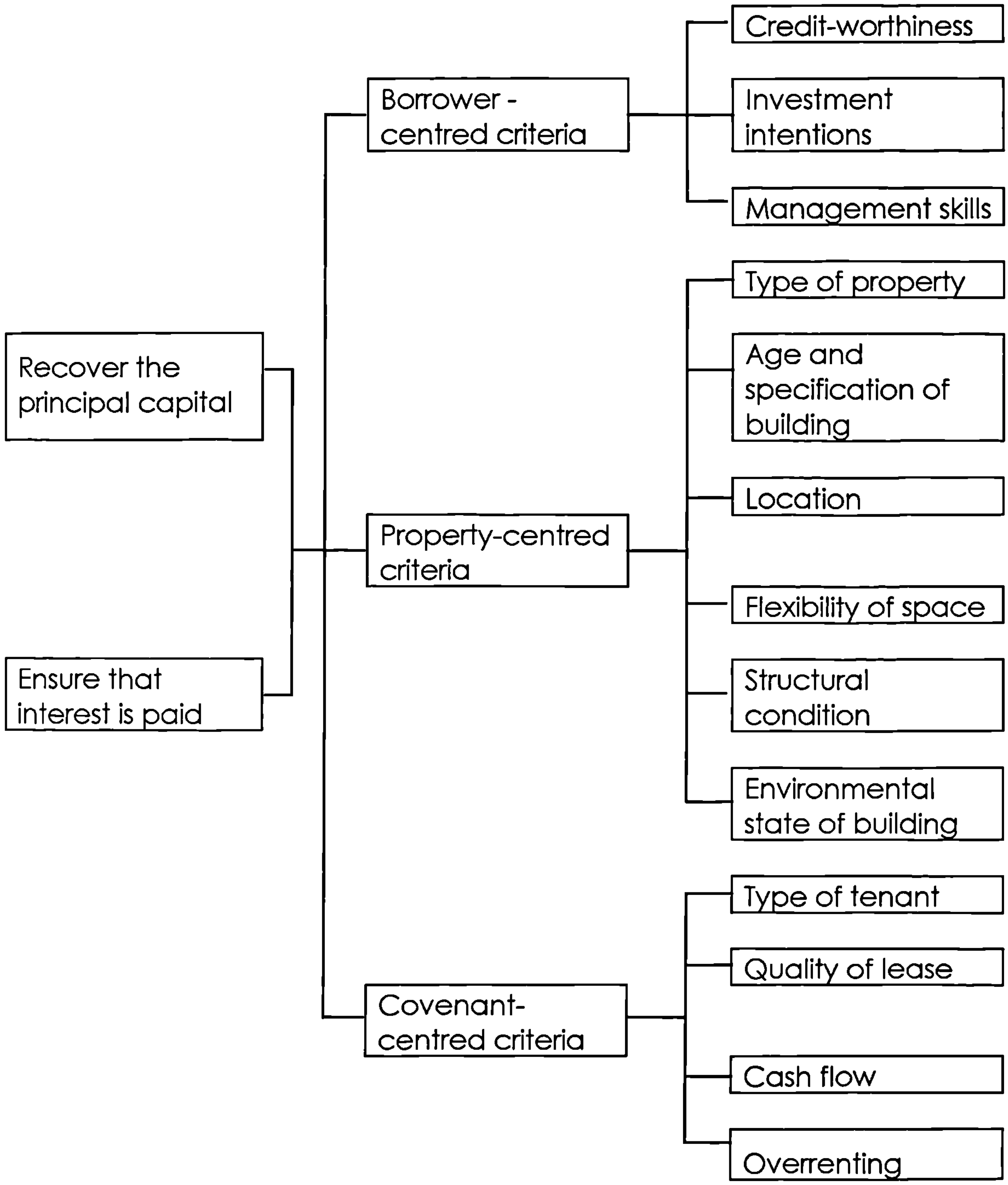


Figure 5.5: The value objectives structure of property Financiers

The borrower-centred criteria concern who and how good the borrower is. These involve the assessment of the credit-worthiness of the borrower, his investment intentions and his management skills. The lenders would be concerned with the ability of the borrower to realise continuous increases in value.

The property-centred issues concern the suitability of the property to be funded as security for the loan. Here the financiers would be looking at the quality of the property and its location as they influence its resale or refinancing potential. The more marketable the property is, the more likely that the capital can be recovered. Some of the issues to consider include (Brett, 1995):

- the type of property;
- the age of the building and its susceptibility to obsolescence;
- the building specification: floor plate size, load-bearing capacity and what the services are like;
- the location - is it prime and will it continue to remain so?
- the flexibility of space - how easy would it be to convert to multi-let if a single covenant disappears;
- the structural condition of the building; and
- the environmental state of property and site.

Finally, property lenders attach great importance to the quality of the tenant covenant when considering the funding of property investment. It is important because it indicates the adequacy of rental income to cover interest payments, and where required, some capital repayments, over the term of the loan. The questions asked usually include (Hazeel, 1995):

- type of tenant: whether the tenant is a parent company or a subsidiary; if a subsidiary, is the tenancy guaranteed by the parent company? If not a subsidiary, how good is its business?
- quality of the lease: is it five year rent review, FRI, upwards only etc. and does it contain any break clauses?
- what the period of the unexpired lease is: is it greater than the duration of the loan?
- how robust is the cash flow: is it sufficient to cover interest payments with a surplus? If there is a surplus, can some of it be used to make capital repayments?, and
- how overrented the subject property is: should the tenant disappear, can he be replaced quickly and at what rent compared to present?

5.7 The Objectives of the Public Sector

The functions of the public sector in connection with the development of property are preoccupied with safeguarding social needs, conserving resources and maintaining the environment (Healey, 1990). Thus the prime objective of the public sector is to act to moderate any adverse effects of property development. For instance in the UK, there exists a comprehensive and extensive planning system supported by several Acts of Parliament (eg. The Town and Country Planning Acts, 1971 and 1972; the Fire Precautiions Act, 1972, the Local Government Planning and Land Act, 1980) to ensure that (Ashworth, 1996: p. 133):

- conflicts between competing land uses such as agricultural, retail, industrial, etc. are resolved;
- improvements in standards of design and construction are achieved;
- the safety and health of occupants of developments are protected;
- proper locations are determined for different property types; and
- the safety, health and welfare of those engaged in the development process and those affected by it are safeguarded.

According to Healey (1990), the planning system is underpinned by a set of firm and 'appropriate' values. These values are established by central government influenced to a large extent by its political philosophy. The application of the values to local situations are however framed by County Councils to the approval of central government to be detailed, interpreted and enforced by local and district councils (*ibid*).

There are two main tools available to the public sector in regulating and controlling development. These are: the establishment of rules and regulations and the implementation of fiscal policies geared towards encouraging desirable developments and discouraging undesirable ones. These tools define the objectives of the public sector in property development (figure 5.6):

- as a direct property developer;
- as a facilitator of development; and
- as a regulator of development.

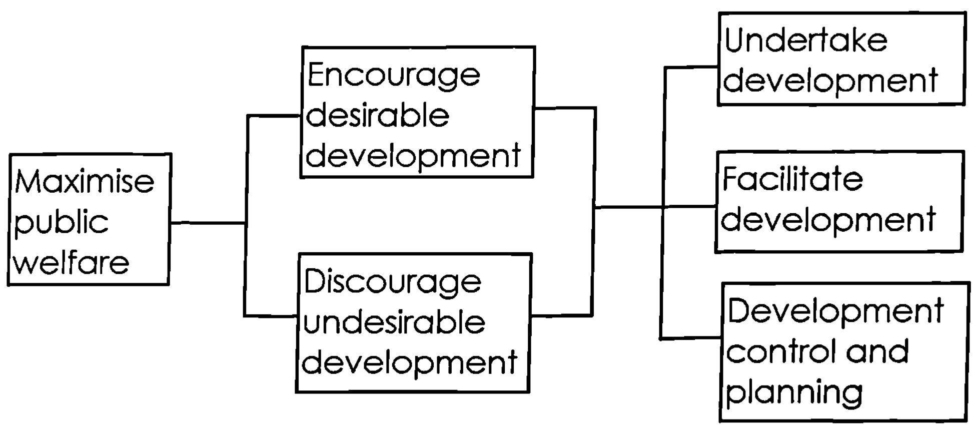


Figure 5.6: Public sector objectives

The public sector, as a landowner and with the powers available to it to assemble viable sites, at times engages directly in development (Adams, 1994). This may be to achieve a political or social objective. There are times however when the aim may be economic . In this case, it may act to boost the confidence of the private sector by either subsidising the costs of development or providing common social infrastructure to make private sector developments viable (*ibid*).

Where the public sector engages in more complex developments, it prefers to share the costs, rewards and the associated risks with others by going into partnership with one or more private developers for the mutual benefit of all. This sort of contractual arrangement is common in the UK between Local Authorities and private developers. The Local Authority may gain by sharing in the profits achievable from the perceived efficiency and expertise of the private sector. It may also be a vehicle to achieving the Authority's political and social objectives. The private developers in turn may benefit from the credibility afforded by their association with a public body and the likely 'smoother' planning permission process. The private developers may also benefit from the fact that the council may own the land or possess powers to assemble viable sites (Stevenson et al, 1994; Adams, 1994).

Apart from participating directly in development, the public sector also acts to facilitate development. There are various means through which it acts to ensure that developers, irrespective of their basic motivations, do not face unnecessary obstacles in their ventures. This is more so if the proposed development accords with public sector goals of ensuring the welfare of society. Some of the measures adopted to facilitate private sector development include the following (Cadman and Topping, 1995: chapter 2):

- exerting pressure on landowners, especially in inner city derelict areas, who are refusing to sell, to enable viable development sites to be assembled. If all else fails, local authorities can for instance exercise their compulsory purchase powers under ***the Local Government Planning*** *and Land Act, (1980)* to acquire adjacent multiple ownership lands. This enables them to assemble sites which are viable to interest private sector developers.

- defraying some of the costs associated with property development by establishing various grants and subsidies to promote certain specified developments (Couch, 1990). Recent schemes include city challenge, city grants, land reclamation grants and infrastructure grants. The aim of such grants is to make developments commercially viable whilst at the same time realising public sector aims of regeneration and job creation.
- ensuring that local authorities do not hinder private sector investment by reducing some of the uncertainties associated with applying for planning consent. As such whenever central governments want to achieve certain regional-based development policies, they tend to mandate quasi-public planning agencies to take planning control decisions and award grants. It is believed that such agencies act quickly, efficiently and flexibly (Adams, 1994; Couch, 1990).
- guaranteeing the rental value of developments. The public sector at times tend to attract developers by guaranteeing the rental value of developments to make them viable. It usually pays the difference in rents between the actual and what will make the scheme profitable. One other tool is to pay subsidies to prospective occupiers to attract them to locations where they would otherwise avoid.

One recent initiative in the UK to facilitate developments is the Private Finance Initiative (PFI) announced in 1992. This was introduced to attract the private sector into providing, financing and managing public sector facilities. In return, the public sector will guarantee the value of the developments by paying rent to the private developer for occupying the facilities concerned (Hart, 1996; Greenlagh, 1996; the ***Estates Gazette***, November 23, 1996). The hope is that under this initiative, the public sector can realise its social goals, get value for money and shift the risk of development to the private sector. This is founded in the notion that the private sector is more efficient and has the management expertise not available to the public sector. By paying rents instead of a single major capital investment, public spending can be spread over several years, thus relieving the public purse.

The last instrument available to the public sector to influence private sector property development is the enforcement of rules and regulations governing developments. These rules and regulations may be positive such as attaching conditions to planning approvals or they may be restrictive such as forbidding demolition of listed buildings (Couch, 1990). They may also be permissive such as allowing local authorities to compulsorily purchase land from owners standing in the way of viable development or they may be mandatory such as imposing a duty on a developer to take certain actions in some given circumstances (*ibid*).

5.8 Application to the Building Renewal Problem

Throughout this thesis and up to this point, it has been maintained that property development involves the interaction of several actors whose objectives could be in conflict. This chapter has examined the conflicting value objectives of those considered to be the main actors: developers, occupiers and investors. The value objectives of financiers and public sector agents have also been discussed due to the enormous influence they have over the actions of the main actors. In the next chapter, the value objectives identified above are applied to the building renewal problem.

Already, without any in depth treatment, it is not difficult to deduce some of the reasons and objectives for building renewal. For instance, it is not difficult to deduce that the developer might become involved in renewal because he wants to realise development profit. It is also clear that the investor might get involved in renewal because he wants to maintain or increase rental income and capital value. Finally, the wish to cut down occupancy costs and to improve the functionality of buildings can be valid incentives for the occupier to be interested in building renewal. The next chapter addresses all these issues in the context of building renewal.

CHAPTER SIX

OBJECTIVES OF BUILDING RENEWAL

6.1 General

In chapter five, the value objectives of the main actors who influence building development were discussed. This chapter explores how these objectives can be applied to derive the objectives of building renewal.

The study begins by examining why the need arises for buildings to be rehabilitated. The reasons discovered are then studied in depth as to what brings them about, how they affect the performance of buildings and the role rehabilitation can play in reversing any of these effects.

Next, the rehabilitation decision process is studied in depth by examining each stage of the process and identifying the internal and external factors that affect the decision.

Finally, the issues uncovered in the exercise described above are summarised in an objective hierarchy. The criticality of these objectives to building renewal and the factors that affect their achievement will be tested in the primary research which follows.

6.2 Reasons for Building Rehabilitation

The need for a decision framework to guide building renewal decisions stems from the observation that it is not always easy making the decision on whether to renew buildings through rehabilitation or redevelopment. Despite the apparent existence of a decision problem, building renewal decisions are made in practice even though the chosen action may in some cases be viewed as controversial by concerned individuals and organisations.

Whatever the renewal action taken, the reasons for renewal are not in doubt. Renewal is usually required because some existing buildings are unable to meet objectives set for them by either their users or owners. Any controversy surrounding building renewal is not therefore about the reasons but rather the option chosen.

Recalling some of the early chapters of this thesis, the performance required of buildings is said to depend on the kind of interest one has in the building. In the private sector, a building owner expects a building to perform as an investment asset: maintaining its value and guaranteeing streams of income over a relatively long lease period. Building users, on the other hand, are usually concerned with the functionality of buildings and costs associated with occupation. There is also society at large which is concerned with the effect of buildings on the welfare of its members and the environment. Finding out the reasons for building rehabilitation may therefore lead to uncovering some of the objectives of building renewal.

From figure 1.1 (chapter one), what underlies the need for rehabilitation is the existence of a gap between requirements and performance. This deviation is due to two main causes: physical deterioration and changes in requirements. The changes in requirements may be associated with advancements in technology and changing practices (obsolescence) or they could be due to a change of use.

The major reasons for buiding rehabilitation are thus to repair physical deterioration, to reverse the effects of obsolescence or to match the requirements of a new use. Aikivuori (1994) added three more reasons in connection with refurbishment, which are:

- optimisation of economic factors - refurbishing to increase or uphold value or to reduce operating costs;
- subjective features of owners - refurbishing to add comfort or improve appearance; and,

- changing circumstances - refurbishing as a response to changing circumstances such as new legislation.

As will become clearer in the next section, there are several perspectives of building obsolescence which includes functional, style, economic, locational, and technological obsolescence. These additional reasons for rehabilitation supplied by Aikivuori can therefore be subsumed within the concept of obsolescence.

If the wish of society to conserve buildings of architectural and historical interest are taken into consideration as well, then the main reasons for building rehabilitation can be summed up as:

i. to correct physical deterioration;
ii. to reverse obsolescence;
iii. to meet the requirements of another use; and
iv. to conserve buildings of architectural and historical interest.

Each of these reasons are individually examined in the next few sections.

6.3 Physical deterioration

Physical deterioration is a characteristic of existing buildings without comparison to other buildings. This is what sets deterioration apart from obsolescence even though some commentators (eg. Golton, 1989) may disagree with this view. This debate is picked up further in the section on obsolescence. Physical deterioration refers to the physical degradation of building exterior fabric, interior finishes and structure as well as services as a result of ageing, usage and unforeseen occurrences.

The causes of physical deterioration come from both within and without buildings. They include (Bernard Williams Associates, 1994):

- neglect and lack of maintenance;
- attack by elements of the environment:- the effects of snow, rain, wind, atmospheric pollution and chemical action cumulatively cause

erosion and/or corrosion in the external fabric of buildings (Blanc, 1994).

- general wear and tear due to the ageing and intensity of usage;
- accidental occurrences such as fire, earthquake and storms; and
- design and construction defects.

The effects of physical deterioration may result in for example:

- excessive deflection of walls, columns and floor slabs;
- unsightly cracks in structural elements, cladding and plaster;
- corrosion of the external building envelope; and
- leaking roof and rust staining of concrete.

A deteriorating building, if neglected, may ultimately not be able to support the functional requirements of its users or meet the objectives of its owners. Besides, it could pose a health and safety risk to its users, their neighbours and passers-by.

In the short term, the effect of deterioration would be to consume more revenue resources in terms of increased cost of maintenance and other occupancy costs such as space heating and cooling. In the long term, it will affect lettability, then rental income and finally investment value.

If rehabilitation is required to correct physical deterioration, its aim mainly would be to restore the building condition to its former state. Advantage could be taken of the opportunity to rehabilitate to add some elements of modernisation.

6.4 Obsolescence in Buildings

Building obsolescence occurs when there is a mismatch between the performance of a building and the requirements of its users leading to a decrease in utility and hence investment value. Obsolescence becomes apparent when the attributes of the building in question are compared to the attributes of similar buildings in the same or different location.

Obsolescence may be caused by limitations imposed by the physical attributes of the building in question in the light of current practices, tastes and preferences. It could also be due to changing locational characteristics and other external factors and how they affect the determinants of quality and value.

Obsolescence in built properties is a very broad and complex subject. This is evidenced by the large number of perspectives or aspects that abound in the literature. Golton (1989) wrote about several perspectives of obsolescence including structural, site, financial, locational, functional, control, style and perception. Ashworth (1996: p. 64) also listed several perspectives of obsolescence including physical, economic, functional, technological and locational.

It can of course be argued that some of the aspects of obsolescence mentioned by these commentators are higher-level perspectives under which the rest that could be considered as lower-level, fall. Salway (1986) reduced the aspects of buiding obsolescence to four main categories: aesthetic, functional, legal and social obsolescence. Baum (1991: p. 68) reduced them even further into 'two major' obsolescence types: functional and aesthetic.

The classification of obsolescence is not the object of this research study. Rather, the relevant issue is the effect of obsolescence and how it helps to define the objectives of building renewal.

In discussing the effects of obsolescence on buildings, a very simplistic classification model is derived based on what is considered as the global sources of obsolescence. These are:

- the limitations imposed by the physical attributes of buildings;
- the limitations imposed by the characteristics of location;
- the limitations imposed by legal and statutory obligations; and,
- the reaction of the market to these limitations.

In this thesis, building obsolescence is therefore classified as: functional, locational, legal and economic. The factors contributing to each of these higher-level categories are given in the obsolescence hierarchy shown in figure 6.1.

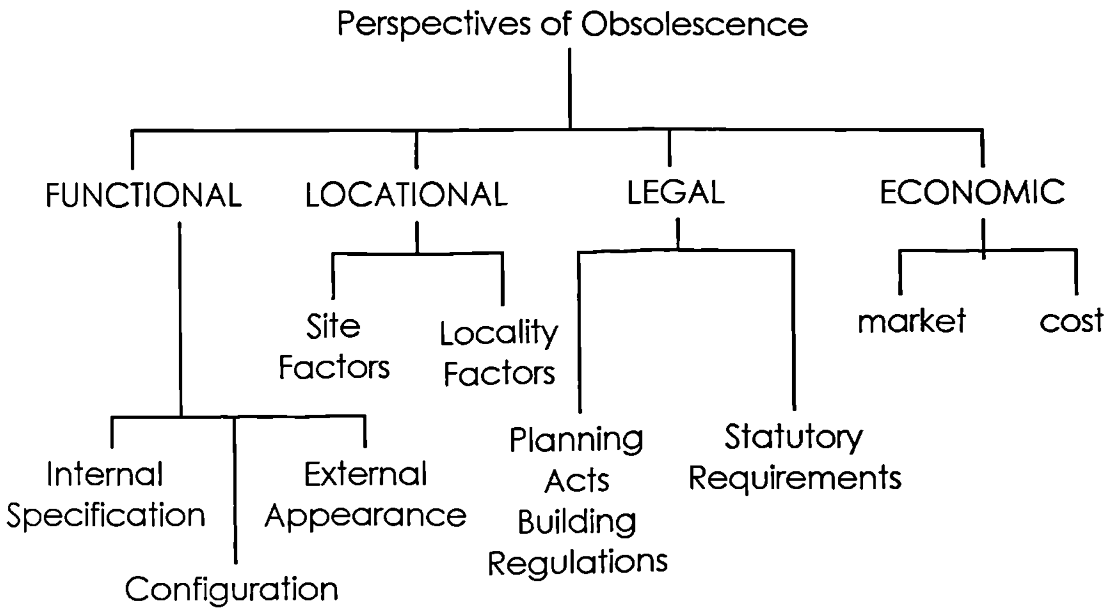


Figure 6.1: Obsolescence Hierarchy

One source of contention in discussing building obsolescence is whether or not physical deterioration is a perspective of obsolescence. From the illustration in figure 1.1 (chapter one), physical deterioration is clearly a separable issue from obsolescence. Thus a building can be structurally sound but obsolescent, modern but structurally unsound, or both. Some commentators (eg. Golton, 1989; Ashworth, 1996) classified physical deterioration as part of obsolescence. In contrast, others (eg. Taylor, 1980; Salway, 1986; Baum, 1991) discussed physical deterioration as a separate issue from obsolescence.

Aikivuori (1994) quotes Taylor as having written that "deterioration has no part in the accumulated inferiority caused by obsolescence". Salway (1986) also defined obsolescence as: " the decline in utility not directly related to physical usage or the passage of time". Baum (1991: p. 65) was even more explicit as the following statement shows:

"Obsolescence, in contrast to physical deterioration, is a value decline not directly related to use, the action of the elements or the passage of time. Obsolescence may be instantaneous as a result of a technological advance. It results from change which is extraneous to the building in question, such as changing market perceptions about such factors as quality and design."

The view expressed by Taylor, Salway and Baum is adopted in this study. Hence physical deterioration has been discussed as a separate issue from obsolescence.

The perspectives of building obsolescence shown in figure 6.1, that interact to reduce the utility of a building are discussed in some detail in the sub-sections that follow.

6.4.1 Functional Obsolescence

Functional obsolescence is the fall in value as a result of an existing building's inability to efficiently and effectively meet the objectives of its functional purpose. A building's inability to meet functional requirements may be due to the limitations imposed by its configuration, the specification of its internal finishes and services and/or its external appearance, as it tries to cope with changes (Baum, 1991).

Functional obsolescence is caused by changes in occupiers' building requirements, resulting from technological change, increase in standards or the introduction of new building products (*ibid*). In the USA, for instance, it is believed that the rapid technological advancements in the 1990s have already significantly reduced property life-cycles, driven shorter-term renovation of high quality space and forced more inflexible properties out of the market (Brown, 1996).

Technological improvements and changes affect properties in a number of ways. Through the changing patterns of commerce and industry that accompany technological changes, the configurational requirements (eg. floor plate area, floor depth and ceiling height) of occupiers are changing (Sullivan, 1996). The extensive use of IT equipments and the adoption of air conditioning in offices, for instance, have introduced the requirement for raised floors for cabling and ceiling voids for ductwork.

The British Council for Offices' (BCO) *Specification for Urban Offices* (July, 1994) recommends floor to ceiling heights of between 2600 and 2750 mm in addition to a ceiling/lighting zone of 150mm and a raised floor of 150mm. It would be difficult to meet these requirements for some existing office buildings thus becoming susceptible to obsolescence. In a study of five London offices typical problems uncovered included poor ceiling heights; inadequate riser provisions; suspended ceiling voids impinging on window openings and small floor sizes (Kiely, 1992).

Problems similar to those mentioned for offices can be found in today's warehouses. The increasing use of automation and the 'just-in-time' delivery methods have led to the requirement for 'high-cube' spaces (ie. high ceilings and plenty of floorspace clear of structural obstructions) on which to stack and manoeuver (Brown, 1996). A recent survey conducted jointly by Fuller Peiser and Lansing Linde in the UK among major warehouse occupiers found that 73% of respondents preferred racking heights of 7.1m or higher. This can be contrasted with the fact that the bulk of the existing warehouse stock in the UK can only accommodate racking heights of 5.75m (Keith Blake, 1993).

The possibilities opened up by new communication technology are forecasted to affect future space requirements as occupiers free themselves from existing leases (Tapping, 1995). For instance, if it is widely adopted, telecommuting could greatly affect the space required by office users. Through space rationalisation and so called 'hot desking' it has been observed that the achievement of up to 30% space reduction per person is very possible (*ibid*).

New technology may also have implications for the load capacity of floor plates and ultimately load-bearing structural elements such as columns, walls and foundations. The requirement for plant rooms in roofs, for instance, has implications for building roof structures.

Social tastes, standards and perceptions influence the specification of internal finishes and services as well as the external appearance of buildings. Any shifts in the market concerning preferences for the quality-dependent elements of building internal finishes, services and external appearance can affect property values.

6.4.2 Locational Obsolescence

Locational obsolescence occurs when negative changes in the location of a building leads to diminished utility that results in reduced investment value.

It is an often maintained assertion among property professionals that as far as property values are concerned, the most important issue is location, location and location. This may sound overstated, but the importance of location to property values is well documented. The following statement by an Investment Surveyor contacted during the exploratory stages of this research illustrates this:

"The important point to note is that property is a raw material to commerce. Our job as an industry is to provide the right accommodation for occupiers. The reason for concentrating on location is that the right product in the right location will attract alternative occupiers making the investment safer and hence more saleable (liquid)"

The risk associated with location comes from the fact that with the passage of time, what was once considered as a prime location, may lose its attractiveness thereby affecting property values. The loss in attractiveness could be due to (Baum, 1991; Dubben and Sayce, 1991; Kivell, 1993):

- changed land use on adjacent sites;
- population movement away from an area;
- major companies ceasing operation or relocating from an area;
- declining adjacent properties, changes in technology and transport patterns).

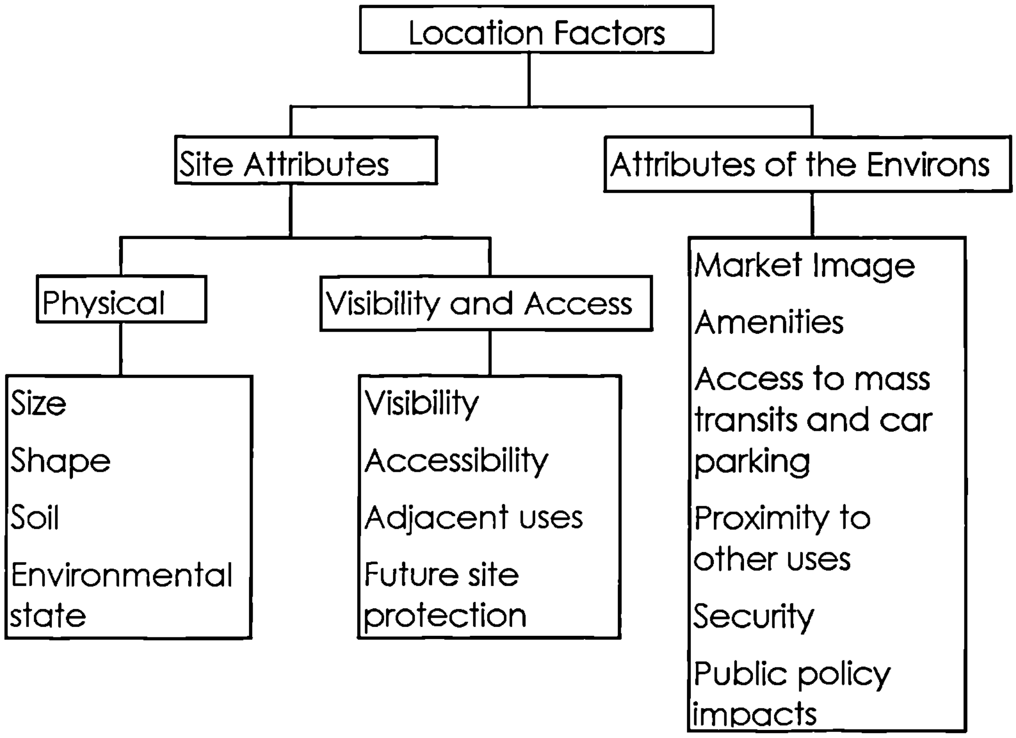


Figure 6.2: Locational factors that affect property values.
(*Source*: adapted from Kateley, 1993)

Locational obsolescence is caused by negative changes in attributes from two sources as shown in figure 6.2. These are (Kateley, 1993):

- negative changes in site attributes which include the physical, the visibility and access features of the site; and,
- negative changes in the attributes of the entire locality or sub-market in which the site resides.

The negative changes in the attributes of the site can come from:

- the size and shape of the site - in the restrictions they can present to extension to meet future expansion;
- soil and other environmental factors - the major site risk to property values comes from contamination from either previous site uses or changed uses of neighbouring sites. The uses of adjacent sites and whether or not they are protected from uses that could adversely affect the value of properties are therefore important.
- changes in accessibility and visibility features of the site due to say new development on adjacent sites.

In addition to the negative changes in site attributes, there are also negative changes that can affect locality wide factors leading to falling property values. These include:

- changes in the market image of the locality - property values depend on whether the market perceives the location to be prime, secondary or tertiary. Property values would fall if what was once considered as a prime location becomes say secondary or tertiary.
- changes in the level of amenities:- decaying infrastructural amenities can affect property values.
- changes in accessibility to mass transit transport and parking facilities - the closure of say rail terminals serving a location can affect property values in that location. The loss or the inadequacy of relatively cheap parking facilities due to new developments in a location can lead to falling property values.
- changes in the proximity to other compatible, complementary or high profile uses - the moving away of high-profile tenants from a locality or the closure of a major business can cause local property values to fall. For instance, the closure of banks, post offices and restaurants, which make an area self-sufficient, can have negative implications for property values.

- changes in the security situation:- if the security situation in an area is perceived to have worsened, local property values can suffer.
- changes in public policy - property values can be affected by the impacts of public policy changes concerning say transport networks, development plans and other infrastructural investments. If the effects of such proposed changes in a locality are viewed negatively by the market, property values could fall.

The foregoing discussions show briefly some of the means through which locational obsolescence can affect utility of properties and ultimately their investment values. It might of course be said that positive or favourable changes in any of the factors discussed above can enhance property values.

6.4.3 Legal and Control Obsolescence

Legal and control obsolescence occurs when the impacts of a new or an amended legislation cause the utility of a building to decline.

In the UK, there are a host of Acts controlling the development of buildings, the use of buildings, the internal environment of buildings, and the external environment created by buildings. They are often enacted by parliament to be interpreted and enforced by local government to suit local circumstances.

Laws and regulations affect property values positively or negatively depending on whether they affect specific properties, some property types or all properties. In general, there are four kinds of laws and regulations that affect properties:

i. those that affect all properties in all locations such as planning controls, building regulations, etc;
ii. those that affect properties in specific locations such as conservation areas legislation;

iii. those that affect specific properties in all locations, such as the Offices, Shops and Railway Premises Act; and

iv. those that affect specific properties, such as the listing of buildings of historic or architectural interest.

Where planning laws and regulations affect all properties, relative values would not be affected unless the particular circumstances of an existing building constrains its ability to adapt to the legislation in question. It is this differential effect that causes obsolescence. As an example, if statutory requirements concerning, say, means of escape were to be amended, it might be either too expensive or structurally impossible to provide for some buildings. Buildings in this situation would become susceptible to obsolescence.

Planning decisions, especially new permitted uses of adjacent land, can detract from the attractiveness of a locality thereby affecting existing property values. This could be because the new uses either increase the density of development, affecting traffic levels and car parking, or may not be compatible with the predominant land use in the locality.

Where legislation applies to specific properties, obsolescence can be accelerated in such buildings. For instance, the granting of a change of use permission on a piece of land can increase the value of the land. If the existing land use is not considered to be the most profitable, pressure could mount for existing developments to be replaced (Golton, 1984).

Another example of instances where obsolescence can be accelerated in buildings is if they become listed. The effect of listing on property values was the subject of a study conducted by the Department of Land Economy at Cambridge University (Whitehead, 1994; Green, 1995). This research found out that the most significant problem with listed buildings was their lack of redevelopment potential. The study, however, also indicated that majority of listed buildings were capable of achieving similar returns as other unlisted properties.

6.4.4 Economic obsolescence

Obsolescence in buildings is important due to its economic implications. The effects of the perspectives of obsolescence already discussed (ie. functional, locational and legal) on properties are to make them less marketable and more expensive to operate compared to other similar properties. Thus economic obsolescence in buildings breaks down into market and cost obsolescence.

Obsolescence results in falling demand through failure to retain existing tenants at the expiry of leases or to attract new ones to replace them. In a study of property executives prepared for Connaught Group (Chase, 1996), majority of them indicated that the key motivation for refurbishing office buildings were to attract tenants and to increase yields. A not insignificant number of them also gave improving energy efficiency as the reason for refurbishment.

Occupiers are now considered to be very sophisticated in their demand for space (Harrington, 1994). They desire flexible accommodation that allows them to plan and change internal spaces and specification to suit new technology and work patterns. Buildings that cannot offer this flexibility have limited appeal to occupiers and hence investors.

The retail sector is considered to be one area where building interiors and configurations are very much sensitive to obsolescence. Recent years have seen more and more tenants demanding higher standards of accommodation and services from property owners. To maintain or enhance property values, owners of property holdings are having to periodically embark on some form of renewal activity. Hammerson PLC is one such property company which had to embark on a major refurbishment programme to enhance the quality of its UK retail and office stock (Dodds, 1995). Hammerson was projected to spend a total of about £60m on refurbishment alone in 1995. This level of spending was justified by Dodds, a director of Hammerson, in the following words (*ibid*):

'By spending this amount we are ensuring that our buildings compare with the best on the market. This will enable us not only to produce the returns but also maximise capital values.'

Building obsolescence does not only reduce the income from a building but can also lead to greater operation costs in relation to comparable buildings. For instance, lack of configurational flexibility could restrict the ability of occupiers to optimise space use to reduce overheads. The constraints presented to the introduction of cost-saving technology found in newer and modernised properties, is also another example of how obsolescence can affect costs.

6.5 Building Conversion

Conversion, also known as adaptive re-use, is the adaptation of an existing building to serve a different function from what it was originally designed for. There are several factors that lead to building conversion but the most common reasons are obsolescence and redundancy (Highfield, 1987; Johnson, 1994). The wish to conserve buildings of unique historical and/or architectural character can also lead to conversion (Cunnington, 1988).

For a lot of buildings, which are unsuited for modern uses, the only way to extend their economic life is to convert to a different use for which they may be suited. The wish to conserve older buildings must however be tempered by the fact that there must be demand for such properties to make them economically viable. Conversion could provide the needed economic justification for conservation.

Redundancy refers to the situation where a building is structurally sound and suited to its original function but surplus to requirements. In the UK, examples abound of churches, schools, factories and offices that have become redundant due to falling number of users and companies and organisations contracting to reduce overheads. As companies continue to 'downsize' and adopt new practices afforded by new technology, more redundant buildings may become available, which could become the subjects of future conversions.

In the early 1990s, during the peak of the recession, new properties entering the market were difficult to let due to over-supply of especially office space (Gann and Barlow, 1996). These added onto the redundant stock made available through companies adjusting to suit prevailing economic conditions. The dilemma that faced property owners then was whether to wait till the market picked up again or to convert to other uses for which the demand existed. This situation is thought to have spurred a number of conversion projects in the UK in the last few years especially in London (report: *Chartered Surveyor Monthly*, January, 1997).

The trend in London over the last few years is the conversion of office buildings into residential accommodation. Examples of such conversions include Berkeley Homes' conversion of Marathon House in London, NW1 (Coupland, 1997) and Baratt's conversion of the former TeziaK House in Barbican, London EC1 (Macrae, 1995b).

The conversion of offices into residential use is now believed to have "grown up and moved on" (Coupland, 1997). Some of the reasons for this trend are:

- the oversupply of office space as a result of the boom in the 1980s followed by one of the deepest recessions since the war. It was estimated that there were 2.8 million m^2 of obsolete office space in London alone as at January, 1992 (*ibid*).
- the return to demand for city centre residential accommodation as people seek to live near their workplaces to avoid excessive travel

costs and congestion on the roads (Macrae, 1995). It is estimated that 153, 000 homes would be required in London by the year 2006 (report: *CSM*, January, 1997). Given that sites for development are scarce in central London, conversion of offices into residential accommodation has become a popular concept.

- the expansion of higher education and the demand for student accommodation (Balfour-Lynn, 1994).

Conversion usually involves substantial rehabilitation. Without this, the previous use could leave its mark thereby compromising marketability and affecting returns (Coffey, 1994). Unlike new build where there is the relative freedom to design to suit the requirements of known or targeted occupiers, conversion involves the matching of spaces to possible users. The ease with which property can be converted therefore depends on the physical condition and type of structure of the existing building, the previous and proposed new use and planning and building control issues.

Gann and Barlow (1996), examining the technical feasibility of building conversion, listed a number of criteria that influences the feasibility of conversion. These were:

- size and height of building;
- depth of land and building;
- building structure;
- building envelope and cladding;
- internal spaces;
- layout and access;
- building services;
- acoustic separation; and
- fire safety and means of escape.

6.6 Building Conservation

Conservation, as mentioned in connection with buildings, refers to the protection given to a building or a group of buildings in an area from demolition or significant alteration due to social reasons. In the UK, two legislative instruments are employed to effect this: the listing of buildings of architectural and historic interest and the designation of whole areas or districts as conservation areas. These are covered by the Planning (Listed Building and Conservation Areas) Act, 1990.

The legal implication of the Listed Building and Conservation Area Act is that consent is required before any alteration or demolition work can be carried out on listed buildings or buildings in conservation areas. This requirement is in addition to the normal application for planning permission. Failure to obtain listed building or conservation area consent before any alteration or demolition work constitutes an offence.

Owners of listed properties in prime locations have no choice but to carry out rehabilitation to remain competitive. The application process, however, tend to be lengthy and the works required, very expensive. This does not provide the incentive for the rehabilitation of listed properties in secondary and tertiary locations, where demand is not as great. The lack of demand for inflexibe properties and the restrictions imposed by listing on alterations can lead to the eventual neglect of the properties concerned.

The obstacles developers face in rehabilitating listed buildings and the lack of redevelopment potential have been a source of frustration to both developers and owners of listed properties. This has led to some critics of conservation arguing that there is too much conservation. It was estimated that there were 500, 000 listed buildings in the UK (Dean, 1993). The rapid growth in the number of listed buildings prompted a commentator to write that (Wise, 1993):

"It can be said with some convinction that today the conservation lobby has achieved ultimate power".

The criticism of the widespread use of listing powers and the problems owners and developers face in extending the economic life of listed properties have not gone unnoticed. The UK government is now said to have recognised that buildings serve the everyday needs of people and may require adaptation and alteration to suit changing needs (King, 1994). This recognition is contained in Planning Policy Guideline 15 (PPG 15) which states that:

"Generally, the best way of securing the upkeep of historic buildings is to keep them in active use ...and this will necessitate some degree of adaptation".

The Planning Policy Guideline goes on to say that:

"Policies for development ... should recognise the need for flexibility where new uses have to be considered to secure a building's survival".

It is thus recognised by the government that any potential use of a listed building would require a balance to be struck between keeping the building in continued economic use and preservation.

6.7 The Building Renewal Decision Process

The process of rehabilitating existing buildings, in some of its aspects, is not as straightforward as building new. The requirements are on one hand dictated by the intended use, planning controls (ie. where required), building regulations and other statutory requirements and conditions. Also to be considered, on the other hand, are the constraints imposed and the opportunities afforded by the physical attributes of the existing building, its site and location. The final product of the rehabilitation process has to reconcile these two sets of conditions.

The rehabilitation process itself depends on the reasons that trigger it and whether the building is being rehabilitated for the original use or for a different use. Reaching the decision to embark on rehabilitation is not a neat and orderly process. In reality, it involves a lot of forward and backward loops as balances are struck between physical constraints, planning and building controls and limited resources. However, for the sake of presentation, the building renewal decision process is represented by the distinct stages shown in figure 6.3 below. The figure shows the process as consisting of three stages which are (Eley and Worthington, 1984; Green and Foley, 1986):

i. the conception stage;
ii. the information gathering stage; and
iii. the feasibility and viability analysis stage.

The individual stages are described below.

6.7.1 The Conception Stage

In section 6.1, the reasons that trigger building rehabilitation are stated in general terms. At the individual project level, however, the reasons for conceiving the idea of renewal are varied and depend on the motivation of the promoter and the interests he/she has in the building in question. When contemplating redevelopment or rehabilitation on a known building the promoter starts from one of two situations:

i. where the intended use is known from the outset; and
ii. where the most feasible and viable use is not known from the outset.

Practical illustrations of the situations above include the following:

- an owner-occupier may realise that the building he occupies has shortcomings which are impeding the efficiency of his operations. This could be due to obsolescence or physical deterioration or both. He may therefore conceive the idea to upgrade both spaces and services to reverse the effects of obsolescence and also to repair deteriorated structural elements, fabric and internal finishes. This may deliver cost savings whilst at the same time maintaining or enhancing the value of the property.

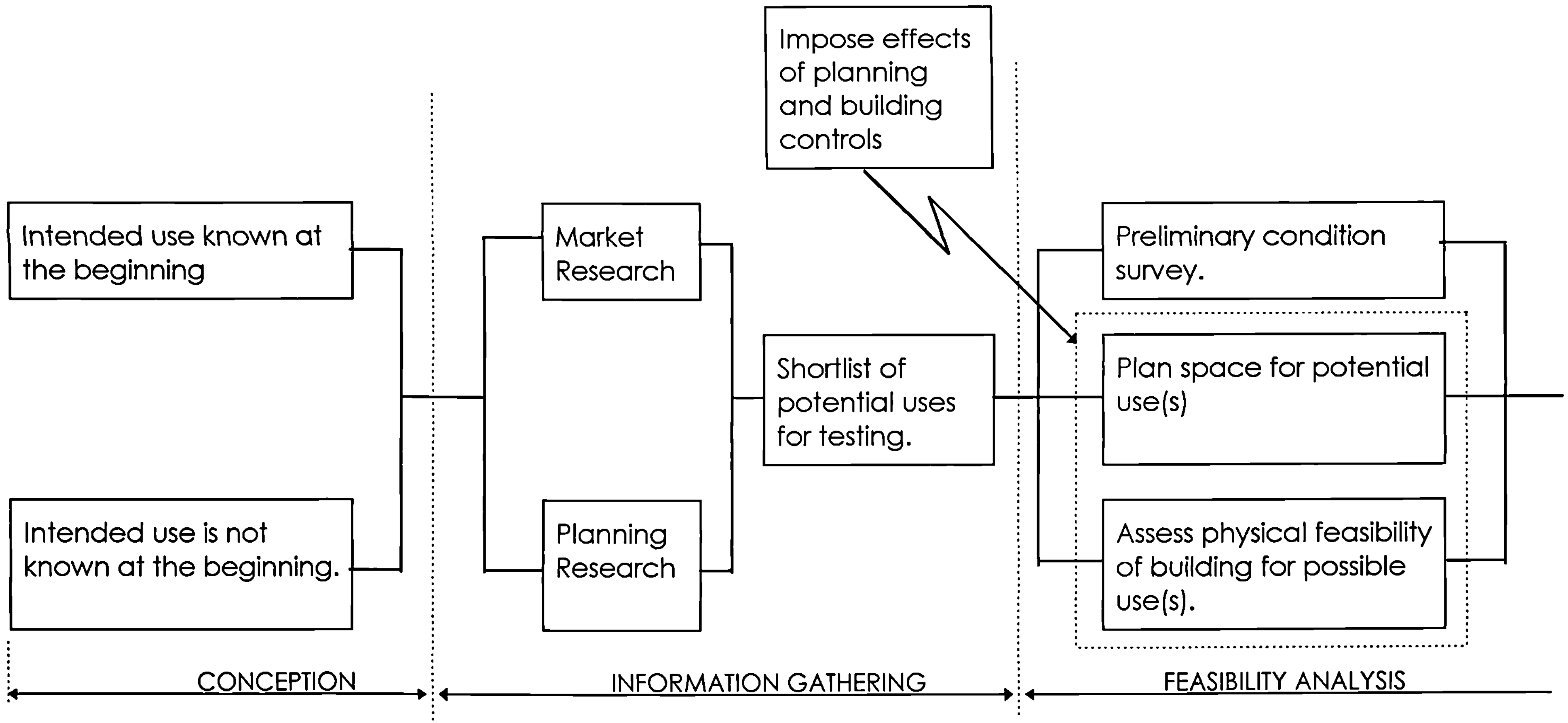


Figure 6.3: The Building Renewal Decision Process (*Source*: adapted from Eley and Worthington, 1984; Green and Foley, 1986)

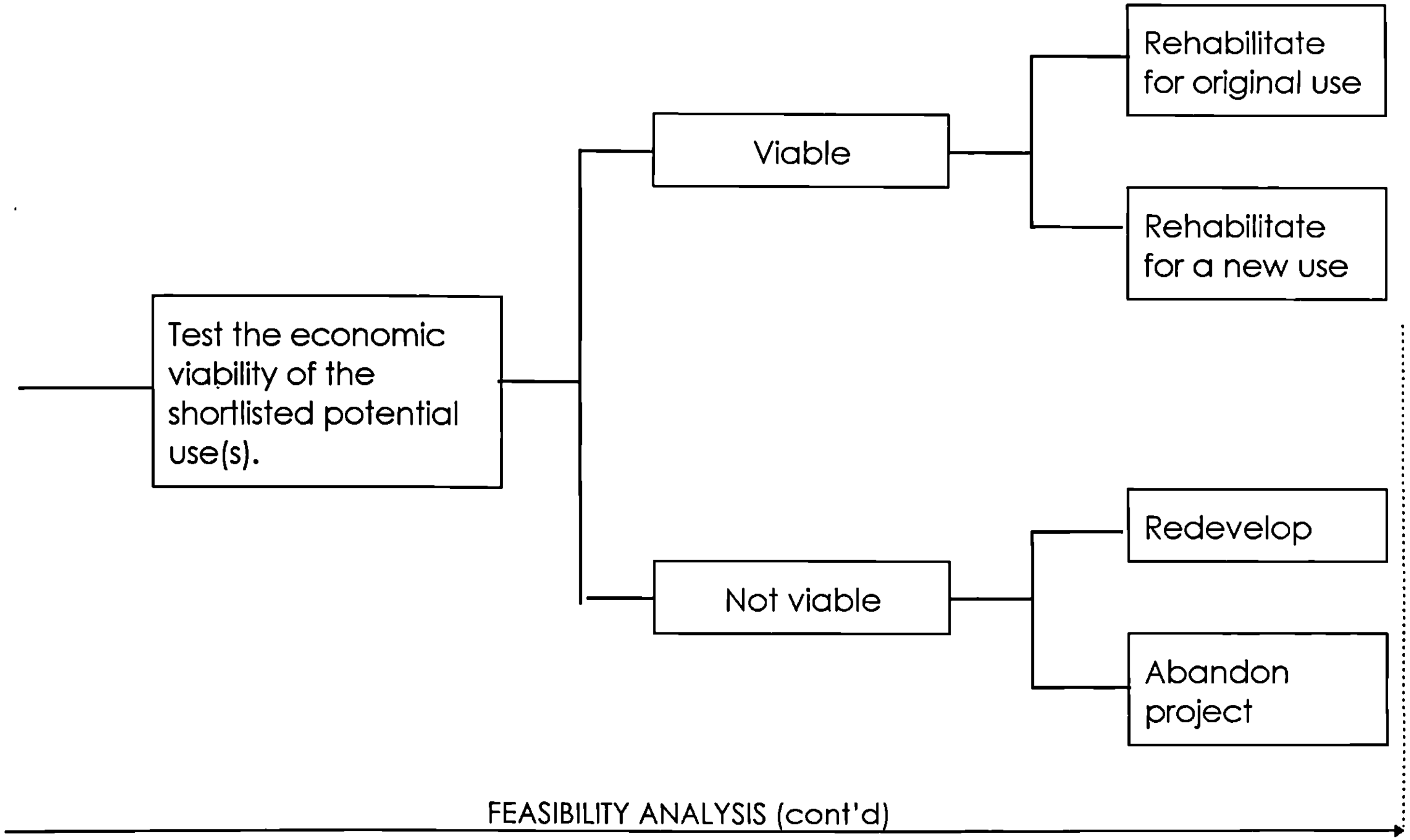


Figure 6.3 (cont'd): The Building Renewal Decision Process

- an investor or developer may initiate rehabilitation if an opportunity is spotted in the market to make long term or short term profits. For instance, a developer or investor may find out that there are several occupiers looking for good quality and affordable spaces to rent. If the rents they are prepared to pay cannot support new build, developers and investors may look for good quality second hand space which could be economically rehabilitated to satisfy this demand. In this instance, a developer or investor may acquire existing properties with the aim of realising profit by adding value through rehabilitation.
- a property owner may conceive the idea to embark on rehabilitation when experiencing falling demand, and with it, rents. This may be due to obsolescence brought about by competition from newer and modernised properties. The situation may become more critical when a major tenant is lost at the end of a lease period. An owner in such a situation has rehabilitation or refurbishment as an option for retaining or attracting new tenants. In the Connaught research mentioned earlier (Chase, 1996), many of the building owners surveyed indicated that refurbishment was much more effective in attracting or retaining tenants than financial inducements such as rent-free periods.
- a local authority may carry out building rehabilitation as part of the regeneration of an area or district. Local communities, conservation and amenity groups also may act to conserve buildings of historic or architectural interest.

6.7.2 Information Gathering Stage

This stage is essential to provide the data and information on which the 'proceed or do not proceed' decision in the feasibility analysis stage is based. Rehabilitation can involve the repair of building structure and fabric, the upgrading of services and the adaptation of spaces to match uses. These are carried out within the constraints imposed by planning and building controls, statutory requirements and local circumstances. The information required before deciding to carry out rehabilitation therefore concerns:

- the size and quality of spaces that occupiers want and other local issues that affect the demand and supply of space;
- where the subject property is not known at the outset, the availability of properties suitable to provide the type and quality of spaces being sought; and
- the planning status of the buildings involved that affect the uses permitted and whether or not demolition and alterations would be permitted.

To obtain the information above, three distinct surveys are called for which are (Eley and Worthington, 1984; Green and Foley, 1986):

- surveying of the local market;
- local area survey to search for suitable buildings: and
- the determination of the planning status of the candidate building.

In the rehabilitation-rebuild decision space, the subject of this research, it is assumed that the decision is being considered on a known building. The tasks that are described below are therefore restricted to the market and planning research.

6.7.2.1 Market Research

The information required varies and depends on the reasons that trigger the rehabilitation. For instance:

- an owner-occupier may like to know the value that the intended rehabilitation would add to his property compared to the amount that would be spent. He may also like to obtain information about the modern technology to introduce to deliver cost savings and the space requirements for such technology.

- a local authority, an amenity or conservation group on the other hand may like to know if the demand exists for the type of space they intend to provide by rehabilitation.
- a speculative developer or investor, however, would like to assess the marketability of the rehabilitated property and the risks associated with it.

Market research is conducted to obtain information on the type of uses that are searching for space, the size and quality of the spaces that occupiers are searching for, the rents that are being charged for such spaces and the availability of such quality spaces. In general, the market information required for analysing the feasibility and viability of any rehabilitation project includes the following (Eley and Worthington, 1984; Green and Foley, 1986):

- the volume and type of unlet space in the locality or sub-market;
- the volume and type of space entering or projected to enter the local market in the near future;
- the rate at which properties entering the market are being absorbed into use, for each use type;
- any ongoing or future demographic changes in the locality - such as companies relocating into or away from the locality, company closures, etc;
- the types of activities looking for space and the quality of space being sought by each use type (ie. location, size of accommodation, floor load capacities, services, internal finshes etc.);
- the rents being asked for various use types and what occupiers are prepared to pay for the quality of spaces they are seeking; and
- the predominant type of tenure for each property type.

iv. establishment of the alternative uses for the building - already known from the information gathering stage;
v. the establishment of a decision criteria;
vi. applying the decision criteria in testing each alternative; and
vii. making recommendation on whether to proceed or not to proceed and with what alternative.

The steps above can be reduced to three main tasks, which are: testing the technical feasibility of achieving the quality of property sought by the potential use(s); testing the financial viability of the feasible use(s) and deciding on the course of action.

6.7.3.1 Testing the technical feasibility

Testing the technical feasibility of carrying out the rehabilitation works on an existing building involves the following (figure 6.3):

- carrying out a preliminary condition survey of the building structure, fabric and services;
- planning the internal and external space to suit each potential use and the services that would be introduced paying regard to planning and building controls and other statutory requirements; and
- finally, assessing the feasibility of the existing building and its site to provide the structure, fabric and spaces required.

Each of the tasks is described below.

(a) Preliminary condition survey

The object of the preliminary condition survey is to gain knowledge of the sort of spaces that can be provided by the subject building. It is also to assess the condition of the building structure, its external fabric and to determine the level and condition of services. This involves two main complementary tasks: studying drawings and design documents of the building, if they are available, and the collection of information from the building itself.

The information to be noted during the preliminary condition survey includes the following:

- type and condition of the building structure: issues of interest might include the type of structural frame, foundation and roof as well as floor construction and their state of repair. One other issue important to re-use is the load carrying capacity of the floors.
- type and condition of external fabric: - issues of interest might include the type of construction material and whether it is load or non-load bearing. The state of repair of the external fabric, its energy and aesthetic characteristics might also be of interest.
- configuration:- issues of interest might include floor layout and internal sub-divisions. Others might be floor plate size (area and depth) and floor to floor heights.
- type and condition of services:- mechanical systems - eg. heating, ventilation and cooling plants; electrical systems - capacity, vertical and horizontal distribution and communication facilities.
- external space: - external access, room for extension, external storage car parking and landscaping.

After collecting these information, together with perhaps others pertinent to the particular circumstances, the stage would be set to create the spaces to match the intended use(s).

(b) Space planning for shortlisted use(s)

Space planning, according to Eley and Worthington (1984), consists of three tasks:

i. planning the site;

At the end of this stage, the use types looking for spaces, the size and quality of space required and the rents achievable for each use type would have been established. The next stage then would be to investigate the specific planning issues that could affect the permitted use(s) and the scope of the works required.

6.7.2.2 Planning Research

The interim shortlist in the previous stage of the uses looking for buildings would have to be refined by considering the impact of local planning and environmental issues. The relevant pieces of information that could be noted include the following:

- whether the building is listed or not - if listed, the questions that might be asked include the grade of listing; whether listed building consent is obtainable and how long the application process would take?;
- whether the building is in a conservation area or not - if it is, questions might be asked concerning whether consent for the type of works envisaged is obtainable and how long the process would take;
- the permitted uses of the building to establish the use class under which the permitted use falls and to determine for each intended use, if a material change of use is involved. This would determine whether planning permission is required or not. Attention would also have to be paid to whether the area is zoned for certain predominant land uses and whether planning authorities would permit an incompatible use. The views of the the local community regarding the use the existing building should be put to could be very important and should be investigated.
- car parking requirements - this would be to establish if there exists local authority car parking requirements for the intended or potential use(s).

At the end of the information gathering stage, if the potential use was not already known from the outset, a shortlist can be prepared of potential permitted uses for the building under consideration. On the other hand if the intended use is already known, the requirement for planning permission would be known after this stage. All the information gathered feed into the feasibility analysis that follows.

If the intended use is known, the issues uncovered at this stage, especially during the planning research, could decide if the process goes beyond this stage at all. For instance, if the subject property is listed, and of a grade that precludes the sort of alterations and/or demolitions envisaged, the project may have to be abandoned.

6.7.3 Feasibility Analysis

Feasibility analysis is the logical follow on from the information gathering stage. It is the stage when the recommendation to proceed or not to proceed is developed for each potential use. This recommendation is developed using all the information collected and bearing in mind the objectives of the promoter. Feasibility analysis therefore makes it possible to examine the subject building for each potential use to make an optimum choice.

Dorchester (1984), writing about office buildings, listed a number of steps for carrying out feasibility studies which are adopted here. They include, but are not limited to the following:

i. the identification of the client's objectives - these would be identified at the information gathering stage and firmed up at the feasibility stage;
ii. the identification of constraints - they can be external such as building and planning controls or internal such as the physical restrictions imposed by the existing building envelope and configuration;
iii. the identification of resources - what is available and/or can be raised and their sources;

ii. planning the building internal space, and where multiple tenancy is envisaged,

iii. planning the individual tenancies.

The input into this stage comes from the space requirements determined during the information gathering stage.

For an existing building, site planning mainly involve planning of the site road layout to facilitate the flow of vehicular traffic. Where site coverage would allow, it also involves planning for car parking, landscaping and the turning of delivery vehicles, if applicable. The external space required will depend on the intended use of the building and local authority requirements on car parking ratios. If there is room on the site, attention would also be paid to the ability to extend the existing building to meet future expansion plans.

Internal space planning involves the initial identification of the different sub-activities to be housed in the building and how to locate them. In locating these activities, recognition would have to be given to the horizontal, and if a building of more than one storey, the vertical relationships between activities.

In summary, the factors that influence internal space planning include the following:

- the activities that are to be located within the building and the space requirements for each of them;
- the relationships and links between sub-activities on each floor and between floors;
- the degree of separation between individual activities, individual users and between employees and management, where applicable. These determine the mix of open plan and cellular spaces required;
- the common spaces to be provided such as stairs, corridors, lifts, toilets, etc.;

- the space required for plant and equipment to be introduced and the housing required for cables, pipework and ductwork. This dictates the requirement for plant rooms, risers, raised floors and ceiling voids.
- fire safety requirements and how they affect compartmentation, escape routes and travel distances.

Where muiltiple tenancies are envisaged, the planning of the individual units would depend on the type of tenants to be attracted, security and how the property is to be managed.

The type of tenants determines the space required for each unit. Where maintaining separate and distinct identities is vital to the business of the tenants, decisions would have to be made concerning whether direct external access is provided to each unit and the degree of separation between tenants. Security and management considerations may also dictate the type of external access to provide, the degree of separation between tenants and the facilities that are to be commonly shared between tenants.

(c) Assessing the technical feasibility of the scheme

After planning the space for each potential use, the next action is to match the space requirements to the space attributes of the existing building. If the spaces do not exist in the form required, this step would entail the assessment of the feasibility of creating the required spaces and its effect on the structural integrity of the building. Also to be assessed as part of the feasibilty testing would be the capability of the structure, its fabric and services to support the activities associated with each potential use.

Every building is unique but there are systems and areas that are common to all buildings that must be assessed as part of any feasibility testing. These include (Coffey, 1993; Mendik, 1993):

- the floor space and its layout - total floor area, floorplate size and depth of floorplate - do they satisfy the minimum space requirements of the intended uses?
- floor to floor heights which affect the type of services that can be introduced.
- the structural system - its condition and capability to determine the scope of repairs and strengthening required for each intended use.
- the exterior system (ie. the exterior walls, windows, roof) - their state of repair; their energy and aesthetic characteristics; type of glass and its effect on the use of VDUs, their effect on daylight penetration; etc. - to determine the scope of repairs and replacement.
- services - adequacy, age, condition and efficiency - to determine the scope of repairs, upgrade and replacement to suit intended uses.
- code compliance - planning and building controls and other statutory Acts - may be different for different uses; the feasibility of the existing building meeting the different requirements for each use must be assessed.
- the presence of toxic substances - to determine the extent of removal of substances hazardous to health which are found in past building materials. These include asbestos found in insulation material and lead in paints.

After testing the technical feasibility of the existing building for each of the intended uses, the final shortlist of possible uses can then be drawn. The next step would be to investigate the economics of each of the feasible options.

6.7.3.2 Testing the financial viability

Testing the financial viability of rehabilitation for the shortlisted uses is the final action that would be required before any decision is made on the course of renewal action. This step brings together all the main variables that underlie the viability of any scheme which are (Cadman and Topping, 1995; Eley and Worthington, 1984):

- development cost;
- profit element; and
- anticipated or expected rental income.

The aim of the viability test is to determine if the expected rental income would be sufficient to cover the development cost, whilst at the same time delivering profit commensurate with the risks associated with the scheme.

The elements of development cost include the following (Cadman and Topping, 1995):

- land cost - (ie. the cost of acquiring the land, if not already owned). It would include stamp duty and agent's fees. It depends on the location, the age and quality of the existing land improvements and planning permission status.
- building cost - it depends on the age and quality of the building and the extent of any repair and strengthening works involved, the type of tenant(s) one wants to attract and the level of specification of space and services. If conversion works are involved, building costs could be influenced by the previous use and the new use(s) in terms of the associated structural alterations, internal space rearrangement and other changes due to fire and health regulations.
- fees - including professional, planning and building regulation fees.
- funding costs - including loan arrangement fees and interest charges which depend on the amount borrowed and the loan term.
- sale and letting costs - including letting agent's fees and promotion costs as well as inducements to be offered to tenants such as rent free periods.

Development profit is calculated according to the interest to be held in the completed scheme. For a developer who is seeking to dispose of the property after development, it is expressed as a percentage of either the net development value or the total development costs. For an investor seeking to hold the completed scheme for investment purposes, profitability may be assessed by the difference between the yield on cost and the capitalisation rate used to obtain the net development value (Cadman and Topping, 1995). Yield on cost is defined as the ratio of the first year's rental income to the total development cost (excluding any provision for profit). If this measure is higher than the capitalisation rate used in determining the net development value, the scheme is considered profitable. Development profit is fixed in relation to what is obtainable on other investments and may reflect the risks associated with the scheme. It may therefore contain an element to cater for contingencies.

Rental income is calculated over an annual period. It is calculated by multiplying the rent per unit area (m^2 or ft^2) by the net lettable area. Rental income depends on:

- location of the property - location characteristics such as level of amenities, accessibility, availability of car parking facilities and image are important.
- the quality of the property - determined by the level of specification of internal finishes and services, building external appearance as they affect aesthetics and image and landscaping.
- the intended use(s) of the building, and
- the factors that affect demand such as the state of the local and national economies and competition from other properties.

If the completed building is to be held as an investment, development cost and the profit element are expressed as annual equivalent costs over the preferred payback period to be comparable with the annual rental income. With all the data required available, the final step is to decide on the course of action.

6.7.3.3 Deciding on the course of action

At this stage, all the information required to make a decision would be available. The options available to the building owner, who may be an owner occupier, developer or investor, are (see figure 6.3):

- rehabilitation for the original use (ie. refurbishment);
- rehabilitation for a changed use (ie. conversion);
- demolition and redevelopment; and
- not doing anything at all.

The course of action chosen would depend on the decision criteria set up which stems from the motivation of the decision maker. If profit is the motive, the ultimate decision would be heavily weighted in favour of the rent that can be recovered from tenants compared to the investment made. If there are social reasons as well, the economics of the scheme can be improved by the availability of grants and subsidies.

Besides economic considerations, there are such social considerations as conservation of a building of significant architectural or historical interest. In such cases, the decision would involve making judgements on whether the qualities of the building to be saved is worth any shortfall in rental income.

6.8 Objectives of Building Renewal

All the issues highlighted in this chapter and chapter five are applied to develop objectives for building renewal. They also aid the identification of factors that affect the achievement of these objectives.

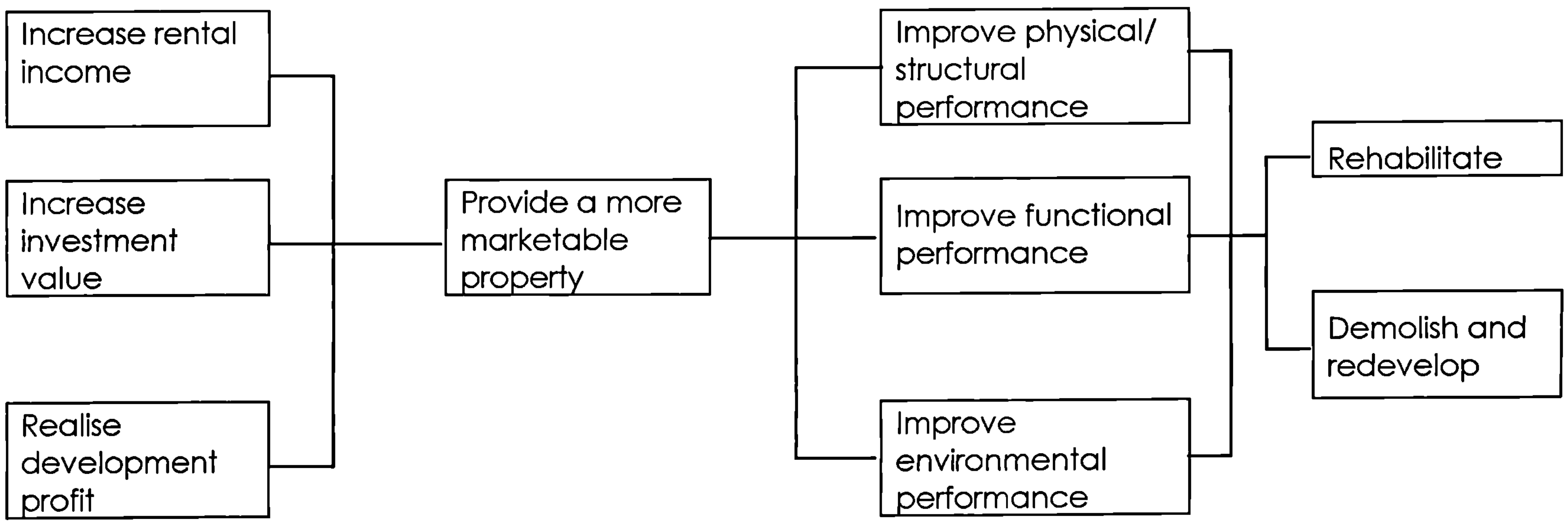


Figure 6.4: Building renewal objectives structure

By inspecting the wide range of issues highlighted in the two chapters, it is clear that the most fundamental objectives driving building renewal in the private commercial property sector are economic in nature. These are:

- to maintain or increase rental income;
- to maintain or increase investment value; and
- to realise development profit.

The link between these objectives and the actions available to achieve them is represented by the objectives structure shown in figure 6.4. It shows the key to achieving these fundamental objectives is to provide a more marketable property. This entails the improvement of the physical, structural, functional and environmental performance of the existing building through rehabilitation. Alternatively, the improved performance can be achieved through demolition and redevelopment. In deciding the option to choose: either rehabilitation or redevelopment, each of them would have to be assessed in terms of indicators that mark the achievement of the required or desired performance objectives. These performance indicators are discussed in the next section.

The outputs from the building renewal process is affected by factors external to the building system and the promoter's organisation. These factors are the sources of risks and uncertainties which must be evaluated before performance forecasts can be made. The factors affecting each objective are therefore examined below.

6.8.1 Improving Economic Performance

The indicators of achievement of the economic objectives listed in figure 6.4 are illustrated in figure 6.5 below. These are:

- rents obtainable;
- the yield obtainable;
- expected future maintenance costs;

- expected future running costs;
- future rate of depreciation; and
- the effect on portfolio values.

These indicators depend on the quality of the building and how it is accepted by the market. They also depend on the workings of the wider socio-economic climate.

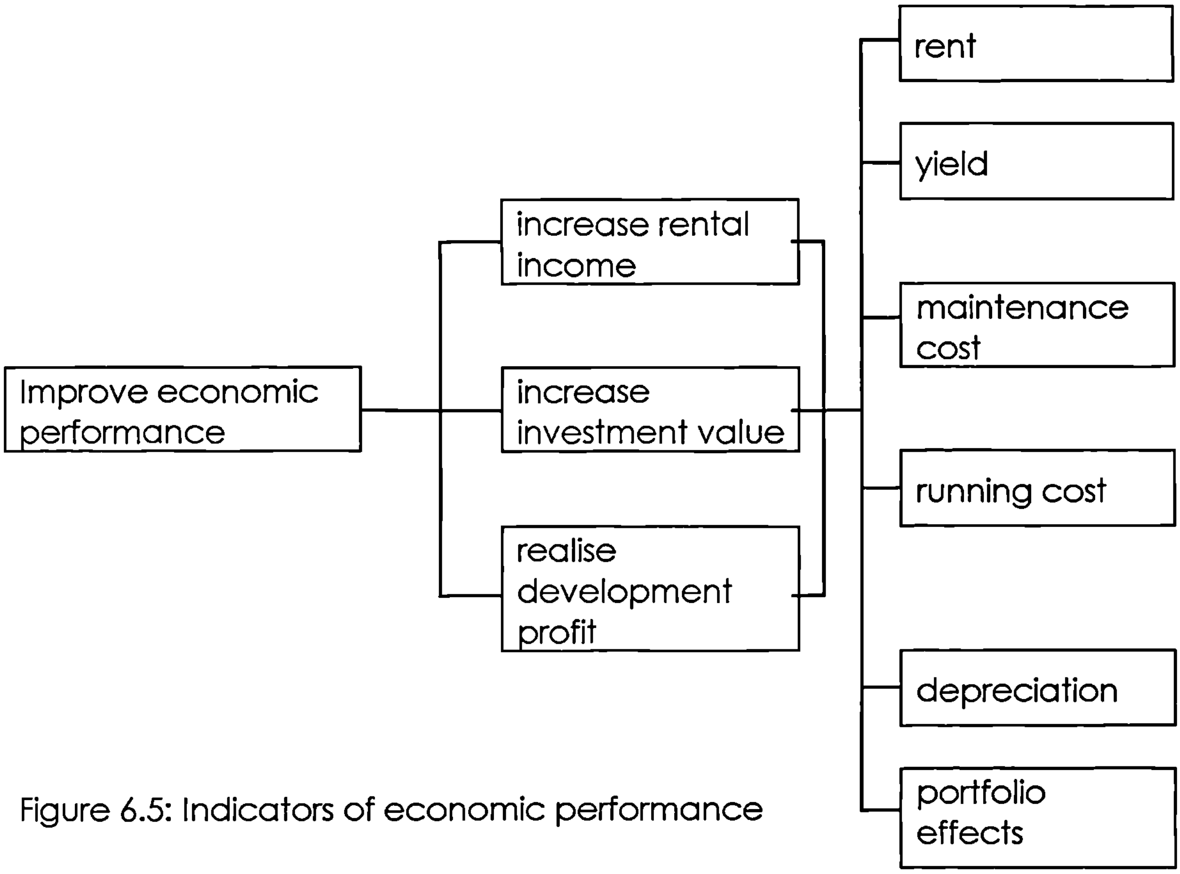


Figure 6.5: Indicators of economic performance

The major factor affecting the quality of buildings that can be provided is availability of resources and hence the cost of development. Not only does development cost affect profit but also the ability to raise the capital required is a major consideration. Efforts are therefore made on any development project to control cost. This implies controlling the major cost components which are site costs, building costs and interest charges. In this regard, one other way of improving the economics of development is also to apply for grants or subsidies where the project meets some public sector goals.

The other factors that affect the economic performance of buildings are those that affect demand and supply. Some of these are:

- taxation (including VAT, land tax, development tax etc.);
- legislation (eg. rent control laws);
- locational factors (eg. local infrastructure, transport links, urban decay etc.);
- the state of local and national economies;
- demographic changes (eg. company closures, ageing population; population movement, etc.);
- changes in central government policies;
- competition from other properties; and
- changes in social tastes and standards.

6.8.2 Improving Physical/ Structural Performance

The physical and structural performance of an existing building is always invariably concerned with the state of repair of the structure and fabric and how durable it is. It is also concerned with the natural fire resistance of the building materials used in the structure and fabric. This is illustrated below in figure 6.6.

The condition and capability of the building structure and the external fabric determines the scope of repairs and strengthening. This in turn affects the cost of rehabilitation.

The statutory requirements for fire safety are different for different building uses. Thus the natural fire resistance of the building materials has influence over the type of uses the building can be put to. It also affects the cost of fireproofing the structure and determines the extra measures that would be required to assure the fire safety of building users and the protection of the building contents.

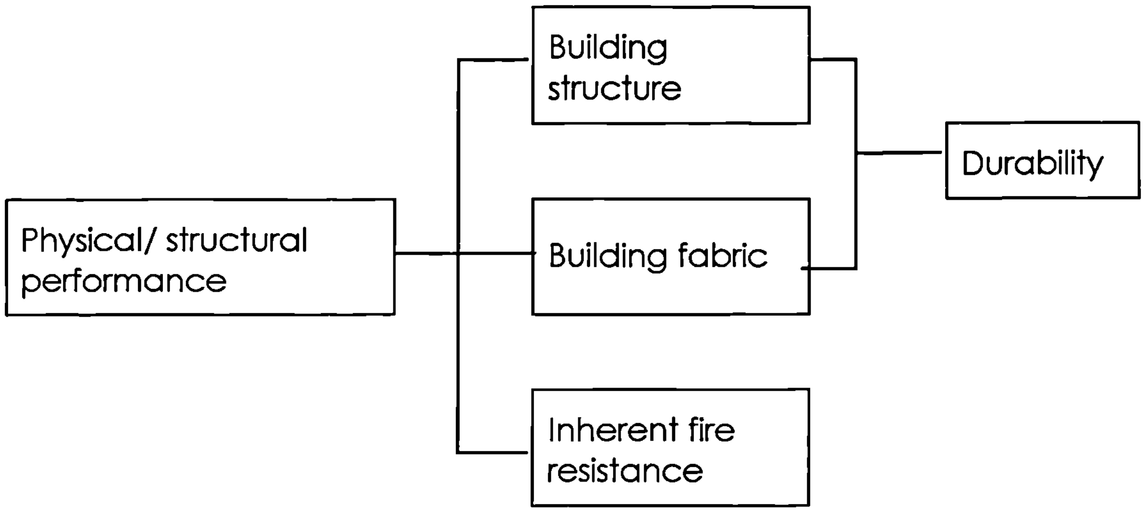


Figure 6.6: Indicators of Physical / structural performance

Thus the factors affecting the physical and structural performance of existing buildings are:

- the condition of the structure;
- the condition of the building fabric; and
- the natural fire resistance as determined by the building materials.

6.8.3 Improving the Functional Performance

The functional performance of buildings is largely determined by the match between space requirements and the quality and size of space available. In connection with this, both the size of floorspace and floor layout are very important. Also important to functional performance is the ability of the building as a whole to support the activities associated with the building use. This includes the housing of services and the plant that heats, cools and ventilates the internal space.

The flexibility to adapt both space and services to cope with new uses and to accommodate new technology is very much important to the functional performance of buildings. This is because occupiers' needs and working practices are continuously changing with time due to increasing advancements in technology.

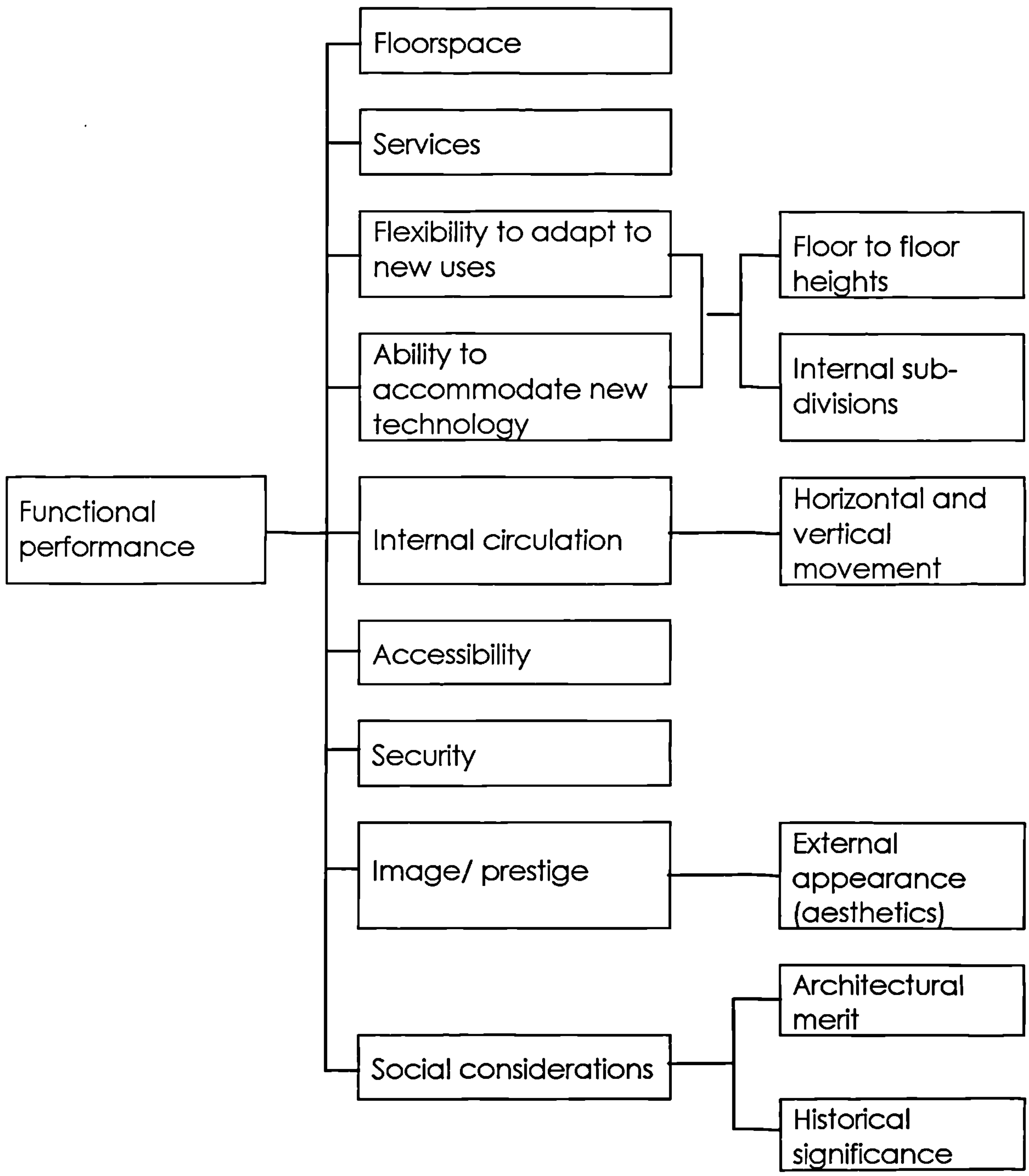


Figure 6.7: Indicators of functional performance

Space flexibility is influenced to a great extent by the internal building configuration. This involves issues like floor to floor heights and internal sub-divisions by columns and load-bearing walls.

The indicators of functional performance are summarised in figure 6.7. It shows that, besides the factors already mentioned, building functional performance depends on issues such as:

- the ease of internal circulation: the appropriateness in number and location of doors, stairs, lifts, etc. that facilitates movement of goods and occupants within and between floors.
- external accessibility:- the ease with which access is gained to the building or site. This is determined by the appropriateness of the entrance(s) to the site, availability of on-site car parking spaces and the location of external doors. It is to be noted that since problems with location may affect both new and existing buildings equally, location factors which do not affect the rehabilitation and the revelopment options differentially are not deemed to be applicable to the decision under consideration.
- security: the protection the building gives to occupants and property kept or stored in it, and
- image and prestige - which is determined by the visual impact in terms of the external appearance including entrances and reception areas (ie. aesthetic characteristics).

The factors above affect the private individual's consideration of functional performance. There are however social considerations as well in assessing functional performance. Societies do become attached to certain buildings to the extent that they would want to protect or conserve some of them. This may be due to the architectural merit of the buildings concerned or their historical significance.

6.8.4 Improving Environmental Performance

The environmental performance of buildings in this thesis is evaluated along the dimensions suggested by the Building Research Establishment Environmental Assessment Method (BREEAM) devised in 1990 by the BRE. In the method, the environmental impact of buildings are grouped under three categories (Parsa and Farshchi, 1996):

- local or neighbourhood impacts;
- global impacts; and
- indoor or internal impacts.

The factors that contribute to these impacts are summarised in figure 6.8.

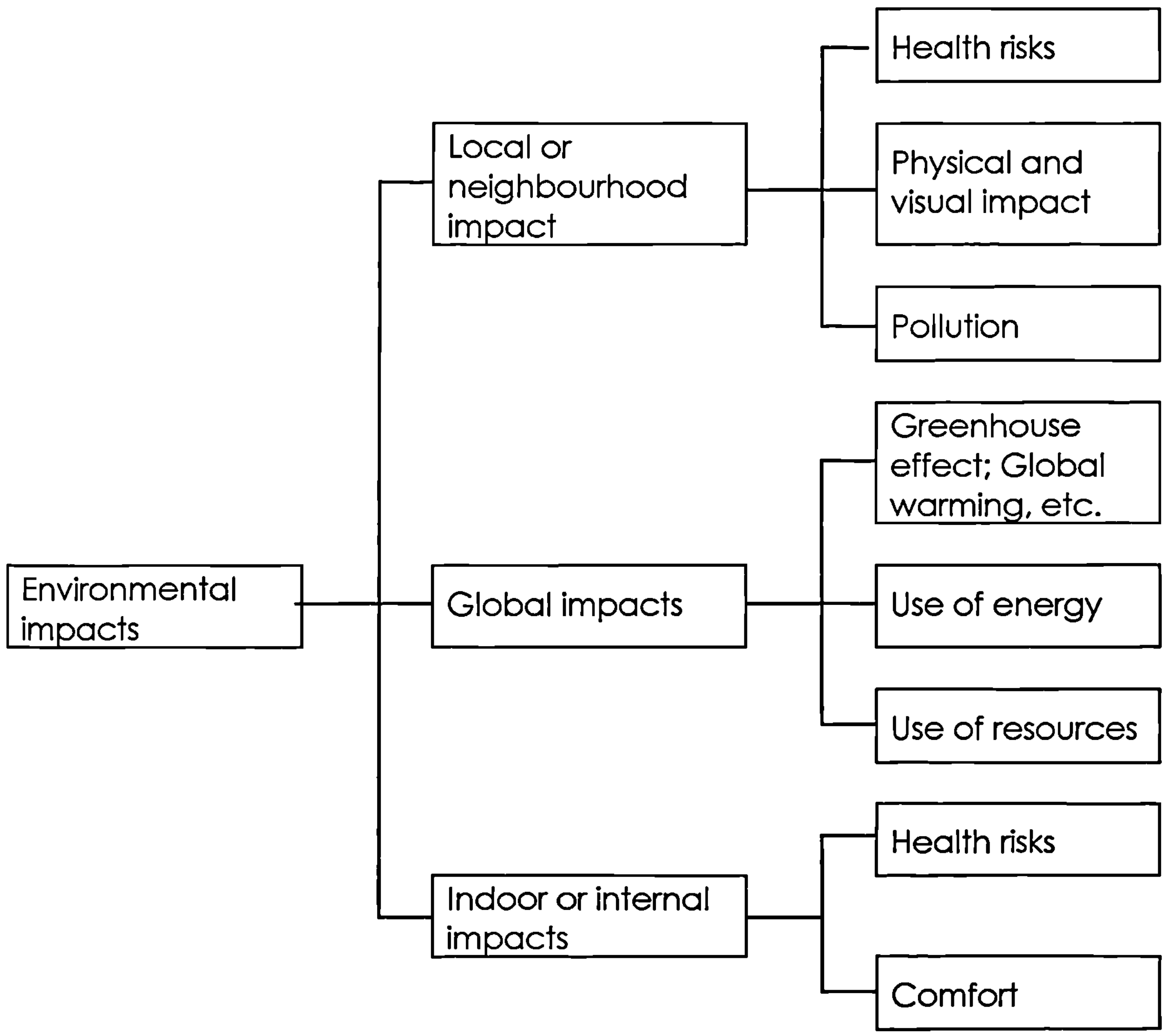


Figure 6.8: Environmental impacts of buildings

The local impacts are assessed in terms of:

- local health risks - legionnaires disease due to wet cooling;
- pollution due to waste disposal and soil contamination;
- effects caused by the physical characteristics of the building such as the effect of its height on local wind; and
- the visual impact caused by its appearance (ie. aesthetics) and how it blends into the locality.

The global impacts include greenhouse effects and global warming due to CO_2 emissions from heating plants and the use of CFCs in say, chillers, which leads to the depletion of the ozone layer in the atmosphere. Other global impacts concern the amount of resources (eg. tropical timber) and energy used in buildings.

Perhaps of most importance to the user is the indoor environment. The concern here is its effect on the health and comfort of users. The health effects are to do with indoor air quality and the presence of substances hazardous to health. The comfort aspects are in terms of the internal finishes, coverings and furnishings as well as thermal comfort and lighting.

6.9 The Primary Data Survey

Testing the criticality of each variable identified in the last section to building development and investment decisions is the subject of the primary research. Rather than test the criticality in the context of building renewal, it is extended to cover all development and investment decisions. It is felt that in this way valid underlying motivations of the main actors (ie. developers and investors) could be identified.

Some of the variables identified were deemed to equally affect rehabilitation and redevelopment. These variables were filtered out and not tested in the survey. The resulting questionnaire, which went out to respondents, is in Appendix A.

CHAPTER SEVEN
ANALYSIS AND DISCUSSION OF PRIMARY SURVEY DATA

7.1 Introduction

This chapter presents the findings of the primary research which is the search of original data to satisfy the objectives of the current research. The chapter therefore presents in the first instance, the data collected through the questionnaire survey followed by discussions of the findings and the results of the analyses carried out on the data.

Going back to chapters one and four, the main aim of the research was to establish a decision model to aid the selection of building renewal actions including rehabilitation and redevelopment. In connection with this, the data collection for this study was to satisfy the following main research objectives:

1. the determination of the value objectives of the main actors involved in property development (represented by developers and investors in this study);
2. the determination of variables that indicate the extent to which each option under consideration achieves the objectives above;
3. the determination of some of the external factors that could affect the achievement of the objectives above; and
4. the establishment of an aggregation rule for combining the degree of achievement of the objectives into a single scalar quantity to reflect relative values of competing building renewal options.

In line with the research objectives above, the data collected through the questionnaire survey were intended to serve three main purposes:

- to confirm and indicate the importance of the indicators in the assessment of the generic performance objectives determined during the secondary data search;
- to help in uncovering additional indicating variables; and

- to provide an indication of the relative importance of the generic performance objectives in property decision making.

The data collected are given in their raw form in the appendices to the thesis. Also in the appendices are data summaries, tables and details of the analysis carried out on the data. The analysis methods themselves are described in chapter four.

The chapter begins with an examination of the quality issues that affect the accuracy of the collected data. The main issues concern the eligibility of respondents, in terms of the ownership of their companies, and the rate of response. The questionnaire had a screening question to ensure that all the completed questionnaires came form privately-owned companies as the subject of the study is private commercial properties. Three further screening questions concerning job title, job responsibility and decision making capacity were included to assess the eligibility of respondents in terms of their 'qualification' to provide the information sought. The population elements of interest were decision makers in the companies contacted.

After the quality issues, the chapter goes into the substantive part of the research. First is the identification of the variables critical to assessing the generic property performance objectives identified in the secondary data search which are economic, functional, physical/structural and environmental performance. The variables are identified by analysing the responses supplied to the survey questions. The responses are also examined to see if significant differences exist between sub-groups of the survey population (ie. developers and investors). Next, the data collected on the relative importance of the generic objectives to property decisions are discussed. The relative importance is in terms of importance weights.

In connection with the objectives of the research, data was also collected on external factors that could affect property performance. The responses to this questionnaire item are tabulated for each sub-group in Appendix E. The findings on these are also discussed in this chapter together with comparisons between the survey sub-groups.

Using a cut-off criteria first mentioned in chapter four, the variables critical to each performance objective are shortlisted. These are listed at the end of the chapter and are to form the bases for the development of the building renewal decision model.

7.2 Response Rate and Respondent Demographics

The samples for the current research were drawn from two independent sampling frames for reasons already explained in chapter four. The two frames are labelled as A and B in the analyses that follow. Sampling frame A is the 'property developers and investors' section in the *UK Directory of Property Developers, Investors and Financiers,* 7th Edition, (1994). Sampling frame B was constructed from the April, May and June 1996 *Directory* supplements to the *Estates Gazette*.

In all, 404 questionnaires were sent out: 300 from frame A and 104 from frame B. The questionnaire returns for each sample are summarised in Table 7.1. It shows that only 59 questionnaires were returned from sample A and 25 from sample B.

At the time of the survey, sampling frame A was over two years old. The currency of some of the information listed in it could not be verified as reflected in the number of questionnaires returned by the post office. This was due to the fact that some of the companies the questionnaires were addressed to had either moved away or ceased trading. The questionnaires returned by the post office are classified as non-contacts. Of the 59 questionnaires returned from Sample A, 15 were non-contacts leaving only 44 which had actually been returned by respondents.

Sampling frame B was constructed from data that was then current, therefore there were no problems of non-contacts.

Table 7.1 Questionnaire Returns

Sample	Questionnaires Returned	Unreturned Questionnaires	Total
Sample A	59	241	300
Sample B	25	79	104
Total	84	316	404

The observed proportion of non-contacts in sample A (ie. 15 / 59) was used to adjust the sample size. This was done by estimating the number of non-contacts in the entire sample. Using the same ratio of non-contacts observed, this approximates to 76, giving an adjusted sample size of 224 instead of the original 300 for sample A.

Besides the non-contacts, the returned questionnaires from both samples contained 'ineligibles' and 'refusals'. The 'ineligibles' refer to those questionnaires completed by subjects who were deemed to be outside the survey population definition. It is to be noted that the survey population was defined in chapter four as 'decision makers from private UK Property Development and Investment companies'. The 'refusals' refer to those questionnaires which were returned uncompleted for various reasons. Details of the number of refusals and ineligibles for both samples are given in Table 7.2. Among the 44 questionnaires returned from Sample A were 6 ineligibles and 8 refusals. Sample B had 1 ineligible and 2 refusals.

Table 7.2: Eligibility classification of the returned questionnaires (ignoring non-contacts)

Sample	Completed Questionnaires		Refusals	Total
	Eligibles	Non-eligibles		
Sample A	30	6	8	44
Sample B	22	1	2	25
Total	52	7	10	69

(Tull and Hawkins, 1990) defined the response rate as the ratio of the number of eligible completed questionnaires to the total number of eligible elements of the sample. By this definition, the response rate for sample A is about 14% [ie. 30/(224-6)]. This is on the low side but is comparable to response rates on similar academic surveys in this subject area. Calculated in the same way, the response rate for sample B is about 21% [ie 22/ (104-1)] which is an improvement on sample A.

A secondary aim of the study was to examine variations between the population sub-groups. According to the population definition, the sub-groups of interest are developers and investors. The breakdown of the repondents by sub-group type is summarised in Table 7.3. It shows that the 30 eligible completed questionnaires from sample A included 21from property development companies and 9 from property investment companies. For Sample B, 9 questionnaires were returned by property investment companies and 13 by development companies.

Table 7.3: Developers and Investors breakdown by sample

Sub-group	Sample A	Sample B	Total
Investors	9	9	18
Developers	21	13	34
Total	30	22	52

7.3 Decision Making Capacities of Respondents

To reiterate, the ultimate aim of this research was to create a decision model to guide building renewal decisions. It was therefore essential that the critical determinants affecting the building renewal decision were identified and incorporated into the model to make it relevant to the problem. The critical indicators were to be derived from the responses to the survey questions. It was therefore considered that the 'accuracy' of the responses would be reinforced if they came from property decision makers. Thus the decision making capacity of each respondent was a fundamental attribute underlying the validity of the survey findings.

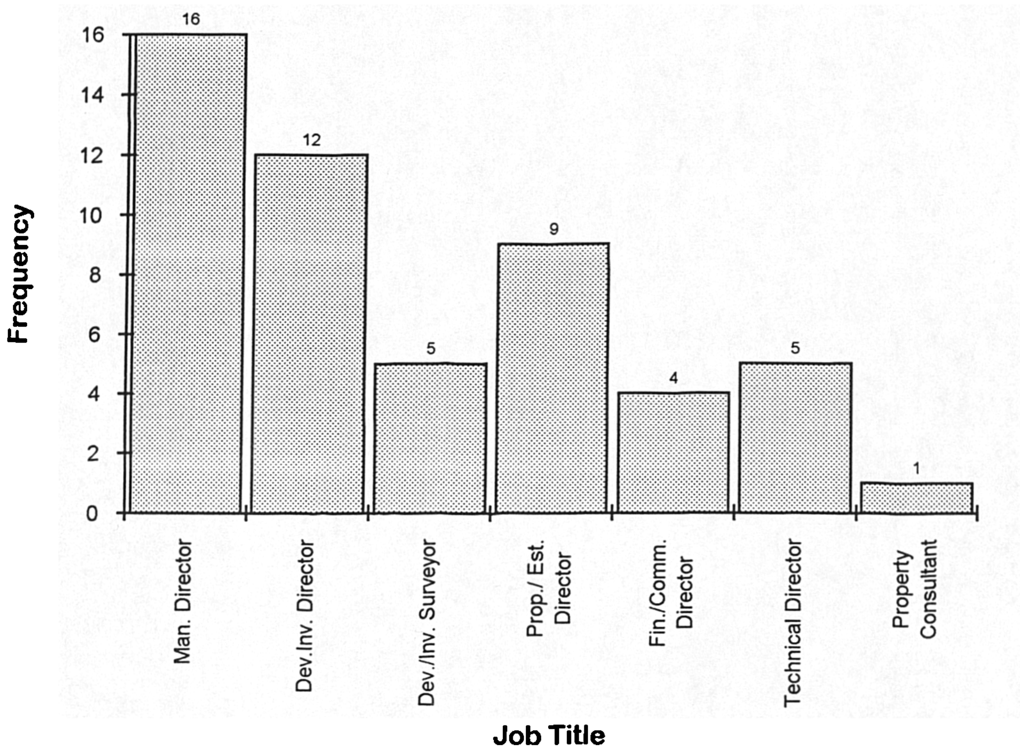
Three additional screening questions were included in the questionnaire on job title, job responsibility and decision making capacity on company development and investment plans. Responses to these questions were to be pooled to form a view on each respondent's 'qualification' to supply the information sought in the research.

The range of responses supplied to the screening question on job titles were grouped under the following titles in the data coding exercise for analysis:

- Managing Director;
- Development/ Investment Director;
- Development / Investment Surveyor;
- Property/ Estate Director;
- Financial/ Commercial Director;
- Technical Director; and
- Property Consultant.

Details of the respondents according to the categorisation above are shown in figure 7.1 below.

Figure 7.1: Breakdown of respondents by Job title



The range of responses supplied to the question on what these job titles entail has again been grouped under the following descriptions:

- drawing up company investment and development policies;
- managing company property portfolios;
- identifying development and investment opportunities;
- raising development and investment funds; and
- others, including project and construction management.

The breakdown of these responsibilities among the respondents for both samples is summarised in Table 7.4.

Table 7.4: Breakdown of respondents by job responsibilities

Job Responsibility	Frequency
Drawing up company development and investment policies.	11
Development and Investment management.	21
Raising and managing investment and development funds.	5
Identification of investment and development opportunities.	7
Others (eg. project & construction management)	8
Total	52

Finally, the respondents were asked choose from the list: ***ultimate decision maker***; ***part of the decision making body***; and ***advisor to the decision making body***, what best describes their decision making capacity in framing their company's development and investment policies. The information supplied is summarised in figure 7.2. It shows that out of the 52 eligible respondents to the survey from the two samples, 35% (18) described themselves as ultimate decision makers, 59% (31) described themselves as part of the decision making body and 6% (3) described themselves as advisors to the decision making body.

The conclusion drawn by pooling the job title, the job resposibilities and the decision making capacity of each respondent is that each of them was 'qualified' to supply the information requested in the questionnaire. The responses supplied to the substantive survey questions are therefore deemed 'accurate' to form the bases of the building renewal decision model.

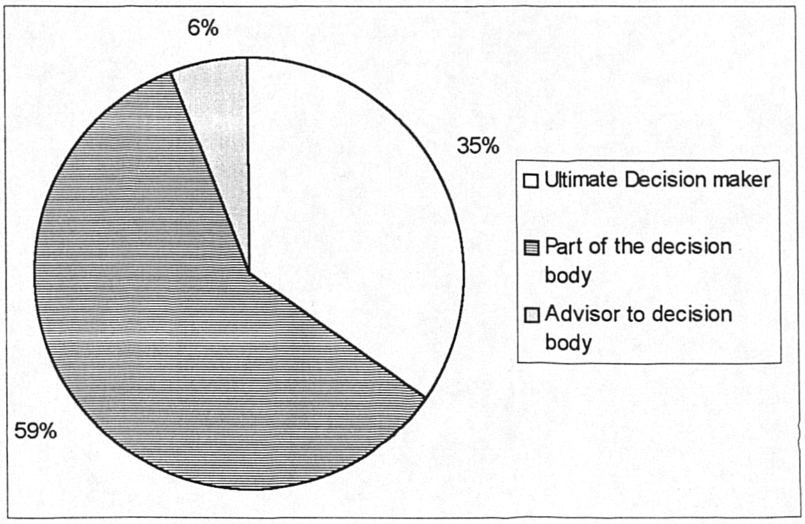


Figure 7.2: Decision making capacities of respondents

7.4 Indicators of Property Economic Performance

After the secondary data search, it was established that aspects of property performance can be classed as functional, physical/structural and environmental. To assess the performance of any property under consideration under these dimensions require indicators. This section presents data collected on the attitude of respondents concerning the importance of presented indicators to the asessment of the economic performance of properties.

In the survey, respondents were asked to express how critical each presented economic indicator was in terms of whether they would consider it: *in all cases, in some cases* or *not at all* in their development and investment decisions.

Details of the response distributions for the economic variables are given in Appendix C1 in which the separate distributions for each sample have been combined into single relative response frequencies for each sub-group (ie. developers and investors). The calculation of the combined relative frequencies are as described in chapter four. A graphical representation of these distributions are shown in figures 7.3 and 7.4 for each sub-group.

Significance tests were performed on the two distributions to determine if there were any variations between reponses supplied by the developers and the investors (see Appendix C1 for details). They revealed the two sub-groups were generally in agreement over the importance of the following indicators:

- *development cost;*
- *saleability/ lettability;*
- *profitability;*
- *depreciation; and*
- *site value*

It can be seen that all the variables are connected with financial gains or returns. In the private sector, financial gain is considered to be the prime objective of property development and investment. It is therefore to be expected that the responses to these variables do not differ significantly between the developers and investors surveyed. There were however significant differences between the two subgroups in terms of the responses to the following variables:

- *effect of subject property on portfolio already held;*
- *rental value;*
- *capital growth potential;*
- *income growth potential;*
- *operating costs; and*
- *maintenance costs.*

Figure 7.3: Relative response frequencies for economic variables (developers)

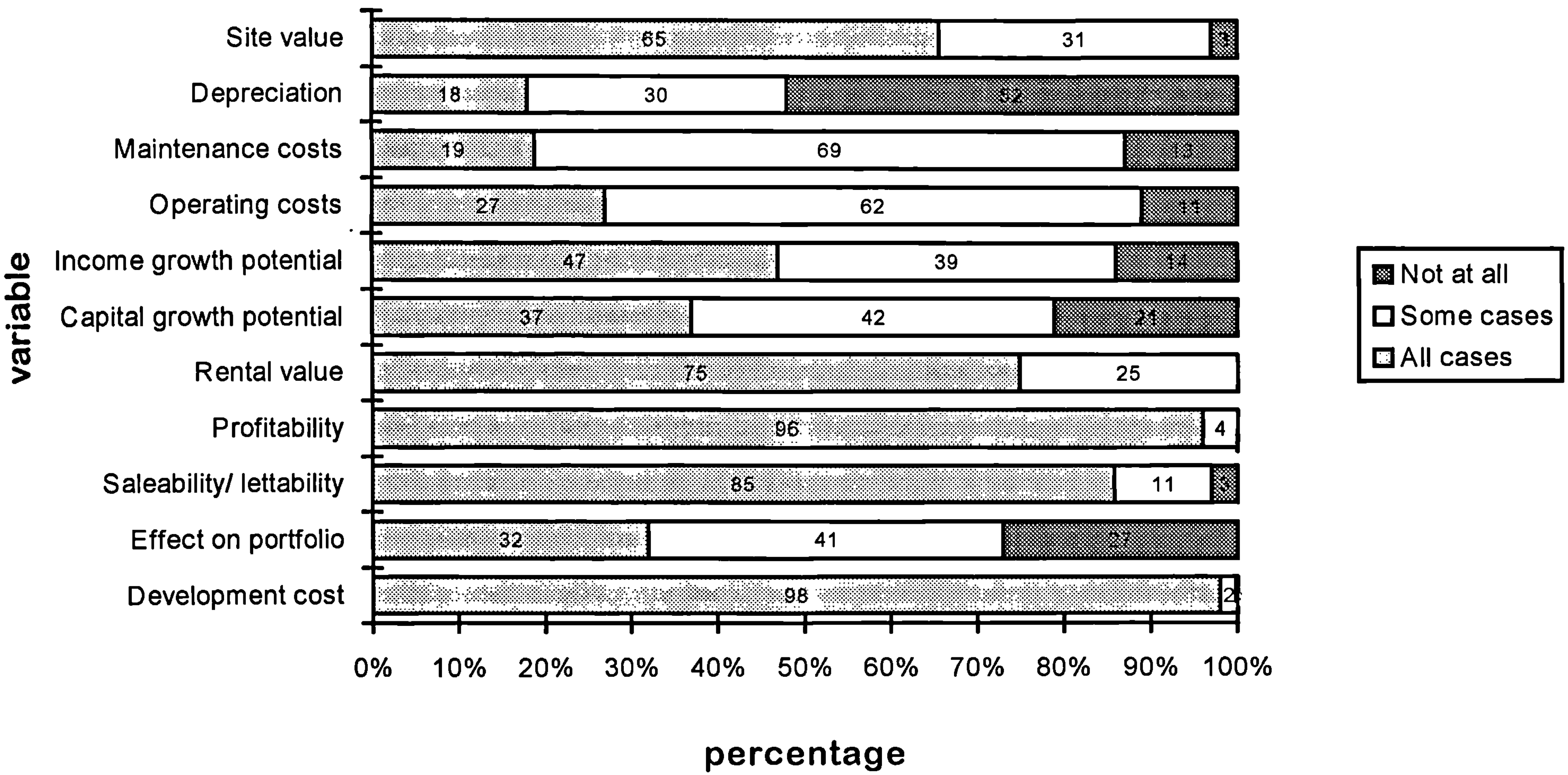
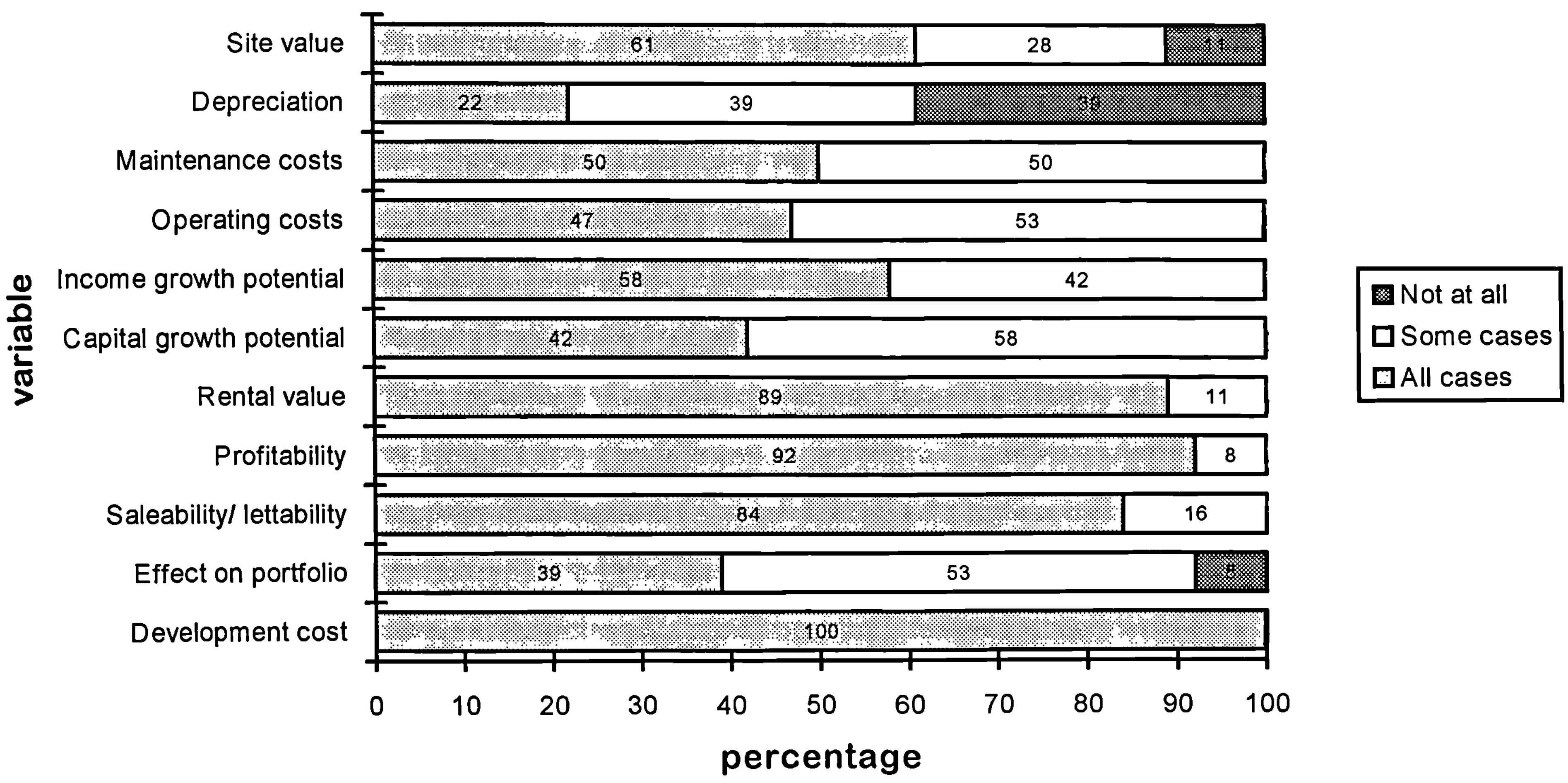


Figure 7.4: Relative response frequencies for economic variables (investors)



The interesting observation made is that all the variables over which significant differences were detected are associated with the long term holding of property. This appears to highlight the basic differences that exist between property developers and investors. Typically, developers hold a short-term view of property returns whereas investors may be prepared to take a long-term view.

The responses supplied by both sub-groups to the economic indicators are discussed in detail below.

There is almost a consensus among the developers and investors surveyed of the importance of *development cost* to the assessment of the economic performance of properties. All the investors surveyed (100%) and 98% of the developers indicated that they would consider this variable in all decision situations. *Development cost* is one of the variables that determine the profitability of development. To investors, it indirectly affects investment returns through its influence on acquisition price. This observation is therefore to be expected.

Portfolio effects however does not appear to have a strong influence on property development and investment decisions. Only a third of the developers surveyed (32%) and 39% of the investors surveyed would consider it in all decision cases. There were significant variation in the responses supplied by the two sub-groups though: whereas 92% of the investors would consider *portfolio effects* in some or all decision cases, nearly a third of the developers (27%) would not even consider it.

Another variable which appeared from the survey to influence property decisions is *saleability and lettability*, which in other words is marketability. The survey showed that more than four in five of all respondents (84% of developers and 85% of investors) would consider *saleability/ lettability* in all cases of their property development and investment decisions.

Consistent with the earlier observation on ***development cost***, ***profitability*** is also shown by the survey to strongly influence property investment and development decisions. Evidence of this comes from the fact that 96% of the developers surveyed and 92% of the investors would consider it in all property decisions. This finding is not surprising as ***profitability*** has been mentioned throughout the thesis as being the key motivation for private sector property development and investment.

Rental value, another of the variables that determines the profitability of property development and investment, is shown to strongly influence development and investment decisions. A very high percentage of the developers and investors surveyed would consider it in all decision cases (see figures 7.3 and 7.4). Significantly, though, a higher proportion of the investors surveyed (89%) would consider ***rental value*** in all decision cases as against 75% of the developers.

In the survey, ***capital growth potential*** is shown to moderately contribute to the assessment of economic performance of properties among both survey sub-groups. Only 37% of developers and 42% of investors would take ***capital growth potential*** of properties into consideration in all property decision cases. The response distribution to this variable among the developers and investors however do differ in that whereas 100% of the investors surveyed would consider ***capital growth potential*** in all or some decision cases, as much as 21% of the developers would not even consider it.

Similarly, ***income growth potential***, from the responses supplied, does not appear to strongly influence property investment and development decisions. The survey findings show that 47% of the developers and 58% of the investors surveyed would consider ***income growth potential*** in all their property decisions. However, whereas all the investors surveyed would consider *income growth potential* in some or all decision situations, 14% of the developers surveyed would not at all.

Operating costs appeared not to be critical to the assessment of the economic performance of properties according to the developers and investors surveyed. However, almost twice the proportion of investors (47%) as developers (27%) would consider *operating costs* in all decision cases. Furthermore, whereas all the investors surveyed would consider *operating costs* in some or all decision situations, 11% of the developers surveyed would not even consider it.

Significant differences were revealed between the developers and the investors in terms of the importance of *maintenance costs.* Whereas half (50%) of the investors surveyed indicated that they would consider *maintenance costs* in all assessment of economic performance, only 19% of the developers would. Furthermore, all the investors (100%) surveyed indicated that they would consider *maintenance costs* in all or some decision cases. However 11% of the developers indicated that they would not consider it at all.

Depreciation is not a major factor to economic performance assessment of properties, according to the two survey sub-groups. Around a fifth of all respondents (18% of developers and 22% of investors) surveyed would consider *depreciation* in all decision cases. Conversely, as much as 52% of the developers and 39% of the investors would not consider it at all. This finding appears to confirm an observation made by Baum (1991: p. 38) that property professionals in the UK pay less attention to depreciation.

There was agreement between the two sub-groups over the importance of *site value* to the assessment of economic performance of properties. More than 60% of all respondents (65% of the developers and 61% of the investors) indicated that they would consider *site value* in all cases of their property decisions. Only 3% of the developers and 11% of the investors would not consider *site value* at all in their decisions.

Provision was made in the questionnaire for respondents to list any additional variables they thought could be critical to the assessment of the economic performance of properties. This yielded a number of additional variables which included: ***institutional investor's requirements*** and ***yield***. The rest were: ***security of income, size as part of portfolio*** and ***what is available or likely to be available on the local market.*** All of these additional variables can be subsumed within the variables already discussed. The original list of variables is therefore deemed adequate for assessing the economic performance of properties.

To isolate the variables critical to each of the generic performance objectives, a composite measure, referred to as a criticality index (CRI), is defined. This measure converts the response spread for each variable into a single scalar quantity to reflect how critical a variable is to the achievement of the performance objective being assessed.

The CRI for each variable is defined as:

$$CRI = \frac{\sum w_i f_i}{N}, \text{ where,}$$

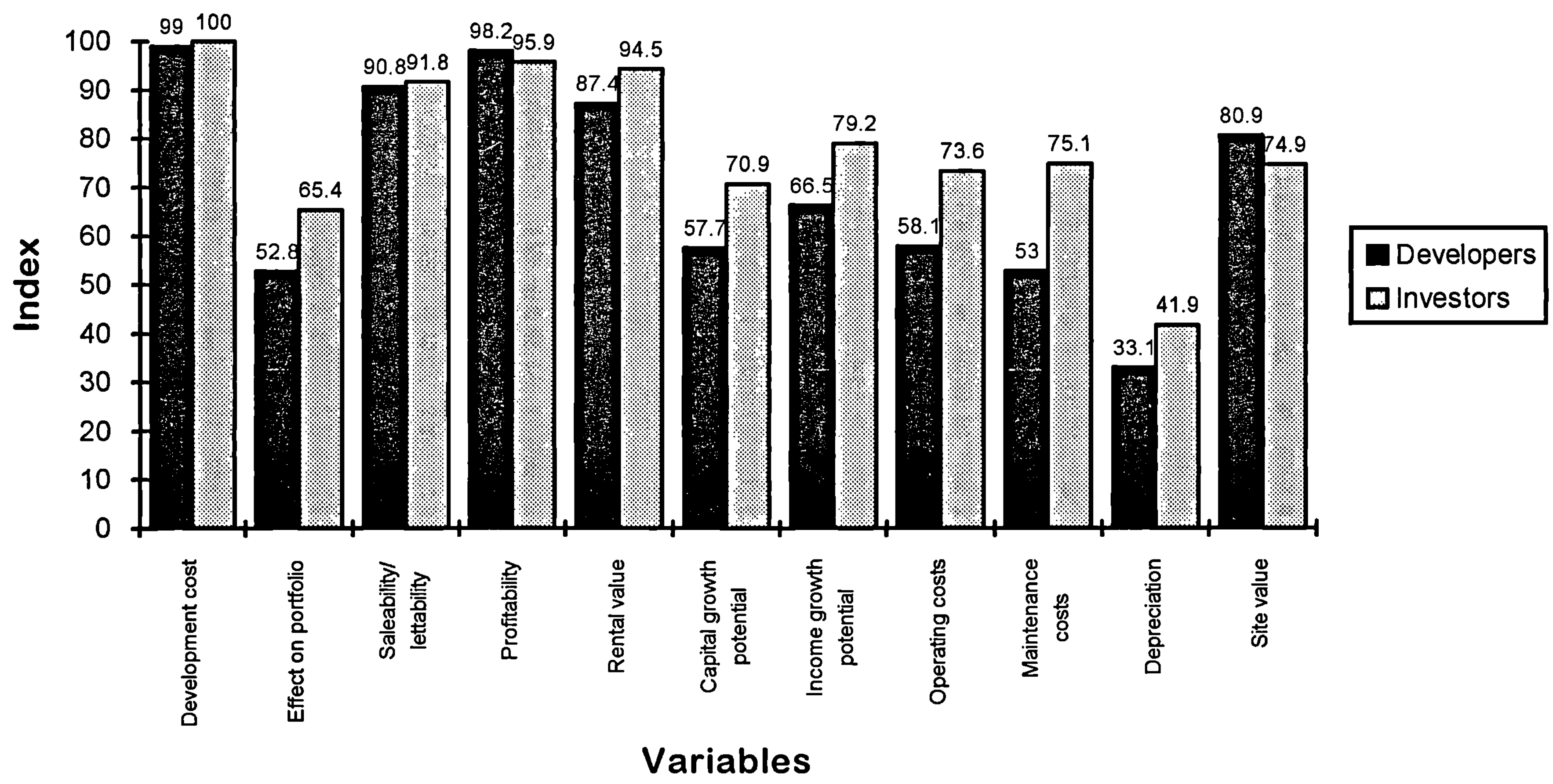
w_i -weight given to each response category to reflect its relative value. (In this study, the weights assigned to the response categories are: ***consider in all cases*** - 2; ***consider in some cases*** - 1; and ***not consider at all*** - 0)

These response weightings assumed that the response categories are spaced equally in value.

f_i - the relative frequency for each response category, and

N - the number of significant scale points (in this case N = 2).

Figure 7.5: Criticality Indices (CRIs) for the economic indicators



The detailed calculations of the CRIs for the economic indicators are given in Appendix C1. These are summarised graphically in figure 7.5 for each survey sub-group.

The CRI scores shown in figure 7.5 confirm those variables for which very significant differences and agreements were detected between the investors and the developers. For instance the CRI scores for the variables *development cost, saleability/lettability,* and *profitability* for both sub-groups are very close whilst those for *capital growth potential, income growth potential, operating costs* and *maintenance costs* are shown to be quite apart. The ability of the CRI scores to confirm the earlier observations made through the significance tests validates the CRI scale.

If CRI scores of 90 or more is arbitrarily used to define key indicators, then to the developers surveyed, the key indicators of property economic performance are: *development costs* (CRI = 99.0), *profitability* (CRI = 98.2) and *saleability/lettability* (CRI = 90.8). Among the investors surveyed, the key economic indicators are: *development cost* (100.0), *profitability* (95.9), *rental value* (94.5) and *saleability/lettability* (91.8). For both survey sub-groups, the least important economic variable is *depreciation* with CRI scores 33.1and 41.9 for developers and investors respectively.

To be able to shortlist the primary or critical economic variables, a cut-off CRI score is defined. Before this though, first some points on the CRI-scale are examined. If 100% of respondents would consider a certain variable in all decision situations, the CRI score is 100, according to the definition of CRI. If 100% would consider a variable in some cases, the CRI score is 50 and if 100% would not consider it at all, the CRI score is 0.

For this research, a primary or critical indicator is defined as a variable which at least 50% of respondents would consider in all decision cases and the remaining 50% would consider in some cases. By this definition, the cut-off CRI score is fixed at 75.0. Thus any variable whose CRI score, when rounded to the nearest 5, is greater or equal to 75 according to at least one of the survey sub-groups is considered a critical indicator. These critical indicators are listed in Table 7.5.

Table 7.5: Primary and secondary economic indicators

Primary variables	**Secondary variables**
Development cost	Depreciation
Saleability/ lettability	Effect on portfolio
Profitability	Capital growth potential
Rental value	
Income growth potential	
Maintenance costs	
Operating costs	
Site value	

7.5 Indicators of Property Functional Performance

To determine the indicators of the functional performance of properties, the respondents were again asked to rate how important a number of functional variables were. They were asked to indicate the importance of each variable in terms of whether, in their property development and investment decisions, they would consider it ***in all cases, in some cases*** or ***not at all.*** The responses supplied to this questionnaire item and the results of the subsequent analysis are presented and discussed in this section.

The responses to the variables were reduced to combined relative frequency tables in accordance with methods already described in chapter four. Details of the calculations are shown in Appendix C2 and summarised graphically in figures 7.6 and 7.7 for each sub-group.

Figure 7.6: Relative response frequencies for functional variables (developers)

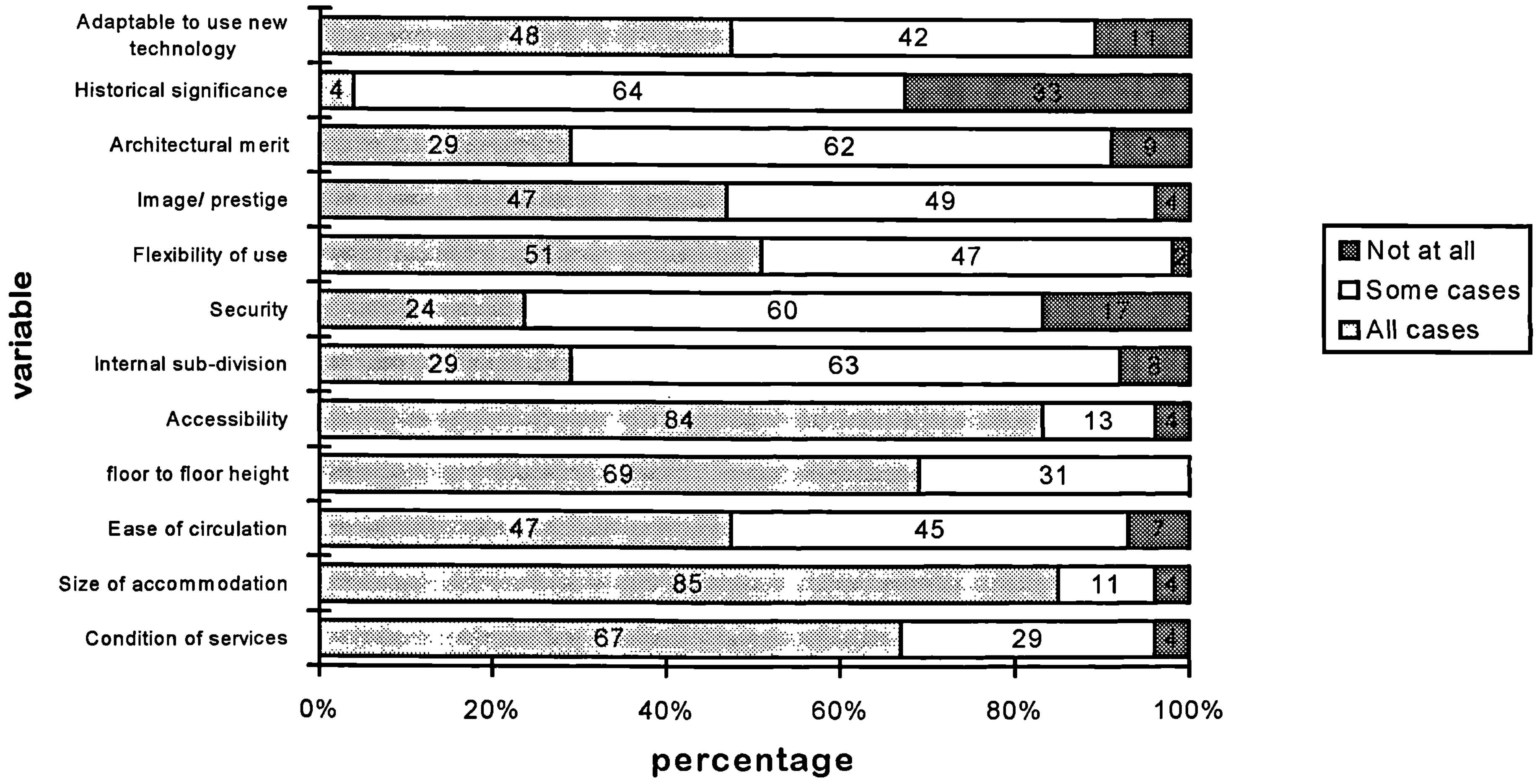
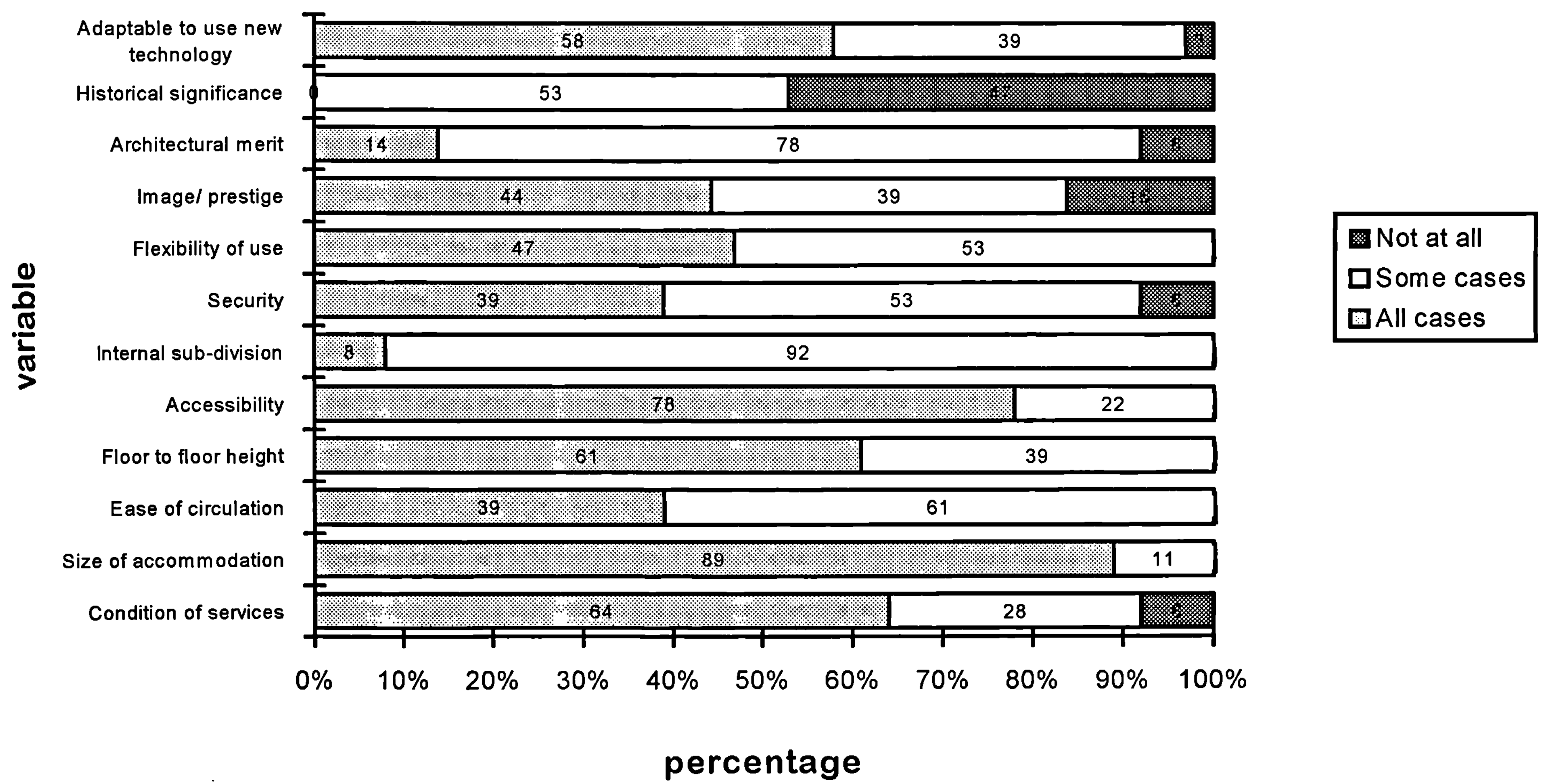


Figure 7.7: Relative response frequencies for functional variables (investors)



Significance tests performed on the response distributions for the variables revealed that for most of them, there were no significant variations in the responses between the developers and the investors surveyed. Significant variations were however detected in the responses to the following variables:

- *internal sub-divisions;*
- *security;*
- *image/prestige; and*
- *architectural merit.*

The response distributions for the individual variables are examined in detail below.

In terms of the distribution of the responses to the variable, *condition of services*, there was general agreement between the developers and investors surveyed over its importance to the assessment of functional performance. About two-thirds of all respondents (67% of the developers and 64% of the investors) indicated that they would consider *condition of services* in all their property investment and devlopment decisions. A further 29% of the developers and 28% of the investors indicated that they would consider it in some decision cases. Only 4% of the developers and 8% of the investors would not consider *condition of services* at all in their property decisions.

Size of accommodation was shown by the survey to be a very important functional performance indicator to both survey sub-groups. In assessing the functional performance of properties to guide their development and investment decisions, 85% of the developers and 89% of the investors indicated that they would consider *size of accommodation* in all decision cases. Further all the investors and 96% of the developers would consider it in all or some decision situations.

The variable, *ease of circulation* did not appear to have a major influence on decisions among both sub-groups. A moderate 47% of developers and 39% of the investors indicated that they would take it into consideration in all property decisions. However, when pooled, all the investors indicated that they would consider *ease of circulation* in some or all decision cases. On the other hand, 7% of the developers indicated that they would not even consider it.

Both survey sub-groups (ie. the developers and investors) were shown to be in agreement over the importance of *floor to floor height* to the assessment of functional performance of properties. Around two-thirds of all respondents (69% of developers and 61% of investors) indicated that they would consider it in all decisions. The importance of *floor to floor height* to both sub-groups is further affirmed by the fact that all of them indicated that they would consider it in at least some decision situations.

Another variable which was shown by the survey to be very much important to functional performance is *accessibility*. A high proportion of the respondents (developers - 84%; investors - 78%) indicated that they would consider *accessibility* in all cases of their property decisions. Further, all the investors surveyed indicated that they would consider it in all or some decision situations with only 4% of the developers indicating that they would not consider it at all.

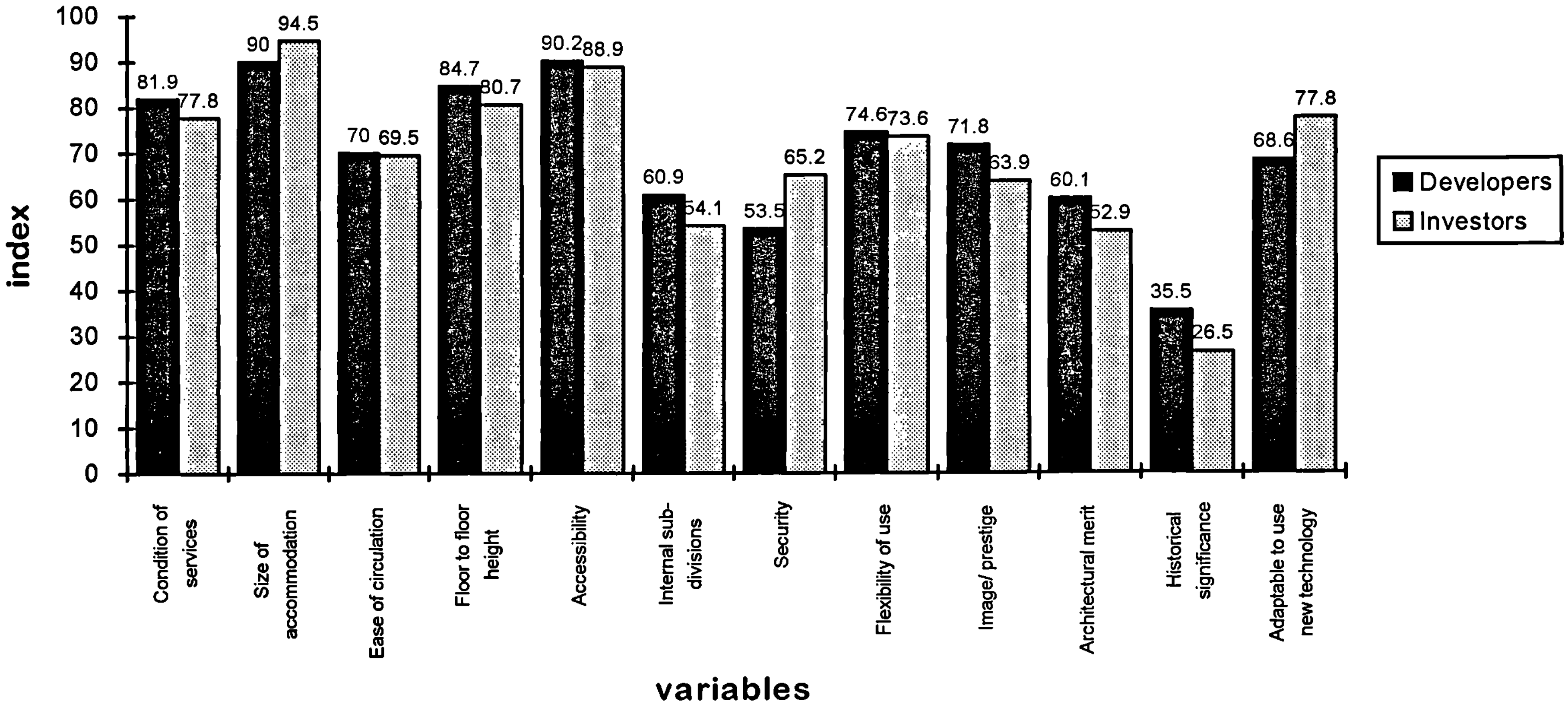
Internal sub-divisions did not appear to influence property decisions greatly among both the developers and investors surveyed. Nonetheless, there were significant variations between the responses supplied by the two sub-groups. Whereas 29% of the developers indicated that they would consider *internal sub-divisions* in all decisons cases, only 8% of the investors indicated that they would. On the other hand, all the investors surveyed indicated that they would consider it at least in some decision cases whereas 8% of the developers would not even consider it.

Security appeared to be another variable that does not influence decisions to any large extent. In spite of this observation, the developers and investors surveyed supplied significantly different responses when asked about the influence of *security* in assessing functional performance. Whilst 39% of the investors indicated that they would consider *security* in all decision cases, only 24% of the developers indicated that they would. Further, when pooled, 92% of the investors would consider *security* in some or all decision situations against 83% of the developers.

The two sub-groups were in agreement over the importance of *flexibility of use* to functional performance assessment. In general though, the survey showed *flecibility of use* to have only a moderate influence on property development and investment decisions. Around half of all the respondents (51% of the developers and 47% of the investors) indicated that they would consider *flexibility of use* in all decision cases. The survey also showed that nearly all the respondents (100% of the investors and 98% of the developers) would consider *flexibility of use* in at least some decision situations.

Contrary to the views widely held during the 1980s property boom, *image/prestige* only moderately influences property decisions, according to the survey. From inspecting the distribution of responses to this variable, what emerges though is that *image/prestige* appears to be much more important to the developers than the investors. About the same proportion of both sub-groups (47% of developers and 44% of investors) indicated that they would consider it in all cases of their property development and investment decisions. However, 16% of the investors would not even consider it against only 4% of the developers who would not.

Figure 7.8: Criticality indices (CRIs) for functional variables



Architectural merit is also another variable which appeared not to greatly influence decisions among the investors and developers, according to the survey. Yet the distribution of responses suggest that it may be more important to the developers than the investors. Whilst only 14% of the investors indicated that they would consider *architectural merit* in all investment decisions, more than twice that proportion of the developers (29%) would consider it in all development decisions. The proportions of the two sub-groups who would consider *architectural merit* at least in some decision cases are however much closer: 91% of the developers against 92% of the investors.

The developers and investors surveyed were in general agreement that *historical significance* does not, to a great extent, influence their decisions. None of the investors and only 4% of the developers indicated that they would consider *historical significance* in all cases of assessing the functional performance of buildings. On the other hand, a third of the developers (33%) and nearly half of the investors (47%) would not even consider it in their decisions.

According to the survey respondents, *adaptability to use new technology* moderately influences functional performance assessment. Nearly half of the developers (48%) and three-fifths of investors (58%) indicated that they would consider *adaptability to use new technology* in all assessments of functional performance of properties. Further evidence of the influence of *adaptability to use new technology* is that 90% of the developers and 97% of the investors surveyed indicated that they would at least consider it in some decisions.

Provisions were made in the questionnaire for respondents to supply additional variables they would consider in assessing the functional performance of properties. The additional variables uncovered were: ***the ability to extend, appropriateness of services to suit users' requirements, car parking*** and *value for money for occupiers*. These variables can be subsumed within those already listed. The original list of variables is therefore adopted for the decision model.

The relative frequencies for the response categories for each variable were once again converted to criticality indices (CRI scores) as defined in section 7.4. The CRI scores for the presented variables are tabulated in Appendix C2. They are also summarised graphically in figure 7.8. These show that the key variables for assessing the functional performance of properties among both the developers and investors surveyed are: *size of accommodation, accessibility* and *floor to floor height*. The CRI scores also show that the most unlikely variable to be considered in assessing the functional performance of properties, among both sub-groups is *historical significance* .

As before, the critical or primary indicators are defined as those whose CRI scores, when rounded to the nearest 5, are greater or equal to 75 among at least one of the sub-groups. By this definition, the primary and secondary functional performance indicators are as listed in Table 7.6.

Table 7.6 Primary and secondary functional indicators

Primary indicators	**Secondary indicators**
Condition of services	Ease of circulation
Accommodation size	Internal sub-division
Floor to floor height	Security
Accessibility	Image/prestige
Flexibility of use	Architectural merit
Adaptable to use new technology	Historical significance

7.6 Indicators of Physical/ structural performance of Properties

In this section, data collected on the criticality of presented variables to the assessment of the physical/structural performance of properties are discussed. In the survey, respondents were again asked to indicate the importance of each presented physical and structural variable in terms of whether they would consider it *in all cases* of their development and investment decisions, or *in some cases* or *not at all.*

Figure 7.9: Relative response frequencies to physical/ structural variables (developers)

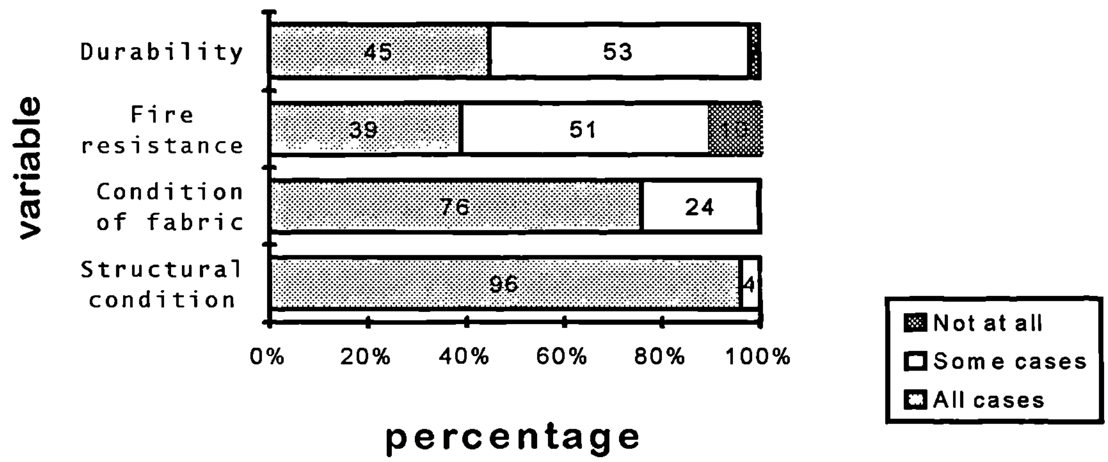
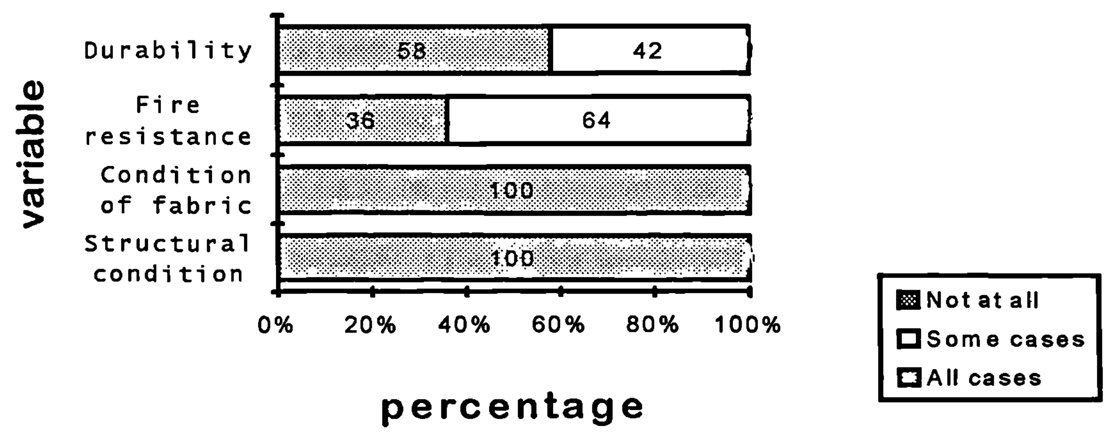


Figure 7.10: Relative response frequencies to physical/ structural variables (investors)



The data collected on this questionnaire item for survey samples A and B have been reduced to relative frequency tables . The separate relative frequency tables constructed for each sample have been combined into single relative frequency tables for each sub-group as described in chapter four. These are tabulated in Appendix C3 and also summarised graphically in figures 7.9 and 7.10 for the developers and the investors respectively.

Significance tests were performed on the distribution of the responses to each variable using the relative frequencies (see details in Appendix C3). These tests revealed significant differences between the two sub-groups in terms of their responses to the variables *fire resistance* and *condition of fabric*. There were however general agreement as far as the responses to the variables *structural condition* and *durability* were concerned. The distribution of the responses to the variables are examined in detail below.

The developers and investors surveyed generally agreed over the importance of *structural condition* in assessing the physical and structural performance of properties. Nearly all the survey respondents (96% of the developers and 100% of the investors) indicated that they would consider *structural condition* in all cases of their property decision making. These high proportions suggest that *structural condition* is a very critical indicator of physical/ structural performance.

Another variable found to be very critical to physical/ structural performance was *condition of fabric*. Significant variations though were detected between the two sub-groups in terms of the distribution of their responses. All the investors indicated that they would consider *condition of fabric* in all decision cases against three-quarters (76%) of the developers. However all the developers indicated that they would at least consider *condition of fabric* in some decision situations.

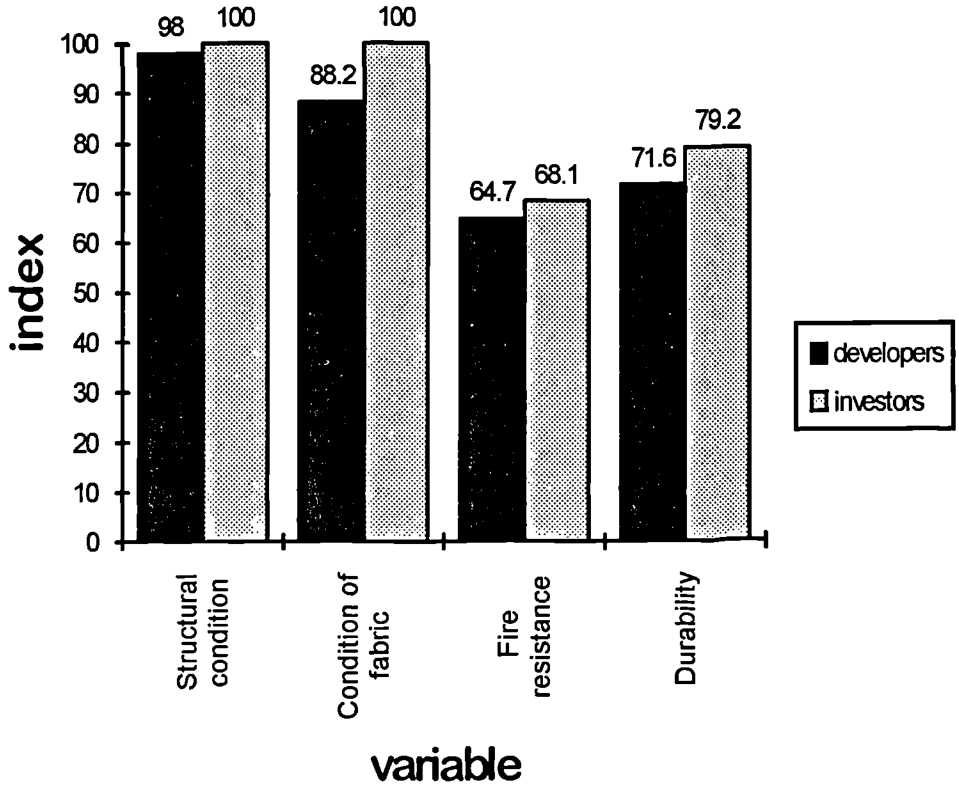
Contrary to expectations, the survey showed that *fire resistance* is not a critical determinant of physical and structural performance of buildings. Nearly two-fifths of the respondents (39% of the developers and 36% of the investors) indicated that they would consider *fire resistance* in all their development and Investment decisions. There were significant variations though in the overall distribution of responses. Whilst all the investors indicated that they would consider *fire resistance* in at least some decision situations, 10% of the developers would not even consider it.

The developers and investors surveyed were also in agreement over how they view *durability* as moderately affecting physical and structural performance. Slightly under half of the developers (45%) and about two-thirds of the investors (58%) indicated they would consider it in all decision cases. Almost all the respondents (100% of the investors and 98% of the developers) however indicated that they would consider *durability* in at least some decision situations.

In response to the open-ended part of this questionnaire item which asked for additional physical and structural variables, the respondents supplied the following: *soil condition and topography, loading constraints of floors, type of structure and construction materials, age of building* and *life of building elements.* All these variables are specific dimensions of the higher level variables already presented to respondents in the survey. The original list of variables are therefore retained but further explication of the higher level variables at the model building stage will take these additional variables into consideration.

Criticality indices or CRI scores, as defined in section 7.4, were calculated for each variable from the relative frequencies of the responses supplied. The indices for all the physical and structural variables are tabulated in Appendix C3 for both the developers and investors surveyed. They are summarised graphically as well in figure 7.11.

Figure 7.11: Criticality indices for physical/ structural variables



It can be seen from figure 7.11 that the key variables to both the developers and investors for assessing property physical and structural performance are clearly *structural condition* and *condition of fabric*. The most unlikely variable to be considered is *fire resistance*.

One of the aims of the current study is to isolate primary or critical indicators to go into the building renewal decision model. These primary indicators have been defined in section 7.4 as variables whose CRI scores, when rounded to the nearest 5, is greater or equal to 75 among at least one sub-group. Table 7.7 lists the primary and secondary physical and structural variables in accordance with this definition.

Table 7.7 Primary and secondary physical/ structural indicators

Primary variables	Secondary variables
Structural condition Condition of fabric Durability	Fire resistance

7.7 Indicators of Environmental Performance of Properties

The final generic property performance objective for which indicators were sought was environmental. Here also, respondents were presented with a list of environmental variables and then asked to indicate their importance. They were to this by stating if they would consider each variable ***in all cases, some cases*** or ***not at all*** in development and investment decision making. The data collected on the responses to these variables are discussed in this section.

The response data collected for both survey sub-groups were reduced to relative frequency tables which are tabulated in Appendix C4 for both samples. The separate relative frequency tables for the two samples were then combined into single relative frequency tables for each sub-group as described in chapter four. These combined relative frequency tables are summarised in figures 7.12 and 7.13 .

Significance tests (details in Appendix C4) performed on the distribution of responses among the survey sub-groups revealed general agreement over the criticality of the variable ***internal health/comfort*** to environmental performance. Significant variations, though, were detected between the sub-groups in respect of their responses to the variables ***local effects, energy/resource conservation, aesthetics*** and ***pollution.***

Figure 7:12: Relative frequencies for responses to environmental variables (developers)

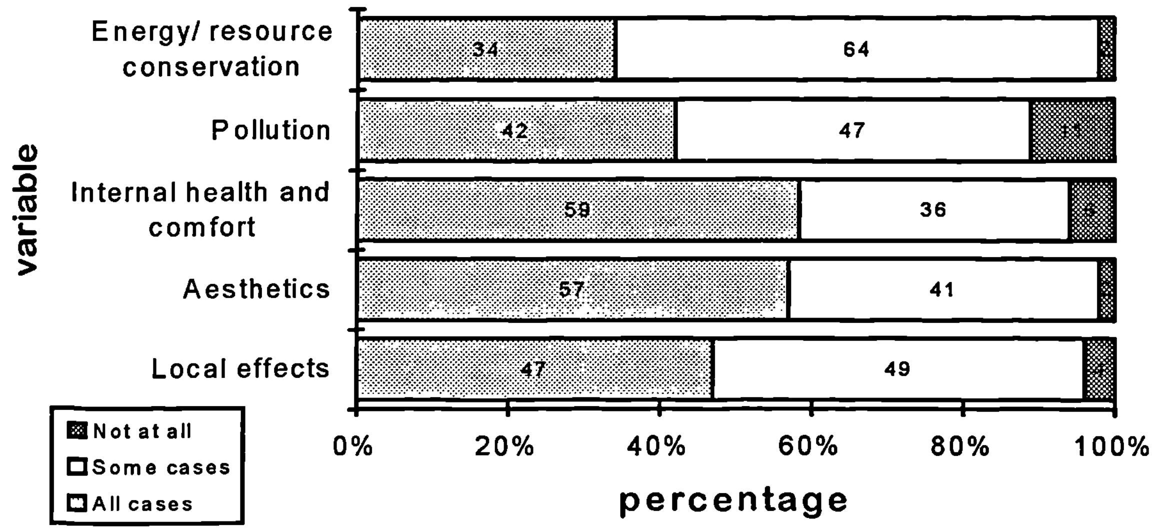
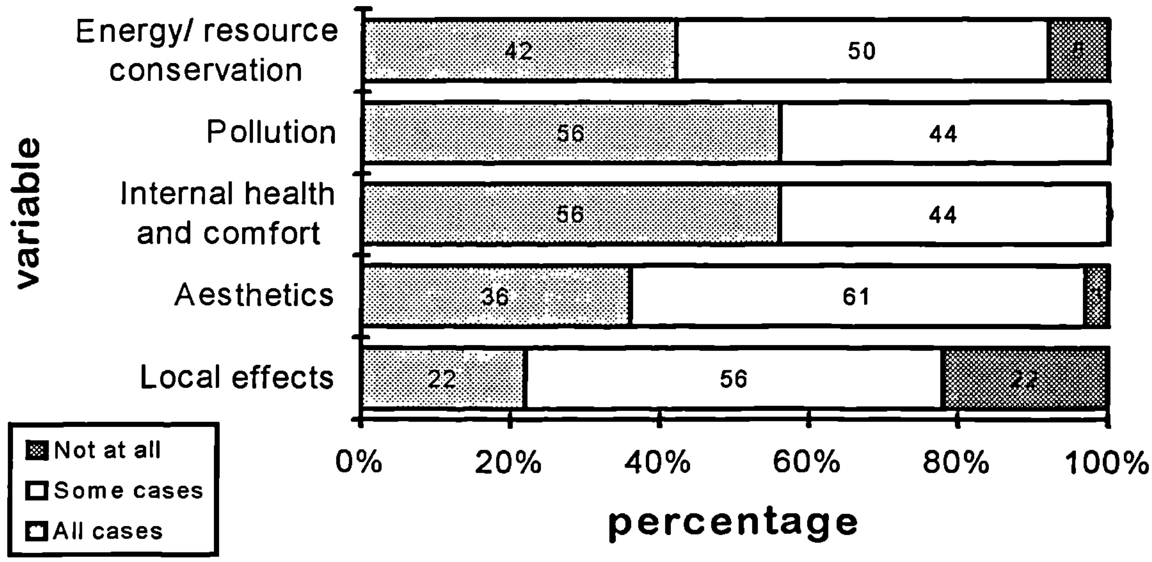


Figure 7.13: Relative frequencies for responses to environmental variables (investors)



The responses to the individual variables are examined in detail in the paragraphs that follow to assess how critical each variable is to the assessment of the environmental performance of properties.

The survey showed that *local environmental effects* appeared to be more important to the developers surveyed than the investors. More than twice the proportion of the developers as investors (47% against 22%) indicated that they would consider *local effects* in all decision cases. Moreover, whereas nearly all the developers (96%) indicated that they would consider *local effects* in at least some decision cases, 22% of the investors indicated they would not consider it at all.

Aesthetics was also another variable that appeared to be more important to the developers surveyed than the investors. More than half the developers (57%), against 36% of the investors, indicated that they would consider *aesthetics* in all decision cases. The two sub-groups were however closer in agreement if considering the proportions who would consider *aesthetics* in at least some decision cases. Almost all the respondents (98% of the developers and 97% of the investors) fall into this category.

As already mentioned, the developers and investors surveyed were in agreement over the importance of *internal health/comfort.* More than half of all respondents (59% of the developers and 56% of the investors) indicated that they would consider *internal health/comfort* in all decision cases. Furthermore, all the investors surveyed and 94% of the developers indicated that they would at least consider it in some decision cases.

The developers and the investors surveyed differed significantly in terms of their responses to the variable *pollution.* The investors surveyed are shown to be more concerned about *pollution* than the developers with 56% of them indicating that they would consider it in all assessments of environmental performance against 42% of the developers. Further, whilst all the investors indicated that they would consider *pollution* in at least some situations, 11% of the developers would not consider it at all.

There was a slight disagreement between the two sub-groups in terms of how critical *energy/resource conservation* is to assessing the environmental performance of properties. Around a third of the developers (34%) and two-fifths of the investors (42%) indicated that they would consider *energy/resource conservation* in all cases of their property decisions. A higher proportion of the developers, however, would consider *energy/resource conservation* in at least some decision cases than the investors (98% of the developers against 92% of investors).

Provisions were made in the questionnaire for respondents to supply additional environmental variables, if any. This produced the following additional variables:

- *land contamination*
- *BREEAM rating*
- *scope for natural ventilation.*
- *deleterious material in construction.*
- *former site uses.*
- *air conditioning chillers.*

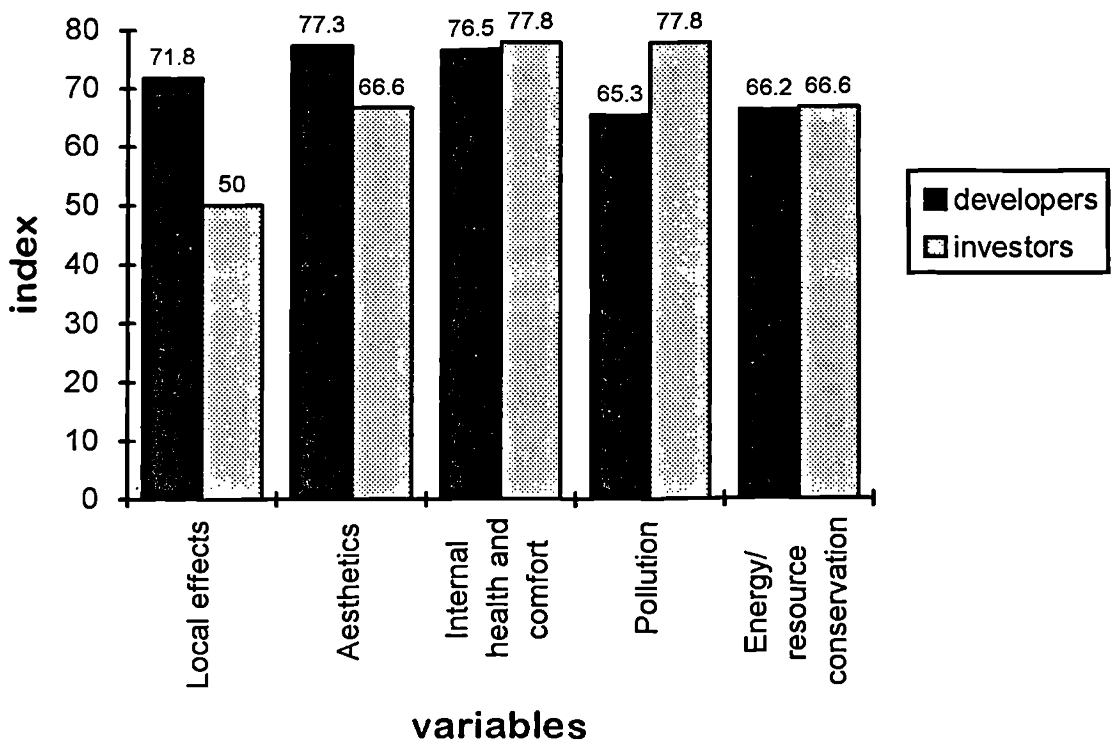
All these additional variables are specific dimensions of the variables presented in the survey. The original list is therefore maintained but the additional ones supplied above would be examined during the model building stage.

As was done with the responses for the previous three performance objectives (ie. economic, functional and physical/structural), the relative frequencies for the response categories are used to calculate the criticality index (CRI scores) for each variable as defined in section 7.4. The results for the environmental variables are tabulated in Appendix C4 and also graphically shown in figure 7.14.

The CRI scores show that the key indicators of property environmental performance among the developers are *aesthetics* and *internal health and comfort*. The most unlikely variable to be considered by the developers in assessing environmental performance is *pollution*

Among the investors surveyed, the key indicators of the environmental performance of buildings are ***internal health and comfort*** and ***pollution***. The most unlikely variable to be considered by the investors in assessing environmental performance is ***local environmental effects.***

Figure 7.14: Criticality indices for environmental variables



As has been defined previously in section 7.4, the primary indicators are those whose CRI scores, when rounded to the nearest 5, is 75 or greater among at least one of the survey sub-groups. By this definition, the primary and secondary variables are listed in Table 7.8.

Table 7.8: Primary and secondary indicators of environmental performance

Primary indicators	Secondary indicators
Aesthetics Internal health and comfort pollution	Local effects Energy/ resource conservation

7.8 Relative Importance of the Generic Performance Objectives

All the indicators discussed in the preceding sections fall under the four generic performance objectives established during the secondary data search. These objectives are economic, functional, physical/structural and environmental performance. The influence each of the indicators has on property decisions is dependent on how important the generic objective under which it falls is to decision makers.

One of the aims of the current research therefore was to determine the relative importance of the four generic performance objectives in property decision making in terms of importance weights. The data collected on these importance weights and the results of the analyses carried out on them are discussed in this section.

During the survey, respondents were asked to indicate the importance of each generic performance objective as they influence their property decisions. They were asked to reflect this by sharing a total of 100 points over the objectives, with the most important objective getting the most, and continuing in descending order.

Most of the respondents were able to meaningfully share the 100 points among the objectives. Some few however were either unable to, or did not, share the points among the performance objectives as instructed. Details of how these questionnaires were 'corrected' are described in chapter four under the section on coding and editing. Besides those some few respondents awarded all the 100 points to the economic performance objective alone. Their explanation was that the other objectives: functional, physical/ structural and environmental form the determinants of economic performance. They did not therefore see the need to weight them independently. For these questionnaires, the 100 points awarded to the economic performance objective were retained in the analysis. The effect of these though was to skew the weighting distribution for the economic objective to the right.

The latter finding coincides with an observation made by Bernard William Associates in their book on facilities economics (BWA, 1994: p. 1-15). In the book, property performance was defined along the dimensions of functional, physical, and financial. They made the following comments in discussing these dimensions:

> *"The three facets are inextricably linked, although the significance of this relationship is frequently missed by those whose pre-occupation is with one particular facet only..."*

The weights supplied for the performance objectives by the respondents from samples A and B are tabulated in raw weight tables in Appendix D. The raw weights have been converted to frequency tables for each survey sub-group, also given in Appendix D.

In this section the weight distributions for each performance objective for the sub-groups are discussed with the aid of histograms and descriptive sample statistics. Details of the calculations to determine the descriptive statistics are given in Appendix D.

7.8.1 Importance Weight for Economic Objective

The distributions of the importance weights supplied for the economic objective are shown in the histograms in figures 7.15 and 7.16 for the developers and investors respectively. The relevant descriptive statistics are summarised in Table 7.9 for both sub-groups.

Figure 7.15: Histogram showing the distribution of importance weight for economic performance among developers (out of 100)

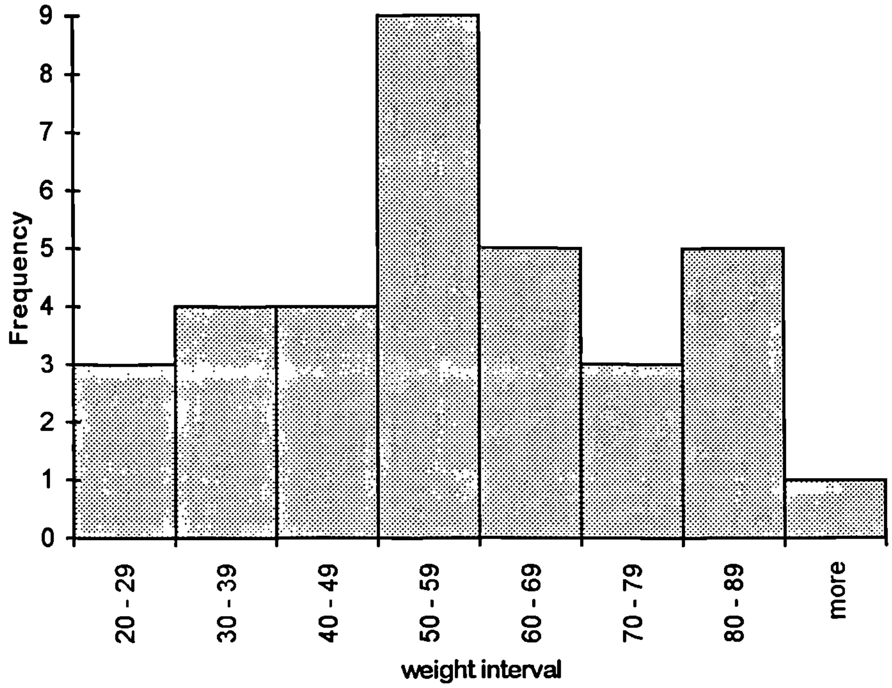
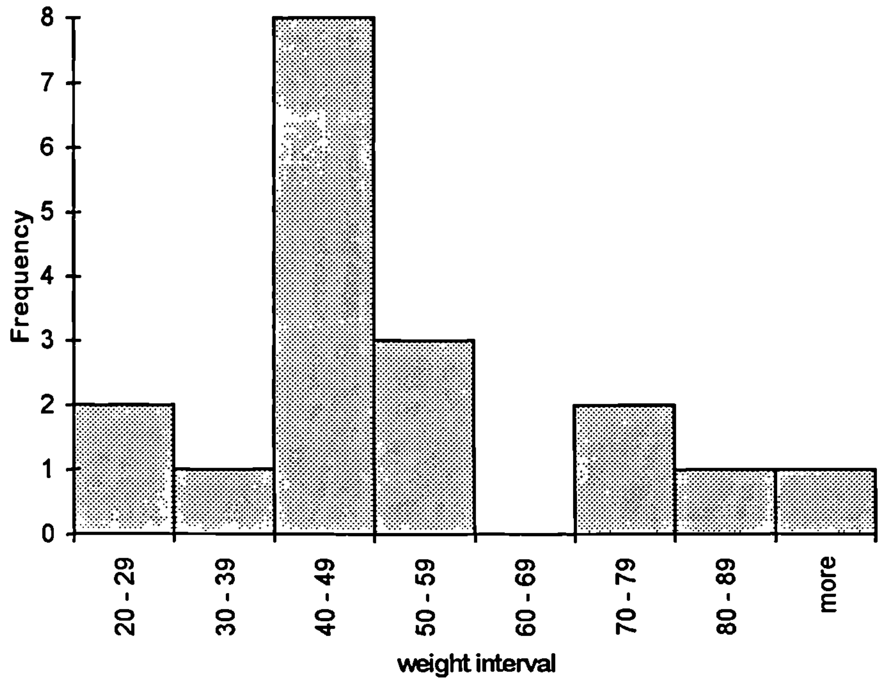


Figure 7.16: Histogram showing the distribution of importance weight for Economic performance among Investors (out of 100)



The importance weights supplied by the developers ranged from 25 to 100 (Table 7.9) with a typical importance weight (mode) of 50. For the investors surveyed the importance weight for economic objective also ranged from 25 to 100 but with a typical weight (mode) of 40.

For both distributions, the mean importance weight is greater than both the median and the mode. This implies that both distributions are skewed to the right due to the presence of some few extremely high weights than typical.

Looking at the values of the mean, median and the mode, it appears that the developers surveyed rated economic performance higher than the investors. Significance test carried out on the two sample means however suggest no significant difference.

Since this research is about the behaviour of decision makers, the mean and median weights are probably of less relevance in this context. The modal weights, in this case, probably give a stronger indication of the predisposition of the decision makers surveyed. Based on the modal weights therefore, it appears that the developers surveyed are inclined to rate the economic objective higher in their property decisions than the investors .

Table 7.9: Summary statistics for importance weights of economic performance

Statistic	**Developer** Sample size = 34	**Investor** Sample size = 18
Range	25 - 100	25 - 100
Median	50	44.5
Mode	50	40
Mean	53.7	49.4
Standard deviation	19.0	19.8
Coefficient of variation	35.4%	40.1%

The standard deviations and the coefficients of variation (Table 7.9) suggest the weights supplied by the developers are less dispersed than those supplied by the investors. This could be due to the different sample sizes. Significance test (F-test) on the two sample variances confirmed this by revealing no significant difference between the variances.

7.8.2 Importance Weight for Functional Objective

The distributions of the importance weights supplied by the developers and the investors for functional objective are shown by the histograms in figures 7.17 and 7.18. Summary descriptive statistics of the distributions are tabulated in Table 7.10.

Among the developers surveyed, the importance weights for functional objective ranged from 0 to 45 with a typical weight (mode) of 20. For the investors surveyed, the weights ranged from 0 to 40 with 30 as the typical weight (mode).

Figure 7.17 shows the weight distribution for the developers to be almost symmetrical with a marked peak. This is confirmed by the fact that the mean, mode and median weights are approximately equal. Figure 7.18 show the distribution of the importance weights for functional objective among the investors to be very flat. The fact that the mean is less than both the median and the mode suggests a distribution skewed to the left.

Inspecting the mean, median and the modal weights, it appears that the investors surveyed do rate functional performance higher than the developers. Significance tests on the two sample means though did not reveal any significant difference between them. The difference in the sample means could be due to sampling effects. Using the mode however as a measure of the predisposition of the decision makers, it appears that functional performance is rated higher by the investors than the developers.

Figure 7.17: Histogram showing the distribution of importance weight for Functional performance among developers (out of 100)

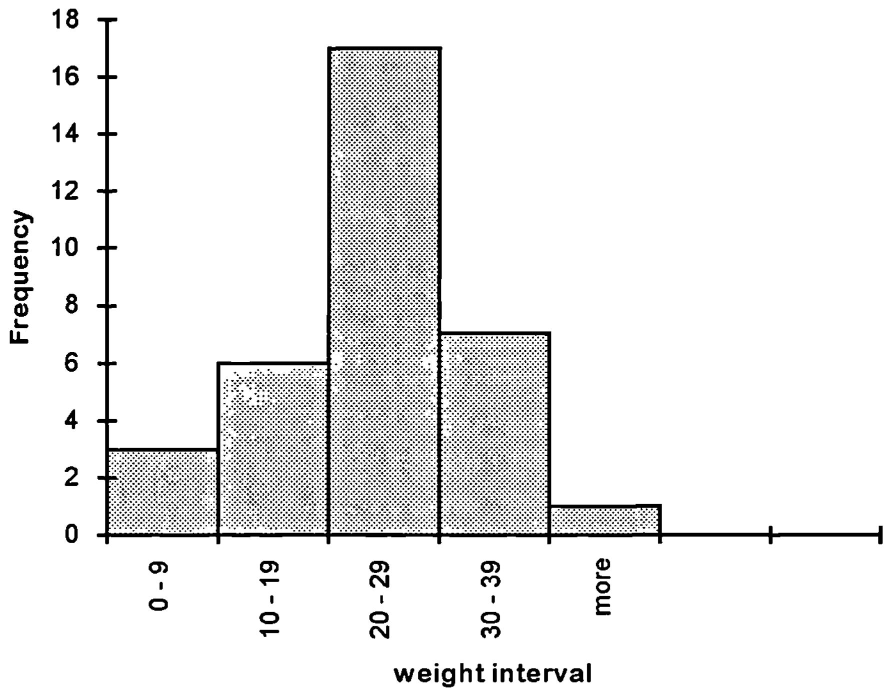


Figure 7.18: Histogram showing the distribution of importance weight for Functional performance among Investors (out of 100)

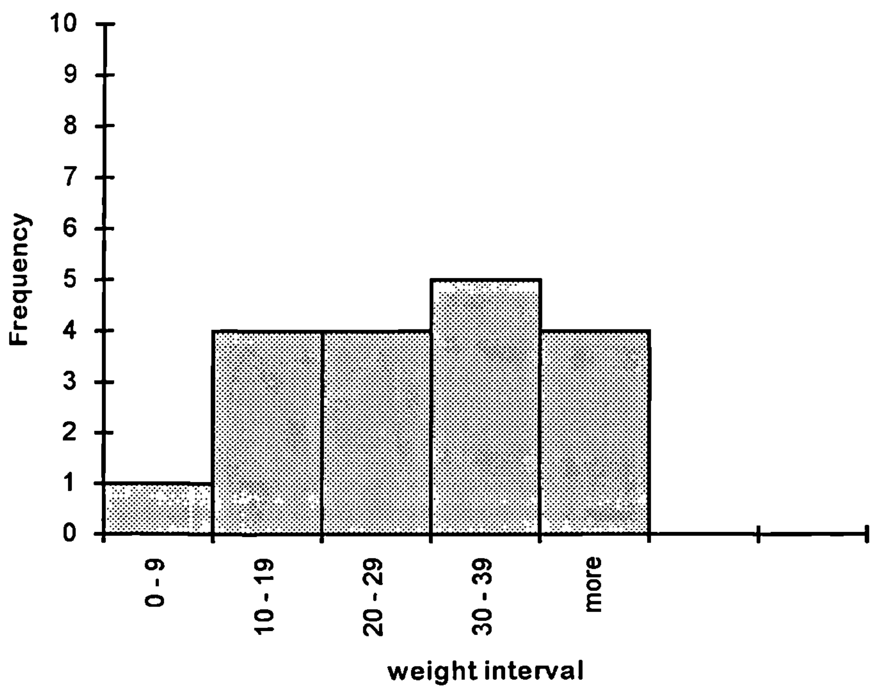


Table 7.10: Summary statistics for the importance weights of Functional performance

Statistic	Developer Sample size = 34	Investor Sample size =18
Range	0 - 45	0 - 40
Median	20	27.5
Mode	20	30
Mean	20.7	25.3
Standard deviation	9.2	11.9
Coefficient of variation	44.4%	47.0%

From the standard deviations and the coefficients of variation, it seems the weights supplied by the investors are more dispersed than those by the developers. Significance test on the sample variances however did not indicate any significant variation.

7.8.3 Importance Weight for Physical/structural Objective

The importance weight distributions for physical/structural performance objectives for the developers and investors surveyed are shown in the histograms in figures 7.19 and 7.20. The summary statistics describing the weight distributions are tabulated in Table 7.11.

The importance weights supplied by the developers ranged from 0 to 30 whilst those by the investors ranged from 0 to 28. The typical weight among the developers is 20 whilst that among the investors is 10.

The histograms show that the weight distribution for the developers is relatively flat compared to the investors. For both distributions the means and medians are greater than the mode suggesting distributions which are skewed to the right.

Figure 7.19: Histogram showing the distribution of importance weights for physical/structural performance among developers (out of 100)

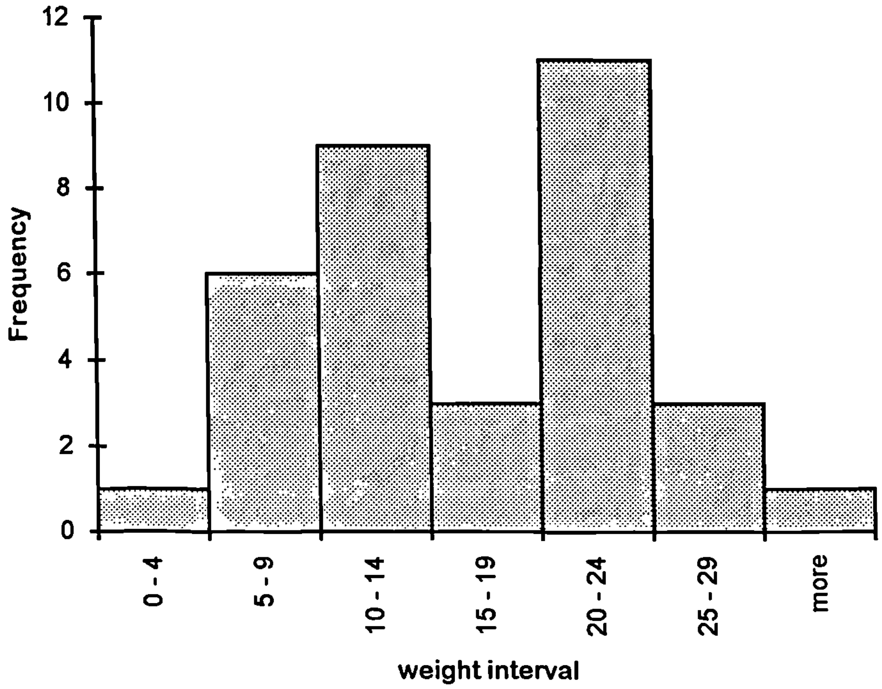
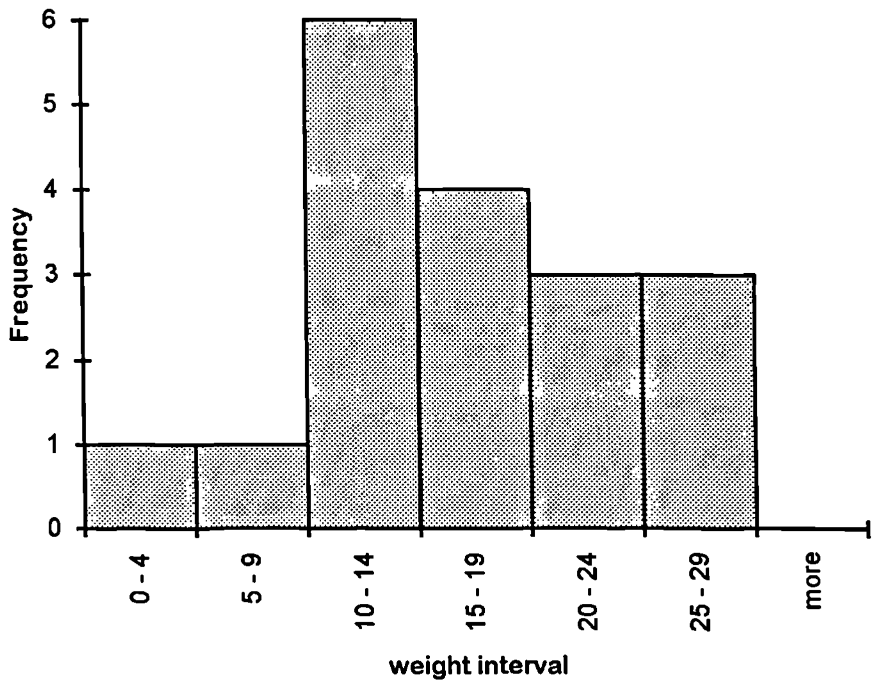


Figure 7.20: Histogram showing the importance weight distribution for physical/structural performance among investors (out of 100)



Based on the mean and median weights, it appears both survey sub-groups rated physical/ structural performance equally. Using the mode though as an indicator of the inclination of the sub-groups, it appears that the developers rated physical/structural performance higher than the investors in their property decision making.

Table 7.11: Summary statistics for the importance weights of physical/structural performance

Statistic	**Developer** Sample size = 34	**Investor** Sample size = 18
Range	0 - 30	0 - 28
Median	15	15
Mode	20	10
Mean	14.5	14.8
Standard deviation	7.4	7.4
Coefficient of variation	51.0%	50.0%

The dispersion of the weights for both developers and investors surveyed are approximately equal from Table 7.11 despite the different sample sizes. This is confirmed by an F-test performed on the sample variances for the two distributions.

7.8.4 Importance Weight for Environmental Objective

The histograms in figures 7.21 and 7.22 show respectively the importance weight distribution for the environmental performance by the developers and investors surveyed. Also, tabulated in Table 7.12 are the summary sample statistics for the weight distribution of both sub-groups.

Figure 7.21: Histogram showing the distribution of importance weights for environmental performance among developers (out of 100)

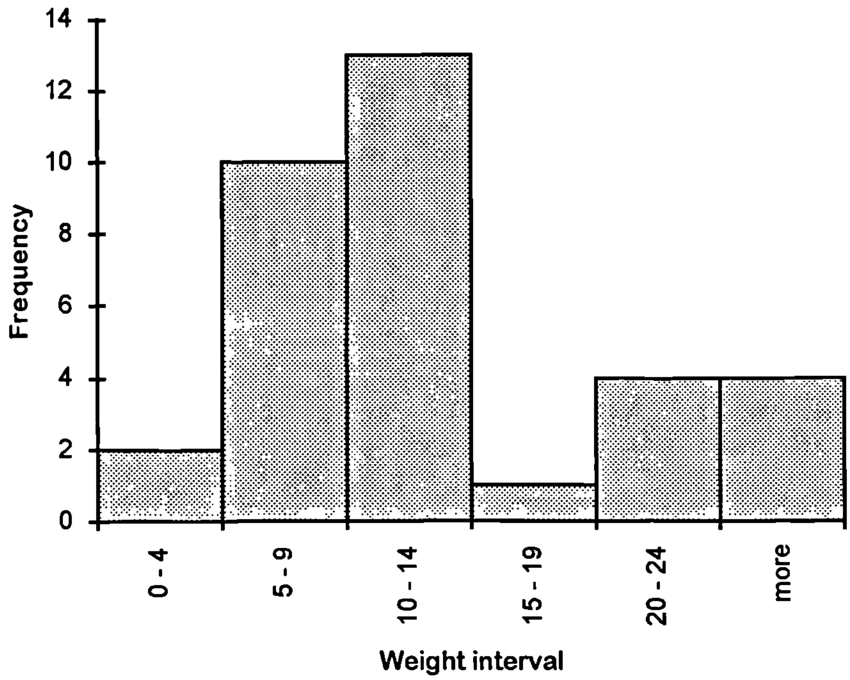
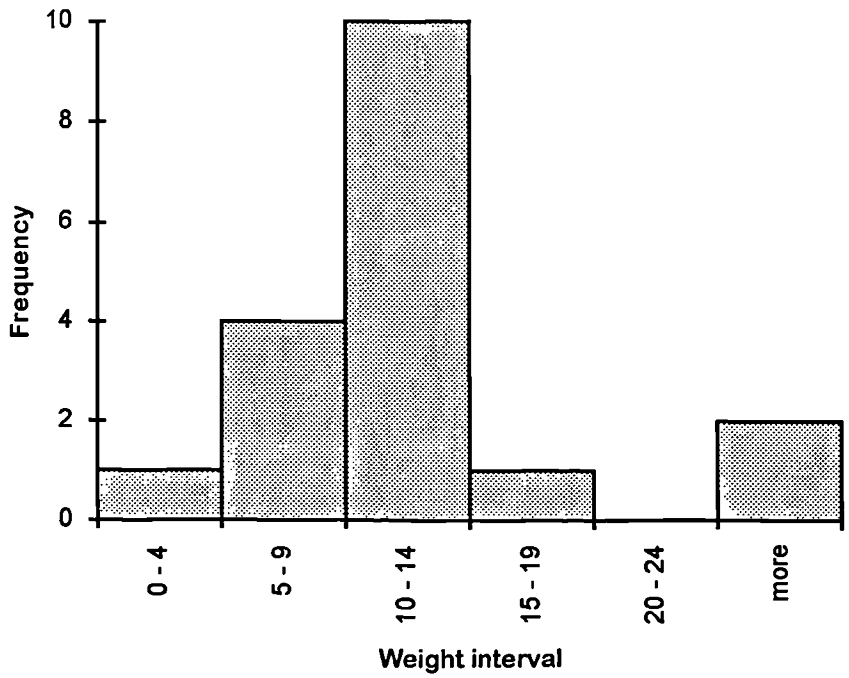


Figure 7.22: Histogram showing the distribution of importance weights for environmental performance among investors (out of 100)



It can be seen from figures 7.21and 7.22 that the weight distribution for the developers is relatively flat compared to that for the investors. For both the developers and the investors surveyed, the importance weights ranged from 0 to 25 with a modal weight of 10.

For the investor weight distribution, the mean, modal and median weights are approximately equal suggesting an almost symmetrical distribution. For the developers though, the mean is greater than both the mode and the median. This suggests a distribution skewed to the right due to the presence of some few extremely high weights than typical.

Inspecting the standard deviations and coefficients of variation for the two distributions (Table 7.12), the weights supplied by the developers were more dispersed than the weights supplied by the investors. An F-test performed on the variances of the two distributions however did not indicate any significant difference.

Table 7.12: Summary statistics for importance weights of Environmental performance

Statistic	Developer	Investor
	Sample size = 34	Sample size = 18
Range	0 - 25	0- 25
Median	10	10
Mode	10	10
Mean	11.1	10.6
Standard deviation	7.2	6.4
Coefficient of variation	64.9%	60.4%

Based on the means, it appears that the developers surveyed rated environmental performance marginally higher than the investors. This variation though is not significant. Here also, using the modal weights as a more appropriate indication of the inclination of the decision makers surveyed, it appears that both the developers and the investors rated environmental performance as being equal in importance.

7.8.5 Comparison of Performance Objective Importance

In the previous sub-sections (7.8.1 to 7.8.4), the weight distribution for the individual performance objectives among the survey sub-groups were discussed. In this sub-section, the relative importance of the four generic objectives themselves to property decision makers are compared in terms of the importance weights. This is done with the aid of point estimates of the weights such as the mean and the mode, which applies to the samples of the study only. Interval estimates are also examined to make inferences beyond the sample studied. The relevant point and interval estimates of the objective importance weights are tabulated in Table 7.13.

Table 7.13: Point and interval estimates of objective importance weights (confidence level = 95%)

Generic Objective	Developers			Investors		
	mode	mean	confid. interval	mode	mean	confid. interval
Economic	50	53.7	47.3-60.1	40	49.4	40.3-58.5
Functional	20	20.7	17.6-23.8	30	25.3	19.8-30.8
Physical/ structural	20	14.5	12.0-17.0	10	14.8	11.4-18.2
Environ-mental	10	11.1	8.7-13.5	10	10.6	7.7-13.5

The importance weights measure the attitudes of the survey respondents concerning the importance of the performance objectives in decisions. In this regard, perhaps the modal weights, which are the most common importance weight by both the developers and investors, inform more about the attitudes of the decision makers surveyed than the mean weights. From Table 7.13, it is clear that, in terms of the modal wieghts, the most important objective to both the developers and the investors is economic followed by functional, physical/structural and environmental performance. Both sub-groups appear to place different emphasis on them though. The developers surveyed rated economic performance higher than the investors (modal weight of 50 against 40). The investors, on the other hand, rated functional performance higher than the developers (modal weight of 30 against 20).

In terms of the modal weights, the position of economic performance as the most important objective is clearly established for the two sub-groups. But when it comes to examination of the modal weights for the other three remaining performance objectives, the relative importance pattern that emerges is not conclusive. Among the developers surveyed, functional and physical/ structural performance objectives are equally important both with a modal weight of 20. Environmental performance is the least important objective to the developers. Among the investors surveyed, functional performance is the clear second most important objective, according to the mode. Physical/structural and environmental performance objectives appear to be equally rated in importance.

The mean importance weights (Table 7.13) indicate that among both sub-groups, the most important objective is economic performance followed by functional performance, physical/ structural performance and environmental performance in descending order. The means also show that the developers rated economic performance higher than the investors. The reverse is however true when it comes to the rating of functional performance.

Inspecting the coefficients of variation for the individual performance objectives (Tables 7.9 to 7.12) and the confidence intervals in Table 7.13, some observations are made about the attitudes of developers and investors on the importance of the generic property performance objectives:

1. the confidence intervals for the mean importance weight for both sub-groups, for all the performance objectives, do overlap. This is a confirmation of the earlier observations made in sections 7.8.1 to 7.8.4 that there are no significant variations in mean objective weights between developers and investors.
2. for both the developers and investors, the confidence intervals for the mean importance weights for physical/ structural and environmental performance do overlap. This implies that there are no significant differences in importance between physical/ structural performance and environmental performance among developers and investors.
3. for both sub-groups, as the importance of the performance objective decreases, the weights become more dispersed suggesting lack of agreement within groups as the objective becomes less important. The inference from this is that the intial preoccupation of developers and investors is with economic and functional issues and even though physical, structural and environmental issues are important, they are only secondary.

The mean and modal importance weights show that there are clear differences between developers and investors over the respective rating of economic and functional objectives. This is in spite of the overlaps between confidence intervals. Whereas the developers rated economic performance higher than the investors, the investors on the other hand rated functional performance higher than the developers. This highlights the fundamental difference between the two. Developers, who typically have short term outlook, are expected to rate economic objective highest of all objectives. On the other hand, investors, who typically have long term outlook are expected to rate economic and functional performance (both associated with long term holding of property) rather more closely in importance.

Physical/ structural performance and environmental performance are shown to be the least important objectives. This finding is perhaps expected with environmental objective. What is surprising though is the apparent low importance of physical/ structural objective.

A survey of property occupiers in a joint research by *Propety Week*, Glamorgan Universty and Fletcher King found that even though property occupiers are prepared to pay more for green buildings, environmental concerns lagged behind familiar issues like rent, location and building running costs (Goodman, 1994).

Some possible explanations for the low relative importance of physical and structural performance might include the following:

1. structural surveys usually precede decisions on the reuse of existing buildings as the physical/ structural condition of an existing building is fundamental to its re-use. Once it has been decided that the physical and structural condition allow re-use, they do not, in the later stages, probably constitute a major decison determinant. The importance of physical and structural issues may then only be in the constraints they may present to remodelling.

2. buildings, from the point of the basic structure, are durable these days. Renewal pressures are therefore not usually introduced by structural problems but by functional and economic imperatives. Most of the 1960s buildings, which were considerd by many to present difficult structural problems, are dropping out of the building stock. According to Nabarro (1990), only 10% of institutions' office portfolios, by the end of 1988, comprised of buildings from the 1960s. The rest were built either in the 1970s or 1980s.

3. most leases are of the FRI kind where the liability for repair and maintenance of structure and fabric is borne by the occupier. It is perhaps expected that building owners may not rate physical issues high in day to day decision making.

7.9 External factors that affect Property Performance

Property development and investment takes place in an uncertain and risky environment. The uncertainties and risks are partly due to external factors that are usually outside the control of decision makers.

The building renewal decision model, the subject of this research, requires the estimation of the levels of performance indicators (refer to chapter three). These estimates would be made in the context of the external factors that affect property performance. Being aware of some of these external factors and their effects will make for better estimates.

In the survey, respondents were presented a list of factors. They were then asked the following question:

What external influences (ie. outside your company's control) could affect the performance of properties?

Details of the responses supplied by both sub-groups are tabulated in Appendix E. The degree of importance of each factor is evaluated in terms of the proportion of respondents who thought it could affect property performance. Figures 7.23 and 7.24 show these proportions for each factor for developers and investors respectively. These graphical representations show, for each sub-group, the degree of concern with each factor from the most to the least important.

The key concern of the developers is with *planning controls* (Figure 7.23). Also high on their concerns are *changes in legislation, changes in locational factors* and *changes in user requirements.* Not far behind are *state of the national economy, taxation, the cost of capital* and *changes in government policy.*

Figure 7.23: External factors that could affect property performance
(Percentage of Developers who think they could)

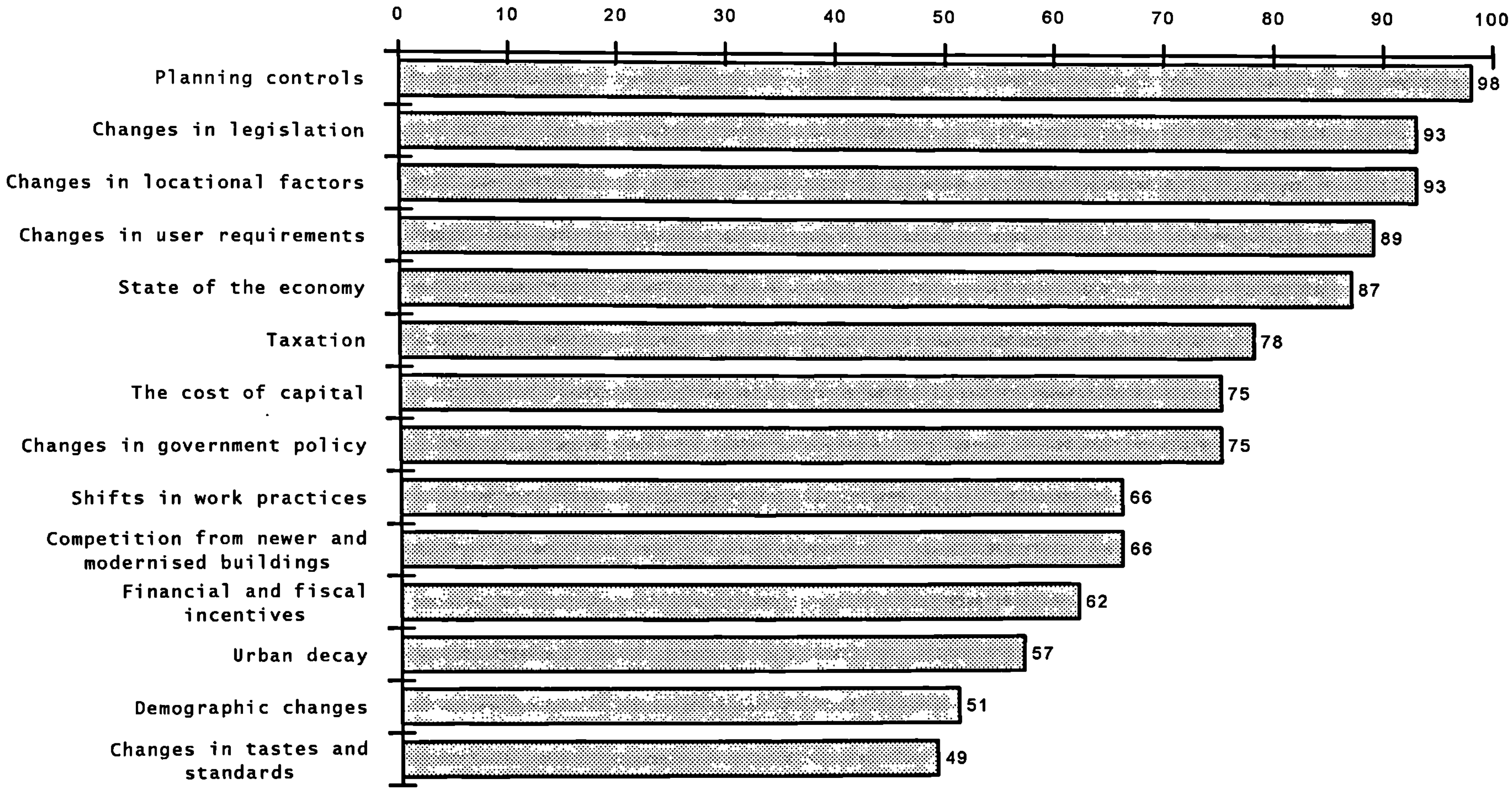
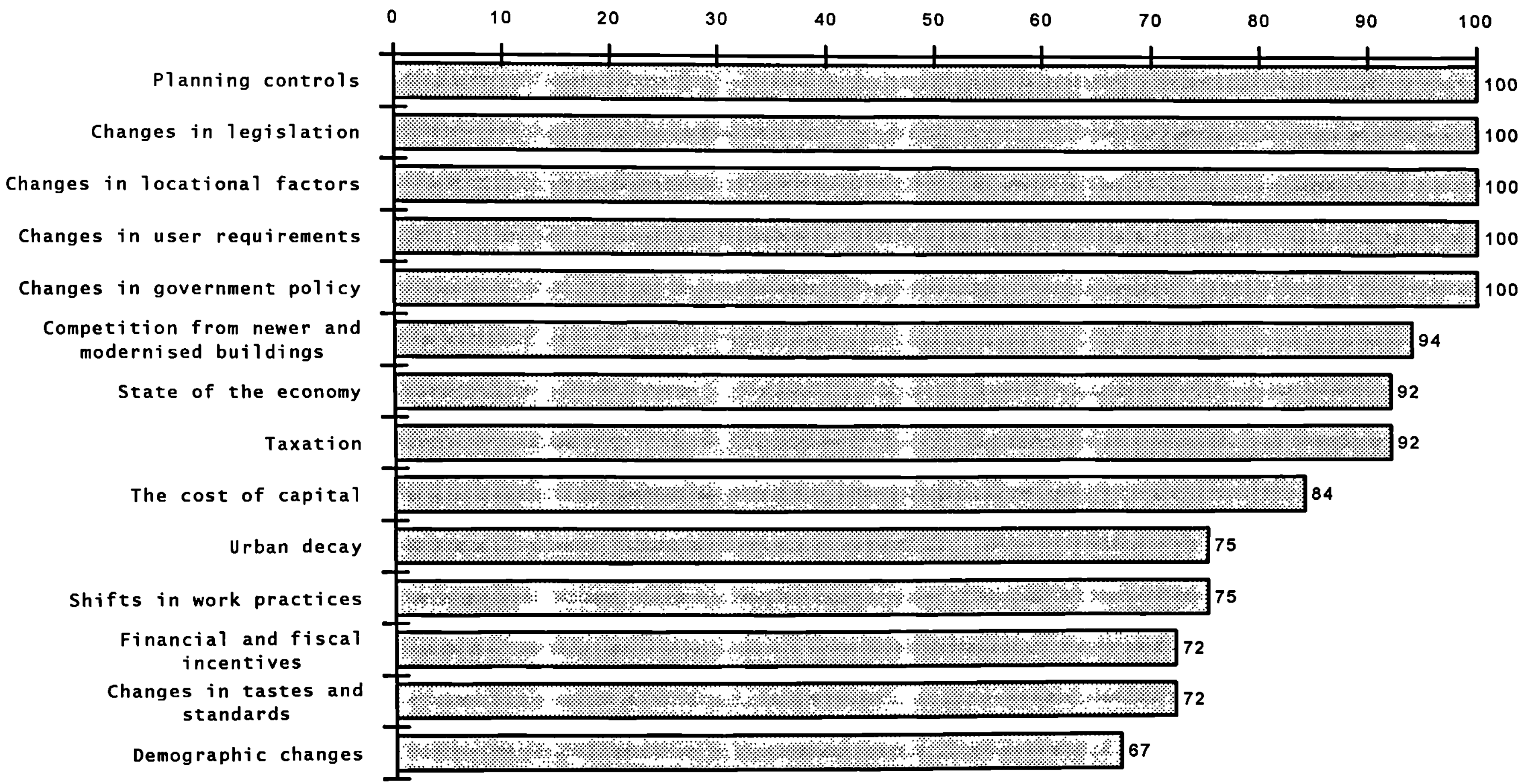


Figure 7.24: External factors that can affect property performance
(Percentage of Investors who thought they could)



Of least concern to the developers is *changes in tastes and standards* with only 49% of them thinking that it could affect property performance. It lags behind such issues as *shifts in work practices, competition from newer and modernised properties, financial and fiscal incentives, urban decay* and *demographic changes.*

The major concerns of the investors are with *planning controls, changes in legislation, changes in locational factors, changes in user requirements* and *changes in government policy.* Also high on their list of concerns but not as important as those above are: *competition from newer and modernised buildings, state of the economy, taxation* and *the cost of capital.*

The factor that causes the least concern to the investors is *demographic changes* which lagged behind issues such as *urban decay, shifts in work practices, financial and fiscal incentives* and *changes in tastes and standards.* Consistently high proportions of the investors thought all the factors presented could potentially affect property performance (figure 7.24). Even for the factor thought to cause the least concern, *demographic changes,* the proportion of the investors who thought that it could affect property performance was high at 67%.

The questionnaire did ask respondents to supply any other factors they thought could affect property performance. The additional external factors supplied are: *international events, contamination Acts, EEC grants to assisted areas,* and *changing trends in acceptable building specification.*

7.10 The Next Stage

The analyses in this chapter have produced the critical indicators of property performance (Tables 7.5 to 7.8). These are again summarised in figure 7.25 below.

Going back to the value-focused procedures in chapter three, the next step in building the decision model is to first structure the indicators. This is followed by the selection of value-relevant scales for measuring the levels of the indicators.

The tasks involved in the variable structuring exercise are: establishing the relationships between the critical indicators in figure 7.25 using factual knowledge and the further explication of the variables into measurable lower-level indicators.

The building renewal model is created after the selection of value-relevant scales to evaluate the final list of indicators. This is the subject of the next chapter.

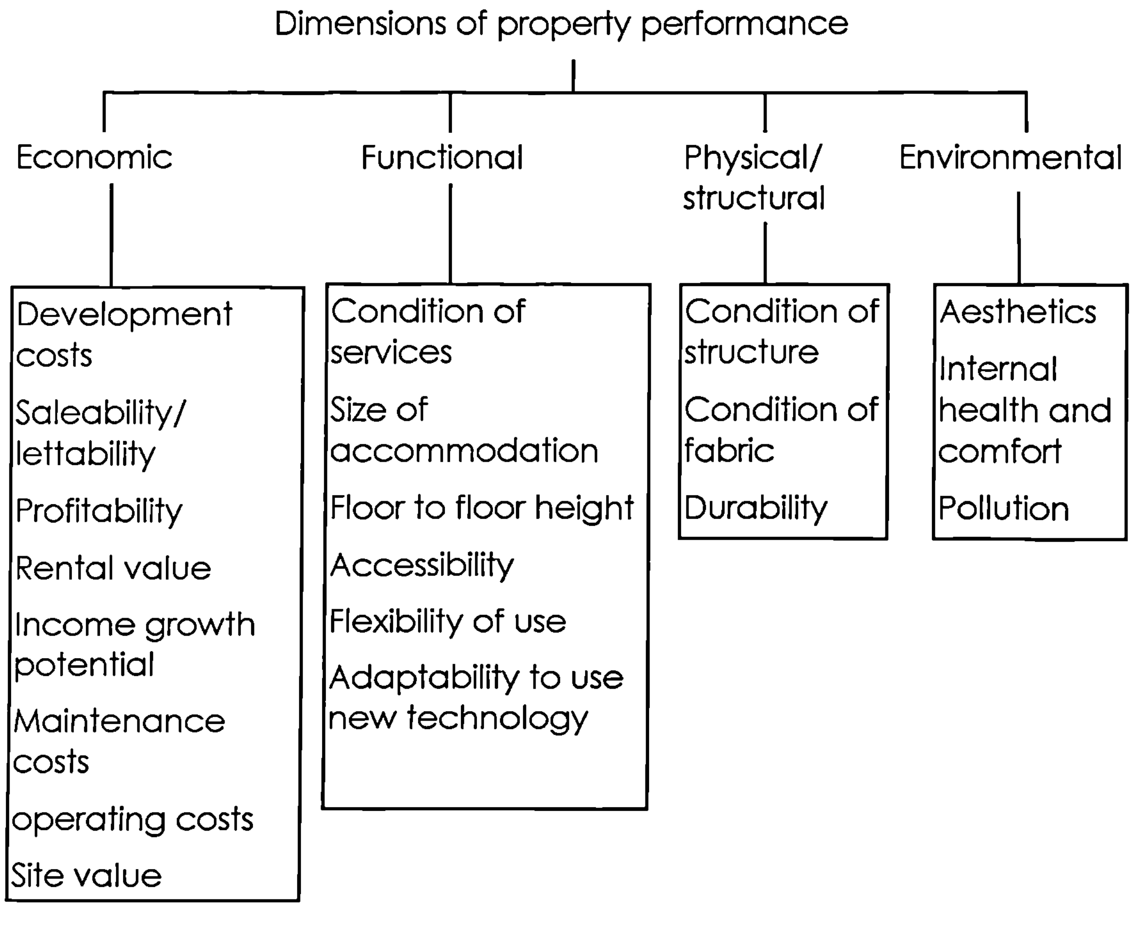


Figure 7.25: Critical determinants of property performance

CHAPTER EIGHT

THE VALUE-BASED BUILDING RENEWAL DECISION MODEL

8.1 Introduction

The proposed value-based model for aiding building renewal decisions on private commercial properties is presented in this chapter. It is appropriate at this stage to review the background and the work carried out so far before proceeding with the creation of the proposed decision model.

Building renewal was considered as a decision problem. This describes the situation where there is more than one course of action in a decision space. On reviewing some past models which attempted to resolve this problem (chapter two), it was found out that most of them originated from the public sector management of housing and the clearance of slum dwellings.

Most of the public sector models reviewed revolve around the widely cited 'Needleman' formulae (Needleman, 1965, 1968, 1970) which gave the impression of the existence of a neat and exact solution in every situation. These models were not deemed to be particularly applicable to renewal decisions on private commercial properties. This is because they were mainly concerned with meeting public sector objectives of showing value for money. They therefore relied on the economics of the situation without considering the physical and functional attributes of the buildings concerned.

Even though numerous textbooks and journal articles mention the problem of building rehabilitation and redevelopment in the private commercial sector, it appears there is no formal model to aid the making of this decision. The few models reviewed that originated from the private sector

The principles of Value-focused thinking are amply covered in chapter three. Essentially what it involves are:

- the identification of the interests impacted by the problem;
- the identification of their value objectives or concerns;
- the derivation of indicators or variables which measure the achievement of the value objectives; and
- the establishment of a value-based model incorporating the identified decision variables.

The major private sector interests impacted by building development have been identified as property developers, investors and occupiers. The research task was therefore to identify the value objectives of these groups for incorporation into the decision framework. The data on the value objectives of these interests were obtained from secondary (chapters five and six) and primary (chapter seven) sources. The means for collecting the data are described in chapter four.

In the primary research, building performance was assessed along four dimensions: economic, functional, physical/structural and environmental. How critical each variable and objective uncovered in the secondary data search is to the four aspects of performance was tested among developers and investors in the primary research. The critical variables are summurised at the end of chapter seven. The value-based building renewal decision framework described below is to be based on these critical variables.

The first task of building the decision model is to explain each of the critical variables and issues uncovered in the context of the research. The next step is to establish and explore the causal or dependency relationships between them. This then leads on to the identification of the final list of indicating variables (attributes) that indicate the achievement of the value objectives of the major interests impacted by property development. After discussing the appropriate scale for measuring each indicating variable, the model itself is then finally presented together with all the required decision steps. The chapter concludes with an application of the new model to a hypothetical case study.

8.2 Explication of the Critical Decision Determinants

Some of the critical decision variables and issues from the primary research may connote a meaning different from what is normally associated with them. Therefore, before the model is created, the variables are explained or defined in the context of this research. The critical variables and issues are summarised in figure 7.25 of chapter seven. They are shown again here in Table 8.1 for ease of reference.

Table 8.1: Critical building renewal decision determinants

Economic Determinants	Functional Determinants	Physical/structural Determinants	Environmental Determinants
Development costs Saleability/ lettability Profitability Income growth potential Maintenance costs Operating costs Site value	Condition of services Size of accommodation Floor to floor height Accessibility Adaptability to use new technology Flexibility of use	Condition of structure Condition of fabric Durability	Aesthetics Internal comfort/ health Pollution

8.2.1 Explication of the Economic Decision Variables

Development costs: It is the total amount spent on either the rehabilitation or redevelopment option. It does not only include the amount spent on the building structure, fabric and services, it also include the cost of acquiring the site or freehold and any demolitions and associated site preparations. Development costs also include professional fees as well as interest and fees charged on development loans. If any special measures are to be taken to attract tenants, such as rent-free periods, these also should be taken into account.

Saleability/ lettability: another word for saleability/ lettability is marketability. It refers to the ease with which a property can be disposed of through either sale or letting at the expected sale price or rent.

Profitability: it is the potential to realise development or investment profit from a property. It refers to the likelihood of expected income to exceed expected costs in the present or in the future.

Rental value: it is the rent that a property can reasonably be expected to command in the open market when let on the same terms as other comparable properties in the same sub-market (ie. in terms of property type and location).

Income growth potential: this refers to the potential or likelihood of obtaining a higher rent in the future than presently being charged.

Maintenance cost: it is the annual expenditure made in retaining or restoring the building structure, its fabric and services, in or to a condition that enables the property to function as required. It includes expenditure made on both preventative and emergency maintenance.

Operating costs: in the context of this research, operating costs refer to the annual expenditure incurred on energy of all forms from heating, cooling, lighting and ventilating the internal building space as well as on other building services.

Site value: used interchangeably with land costs, it refers to the cost of acquiring a site or a freehold interest in a property. It includes agent's fees, legal fees and stamp duty. Land costs contribute to development costs. However, if the promoter already owns the site and existing improvements and is already earning income from it, site cost has no bearing on the decision at hand.

8.2.2 Explication of the Functional Decision Variables

Condition of services: it refers to the age, type, efficiency and durability of the heating, cooling and ventilation plant as well as other building services.

Size of accommodation: it refers to the internal dimensional attributes of the floorplate at each level of a building. The attributes of much interest to both investors and occupiers are the gross internal area and the width of the floorplate.

Floor to floor height: it is the height from the top of a structural floor to the soffit or underside of the next structural floor above. Structural floor refers to that element of the floor on which the strength and stiffness of the floor depend. It excludes finishes, coverings and ceilings.

Accessibility: it is the ease with which access can be gained to a building and its site. It is influenced by both location and site-specific factors. The location factors include communication and nearness to transport networks such as motor ways, airports and train terminals. In these days of advances in telecommunication technology, the importance of communications to accessibility has somewhat diminished. The local factors include access from a local main road, width of site entrances and availability of on site parking. Most of the factors would affect the two options equally with the exception of the car parking provisions which depend on site development ratio.

Adaptability to use new technology: this is the ease with which the internal space, services and building structure can be adapted to allow the introduction of new technology such as IT equipments and associated cabling.

Flexibility of use: this is the ease with which the internal spaces and structure of a building can be modified to suit new working patterns or an entirely new use.

8.2.3 Explication of the Physical/ structural Decision Variables

Condition of building structure: this refers to the state of repair and capability of the basic structure of a building. It includes the condition of the frame, foundations and the individual structural elements such as slabs, beams, columns and load-bearing walls. Capability used here refers to the load-bearing capacity of the individual structural elements, the foundations and the frame as a whole.

Condition of fabric: this refers to the state of repair and capability of a building's external fabric including the external walls and cladding as well as windows and the roof covering. Capability used here refers to the protection the external fabric offers the occupants of the building from the outside elements and noise as well as its energy characteristics (ie. heat loss or retention).

Durability: this concerns the longevity of the building structure, fabric and services. It refers to the time to corrective repair or replacement of an element as a result of deterioration due to usage, attack by the elements or its inferior quality.

8.2.4 Explication of the Environmental Decision Variables

Aesthetics: this is a very broad and complex subject where evaluation depends to a greater extent on the individual observer. In the context of this research, though, aesthetics simply refers to the visual impact created by a building. This may be as a result of its physical size, design, appearance of its external facade and entrances and how it blends in with the surrounding environment.

Internal comfort: the feeling of relaxation and well-being conveyed by the internal ambience of a building due to the ambient temperature, lighting, furnishings and finishes.

Internal health: it refers to the indoor environmental conditions and how it affects the health of building users. Issues of concern include circulation of fresh air, frequent servicing of heating and cooling plants as well as the removal or non-usage of building materials that contain substances harmful to health.

Pollution: refers to the harmful effects of effluents, solid wastes and emissions from a building on the site and the environment beyond. It includes soil contamination, CO_2 emissions from heating appliances and depletion of the ozone layer from the use of CFCs in chillers.

8.3 Causal and Influence Relationships Between Decision Variables

Some of the critical determinants listed in Table 8.1 are just issues which in themselves are not quantifiable. In other words, some of them are merely statements whose achievement depends on other measurable variables with whom they have causal relationships. In this section, the dependency and influence relationships between the critical variables and issues are explored by applying established facts and knowledge of the property development and construction industry.

The most fundamental objective of building renewal, from the viewpoints of private sector operators surveyed is to improve economic performance. This can be achieved in terms of profit from development or investment and reduced occupancy costs. The exploration of the relationships between the critical variables and objectives therefore starts from the nodes of: profitability, maintenance costs and running costs as illustrated in figure 8.1.

Profitability is determined by the relationship between rental income and ***development costs***. Rental income, however, is determined by ***rental value*** and the potential for rents to grow in future. ***Rental value*** and ***income growth potential*** on the other hand depend on how ***marketable*** (ie. how ***saleable*** or ***lettable***) the property under consideration is. Expressed differently, ***rental value*** and ***income growth potential*** depend on how much the property in question appeals to investors and occupiers.

Property marketability partly depends on the quality of the property under consideration and its susceptibility to obsolescence. It is also influenced by the workings of the market which is dependent on the performance of the local and national economies and location. Portfolio measures aside, what is within the control of the property owner to ensure the marketability of a property at a given location is to maintain or improve the quality of the property. The attributes of property quality that influence marketability comes from the interaction between functional, physical, structural and environmental characteristics.

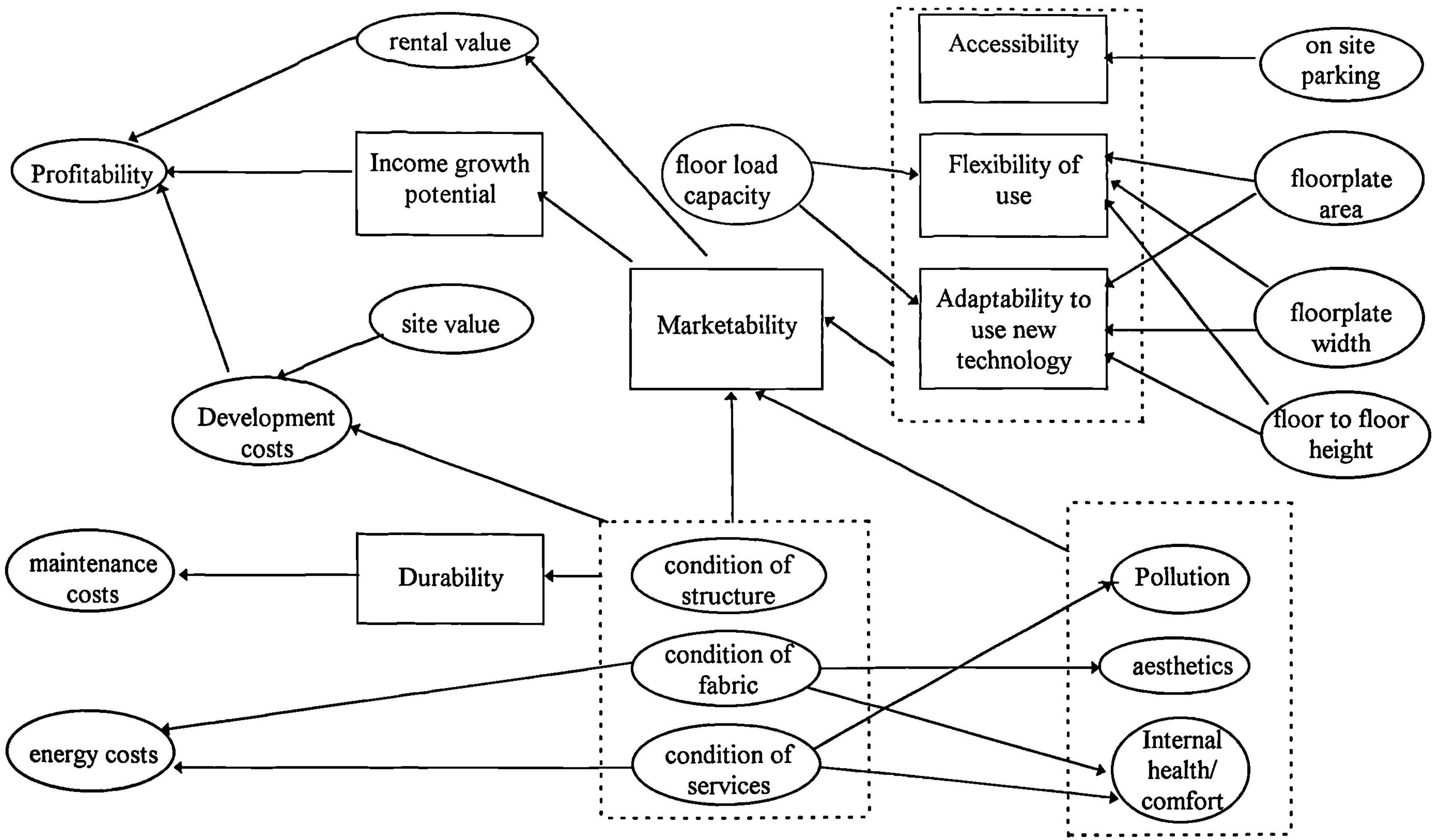


Figure 8.1: Influence and causal relationships between critical decision determinants

The major functional characteristics from the results of the primary research are: ***accessibility***, ***flexibility of use*** and the ***ability to adapt to use new technology***. Ignoring the determinants of accessibility that are deemed to affect both the rehabilitation and redevlopment options equally, the only attribute that can have a differential effect on the options available is *on site car parking*.

Flexibility of use and *adaptability to use new technology* are influenced by:

- *area and width of floorplate*;
- *floor to floor height*; and
- *floor load capacity*.

The physical and structural factors that influence property marketability are: *condition of the building structure*, *condition of the external fabric* and *condition of the services*. During rehabilitation, these factors also affect, to varying degrees, *development costs*, *maintenance costs* and *running costs*.

The environmental factors that affect marketability are: environmental *pollution* (ie. soil contamination, gas emissions, etc.), *aesthetics* (external appearance) and *internal health and comfort*. Environmental *Pollution*, as defined in the last section, depends partly on *the type and condition of building services*, especially the heating and cooling plants. *Aesthetics*, as determined partly by the external appearance of a building, is dependent on the *condition of the external fabric*. *Internal health and comfort* depend on the internal specification of buildings, *the type and condition of services* and *the condition of the building fabric* and its energy characteristics.

Development costs comprise of building costs and *land costs*. Building costs depend on the specification of the building materials and structure, external appearance (including entrances) and the level of internal specification, including spaces, services, furnishings and finishes. For the rehabilitation option, ***development costs*** depend on the ***condition of the building structure, the condition of the building fabric*** and ***the condition of services.***

Maintenance costs depend on how durable a building's structure, fabric and services are. ***Maintenance costs*** are thus influenced by: ***the condition of the building structure, the condition of the fabric*** and ***the condition of the services.***

Finally, ***operating costs,*** which is used interchangeably with energy costs in the context of the research, depend to a greater extent on ***the condition of the building fabric*** and its energy characteristcs. It also depend on ***the type and condition of services.***

The variables indicating the achievement of the fundamental objectives *are enclosed* in *ovals* in figure 8.1. The final decision attributes derived from the exercise above are therefore as listed below:

1. profit, as determined by rental income and development costs, including site value;
2. maintenance costs;
3. running costs;
4. condition of structure;
5. condition of the external fabric;
6. condition of services;
7. floor load capacity
8. on site car parking;
9. area of floorplate;
10. width of floorplate;
11. floor to floor height;
12. aesthetics;
13. pollution; and
14. internal health and comfort.

The variables: ***profit, development costs, rental income and site value*** are related mathematically. ***Profit*** is calculated as the surplus of ***rental income*** over ***development costs,*** which can include ***site value*** or ***land costs.*** Thus ***development costs*** and rental income are ***means objectives*** to ***profit.*** Value judgement in the decision problem at hand should therefore be about the consequences of the relationship between income and costs (ie. ***profit***) and not about the component parts. In the value model therefore, ***profit*** would be used to encapsulate the effects of ***development costs, land costs*** and ***rental income.*** The value function will therefore be constructed over the attribute, ***profit.***

8.4 Scales for Measuring the Attributes

The *construction* of value or utility functions involves the matching of *expressions of preferences by decision* makers to the levels of the attributes in the context of the decision. Scales for measuring the attributes are therefore essential to the construction of value and utility functions. The choice of the scales is guided by the principles first mentioned in chapter three (section 3.8.2), which are that the scales:

i. should be simple and understandable to decision makers;
ii. must be relevant to the attributes they are seeking to measure and to the problem at hand; and
iii. should enable decision makers to discriminate between decision options based on points on the scale, within the context of the decision at hand.

Consistent with the principles above, the scale chosen for each attribute is on the basis of how familiar it is likely to be to decision makers. The scales are therefore mostly what are usually found in property literature (eg. books and journals) and in published data on property performance and costs. One other reason for the choice of the scales discussed below was to be consistent with units used in published data such as cost data by bodies like the BCIS and BMCIS.

The scale for the individual attributes and how each is derived are discussed below.

8.4.1 Profit

Profit is defined as the surplus of income over cost and is conventionally expressed as a fraction of cost. Mathematically, profit is calculated as:

Profit (%) = (income - cost)/ cost x 100.

In the formula above, cost refers to development costs as defined in the last section. Determination of income, however, depends on the purpose of undertaking the development in question.

If the completed development is to be disposed of through sale, income can be either the estimated sale price or the net development value (NDV) which is the capitalisation of the estimated net annual rental income. The capitalisation rate used can be that offered by a potential purchaser or that obtainable on comparable properties in the same sub-market.

If, on the other hand, the completed development is to be held for investment purposes, both the development costs and the rental income could be expressed on an annual basis. The income part would just be the net annual rental income. The total development costs would, however, have to be converted into annual equivalent costs. This requires that a rate of interest and a period in years over which to recoup the initial investment be specified. The choice of these depend on the requirements of the decision maker and his/her organisation.

8.4.2 Maintenance costs

These are the annual costs of maintaining the building and services. Data already exists for these in the form of average occupancy costs compiled by the BMCIS (Building Maintenance Cost Information Service) which lists the maintenance costs for various building elements. The measurement scale chosen is monetary value per unit gross floor area, in this case £/ m^2 or ft^2, whichever is convenient to the decision maker.

8.4.3 Energy costs

These are the annual costs of energy use covering expenditure on gas, electiricity and oil. To be consistent with the DETR's (Department of the Environment, Transport and the Regions) Energy Efficiency Office's guide for good practice energy consumption, the scale chosen is £/m^2 of treated floor area. The treated floor area refers to that part of the building that benefits directly from the heating or cooling energy supplied. For a tenant, treated floor area may refer to net lettable area, unless he is also responsible for paying the energy bills for the common areas.

Energy costs partly depend on the hours of usage of the building. The assumption here is that both the rehabilitation and redevelopment options would be run in a similar manner, leaving any variations between the two to be dependent solely on the quality of the buildings and their services.

8.4.4 Condition of building structure

This refers to the initial condition of the building structure, including frames, foundations and floor slabs, and how it can be transformed to the required goal level. The only action available to change the structural condition from the initial to the goal level is by expending resources in the form of monetary expenditure. The scale thus chosen to evaluate the condition of the building structure is £/m² or ft² of gross internal area as used in the BMCIS or BCIS cost data. For the redevelopment option, 'the building structure' is simply evaluated by the amount of money to be spent on the building structure expressed as £/m² or ft² of gross internal area.

8.4.5 Condition of building external fabric

Here too, like the condition of the building structure, the condition of the building external fabric is evaluated in terms of the money that would be required to transform the initial condition to the goal condition. This is measured as £/m² or ft² of gross building internal area, depending on the convenience of the decision maker. For the rebuilding option, it is simply the cost of providing the building external fabric.

8.4.6 Condition of services

This is evaluated in terms of the cost of replacing or upgrading the existing building services, expressed as £/m² or ft² of gross internal area. For a new building, it is simply the amount spent in providing the desired or required building services.

8.4.7 Floor load capacity

This is the occupancy load per unit area that the upper floors can bear in addition to the dead weight of the floors, finishes and services (eg. cables, lighting and ductwork). It is evaluated as kN/m^2 or lb/ft^2 depending on the convenience of the decision maker. It is also conventional to express floor load capacity as: capacity in kN/m^2 + 1 kN/m^2, where the 1 kN/m^2 caters for the loading due to services and lightweight internal partitions.

8.4.8 On site car parking

This can be evaluated in one of two ways: in terms of site development ratio or as 1 car space per an appropriate unit of gross floor area. If in addition to providing parking spaces, room for external storage is essential to the use of the building, then site development ratio is the appropriate measure. Site development ratio is calculated as the ratio of the area of the building footprint to the site area, expressed in either percentage or decimal fractional terms. On the other hand, where car parking is the only requirement, it can be evaluated in terms of unit car parking space per an appropriate unit of floor area, eg. 1 parking space per 230m^2.

8.4.9 Floorplate size (area and width)

Floorplate area is measured in terms of square metres (m^2) or square feet (ft^2) of gross floor area. Gross floor area refers to the total area within the external walls. The area of interest to tenants and investors though is the net lettable area, which excludes circulation area, toilets, plant rooms, etc. The width of the floorplate is simply measured in metres or feet.

8.4.10 Floor to floor height

This is evaluated in terms of length dimensions. The scale chosen is either feet (ft) or metres (m) depending on the convenience of the decision maker.

8.4.11 Aesthetics

This is a subjective consideration that defies universal evaluation. It is very much dependent on the tastes and preferences of the decision maker. It is envisaged that the analyst (in this case, building adviser) would work closely with the decision maker to lay down markers to represent what is desirable or required. Aesthetics influence the choice of material for the external building fabric. For an existing building, the reverse influence is true. The scale chosen to evaluate aesthetics is in terms of the amount to be spent in providing the desired result. The scale chosen is therefore £/m² or ft² of gross internal floor area.

8.4.12 Pollution

The most important aspects of pollution from buildings are CO_2 emissions from heating plants and the use of CFC in chillers due to their contribution to greenhouse effect and global warming. Research evidence (Goodman, 1994), however, suggests that occupiers would be much concerned with environmental issues if they are compelled by legislation to do so or if they can deliver savings in occupancy costs. Thus the best way to evaluate the use of CFC-free plants or to assess the reduction in CO_2 emissions is to consider the cost of providing the appropriate services and the benefits in terms of potential reduced energy costs and associated possible higher rents. Thus, a decision maker, with the help of professionals, would choose heating and cooling plants based on stated environmental goals, which would then feed into reduced energy costs and increased rental income.

Even though CO_2 emissions from aplliances can be evaluated (in kg/kWh), using the criterion of understandability of the scales chosen, it is felt that decision makers would not be able to make meaningful value judgements based on this scale. Thus £/m² is considered appropriate in this case (subsumed within development cost and rental income)

8.4.13 Internal health and comfort

This basically depends on the internal specification and how it affects the indoor environment. This concerns issues such as air quality, lighting levels, thermal comfort (ie. heating, cooling and ventilation rates), furnishings, finishes and coverings. It is concerned with the presence of substances harmful to health (eg. PCBs, lead, asbestos, etc.) in building materials.

The internal specification greatly influences the choice of services and the building fabric and its energy characteristics. It also determines the choice of internal building material as well as draughtproofing and insulation measures.

The evaluation of internal health and comfort, from the discissions above, is therefore in terms of amount of money spent in providing the desired or required internal environment expressed as £/m^2 or ft^2 of gross internal floor area.

8.5 The Value-based Decision Model

Inspecting the final list of indicators (p. 281), the decision determinants can be grouped into three sets of variables.

The first set of indicators are economic input and output variables. These are profit; as determined by development costs and development value, maintenance costs and running costs.

The second set of indicators are condition state variables. These are indicators that are transformable. In other words, they can be altered from a lower to a higher level by spending resources on them. These include condition of structure, condition of fabric and condition of services. The rest are aesthetics, pollution control (eg. CO_2 emissions) and indoor conditions.

The final set of indicators are fixed physical attributes of the building and its site. They are for all practical purposes fixed when the development is completed. This is to say that they are either physically impossible to alter or the cost of their alteration can be too prohibitive to almost rule any changes out. These indicators are floor load capacity, floorplate area, floorplate width, floor to floor height and on-site car parking.

For a new building, there is relative freedom to determine both the fixed and transformable variables. For an existing building, however, only the transformable variables can be altered. The final product in both cases depend on economic and subjective value considerations.

As can be seen from the nature of the indicators, the building renewal decision making process involves the making of both economic as well as value judgements. The economic judgements are informed by economic facts and assumptions. The value judgements on the other hand are informed by preferences, risk attitude and experience of the decision maker. These in essence are the main tasks of the proposed building renewal framework (see figure 8.2).

In the first instance, building development involves the use of financial resources to create a physical asset which is expected to produce direct or indirect economic benefits. To arrive at a better decision on what has to be provided, within what budget, a balance must be struck between the attributes of the physical asset and the financial outlay to deliver optimum economic results.

Beyond the economic analysis is the fact that buildings are physical assets that satisfy a need or perform a function. Their physical attributes (eg. external appearance, internal spaces and internal specification) can hinder or facilitate activities to be carried out in them. It is therefore not enough to just optimise economic factors, but it is also necessary to maximise the utility or use value of the building.

These two judgements reside within the framework shown in figure 8.2. It shows the renewal decision process as consisting of six distinct but linked steps which are:

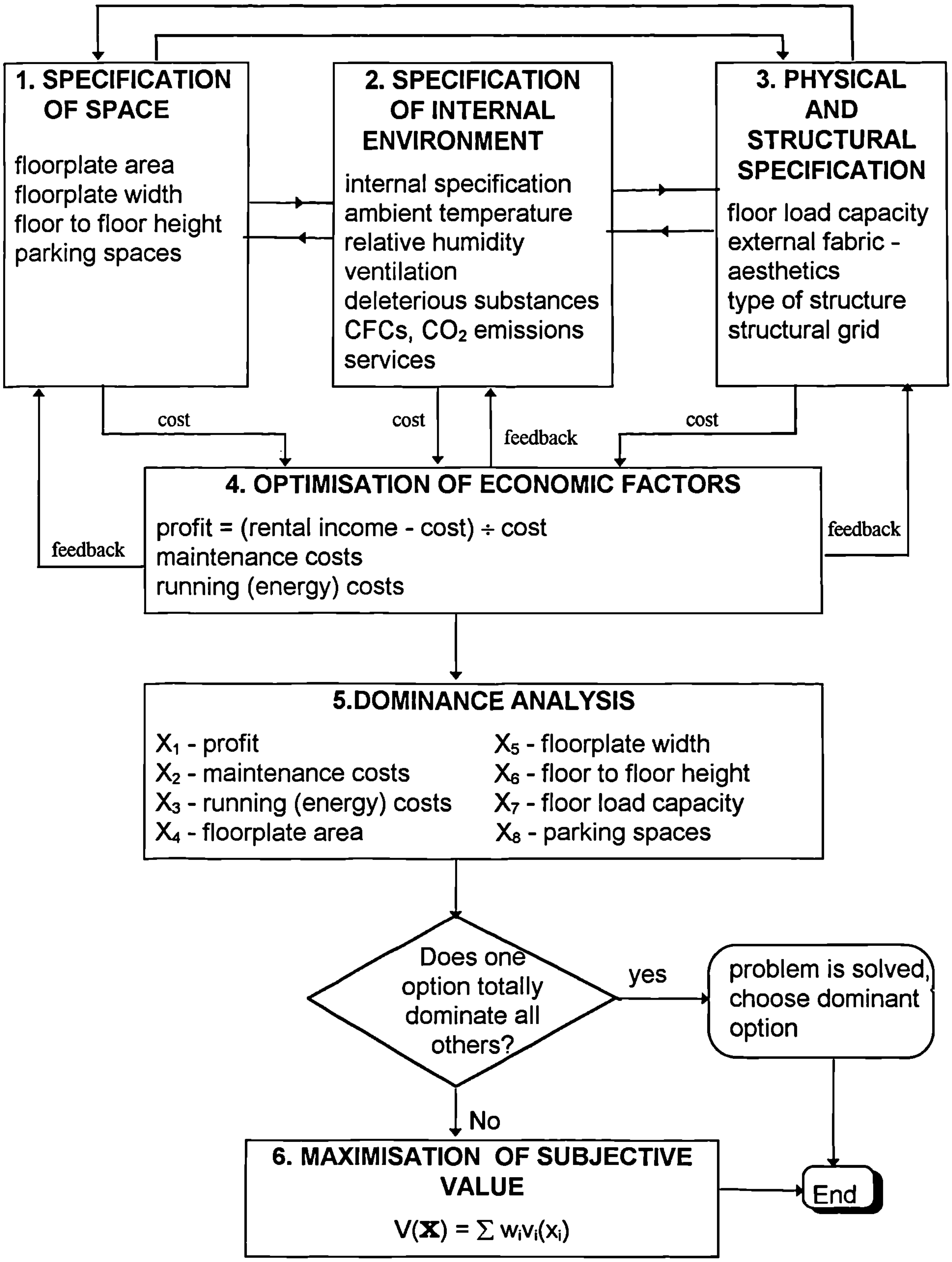


Figure 8.2: Value-based building renewal decision model

1. the specification of space requirements;
2. the specification of environmental requirements;
3. the specification of physical and structural requirements;
4. optimisation of economic factors;
5. dominance analysis; and if required,
6. maximisation of subjective value.

Steps 1 to 3 feed into step 4 where the economic factors are optimised. Steps 1 to 4 are therefore linked by forwards and backwards loops as the decision maker and his advisers seek to optimise the economics of the situation. The outputs from step 4 feed into step 5 and if necessary, step 6. It is noted that the transformable indicators do not feed into the value maximisation stage. This is explained below under economic optimisation (section 8.5.4)

In following the steps in the model, it is assumed that the external factors that affect property performance, which were uncovered in the primary research, would be taken into consideration. These external factors include planning controls, legislation, user requirements, locational factors and government policy. Others are state of the economy, competition from other properties, taxation and the cost of capital.

The steps in the decision model are described below.

8.5.1 Specification of Space Requirements

As an input to the decision process, the decision maker is expected to specify the space requirements. This concerns both internal and external space requirements. The issues involved are size of the building based on number of storeys, floor to floor heights and floorplate size. It also involves the specification of site development ratio which is determined by space requirements for car parking, landscaping and other uses.

For an existing building, the space requirements would more or less be fixed. Opportunities though may exist to marginally increase floorplate size by extensions or to increase floor to floor heights by removing floor screeds. Car parking spaces may also be increased by some limited demolitions of some part(s) of the existing building. However, in a more general sense, these spaces would already be fixed.

For the rebuilding option, the decison maker has to specify the spaces mentioned above to be within the constraints presented by local planning requirements on building heights, sightlines, plot ratios and car parking. Apart from possible planning restrictions, the space specified would be determined by the economics of the proposed scheme and the functional requirements of investors and occupiers.

For the development to be financially feasible, a balance would have to be struck between provisions and what the market is prepared to offer in terms of purchase price or rent and yield.

Building functionality determines the size of floorplates and floor to floor heights, among others. For instance the nature of the activities to be carried out in the building and the specified building services will determine if raised floors and ceiling zones are required. These contribute to the determination of the floor to floor heights.

The relevant data from this stage of the decision process are:

- area of floorplate;
- width of floorplate;
- floor to floor heights; and
- car parking spaces or site development ratio.

8.5.2 Specification of Internal Environmental Conditions

The specification of the determinants of the internal environment depends on the kind of working environment that the decision maker wants to provide. This is influenced by market perception and wider environmental considerations. The main issues to address at this stage include:

- finishes to internal walls, ceilings and floors;
- sanitary facilities;
- the presence of substances harmful to health;
- internal temperatures as they affect thermal comfort (ie. cooling and heating) - design temperature, how to maintain it and how to control it to suit varying conditions;
- ventilation - the means through which, and the rate at which, fresh air is introduced and stale air removed; and
- lighting levels.

The issues raised above more or less determine the type of mechanical and electrical services that are provided and the required asscociated plant and equipment. Other issues that may be considered in choosing the M&E services are:

- the economics of the project - the effects on development costs and occupancy costs;
- building functionality such as the extensive use of IT equipments; and
- the wider external environmental considerations, such as energy efficiency, CFCs in chillers and reduction in CO_2 emissions from heating appliances.

For the existing building, the decision maker would have to assess the nature and condition of the existing services using the same criteria as raised above. He would then have to decide on what needs to be replaced, upgraded or repaired.

The distribution and density of services would determine if there is the requirement for uninterrupted spaces for them to run in. This in turn would determine if riser voids, raised floors and ceiling zones are required. For the existing building the choice of M&E services would be influenced by the spaces already available, which is fixed, for all practical purposes.

8.5.3 Specification of Building Structure and Fabric

After specifying the space and indoor environmental requirements, the next stage in the decision process is to specify the physical and structural requirements. The issues to address include the following:

- floor load capacity;
- floor construction;
- type of structure - structural material, type of frame, spacing of structural grid, etc.;
- roof construction;
- type of foundation; and
- type of external fabric.

The floor load capacity will depend on the occupancy or function of the building and the flexibility the decision maker would like to build in for the building to be able to accommodate different uses.

The type of structural frame specified will depend on the relative cost and availablity of different building materials, durability considerations, speed of construction and intensity of foundation loads. In fixing the structural grid, a balance would have to be struck between floor thicknesses, which affect foundation loads and building height; size of internal columns, which affect internal space flexibility; and the size and span of cladding rails and roof purlins. The foundation type will depend on the building load and the physical properties of the soil on the site.

The specification of the external building fabric may be based on aesthetic considerations to satisfy planning requirements or to improve the appeal of the property to investors and occupiers. Other issues that may be considered in specifying the fabric include energy characteristics such as heat gains and heat losses and how they affect the maintenance of indoor temperatures. The effect of solar glare on the use of VDUs may also be another consideration.

For an existing building, the exercise at this stage would be to assess the condition of the building structure and fabric and its ability to satisfy the performance required. The result of the structural assessment will, for instance, determine the extent and scope of repairs and strengthening.

Similarly, the scope of repairs and replacement of the external fabric would be determined by the results of the assessment of the condition, functional and energy characteristics of the building fabric.

8.5.4 Optimisation of Economic Factors

If private sector building development is viewed solely as an economic activity, it can be described as the utilisation of resources to create an asset to produce economic benefits (figure 8.3). The optimisation step involves striking a balance between the economic inputs, the levels of transformable indicators, the fixed physical attributes and the economic outputs.

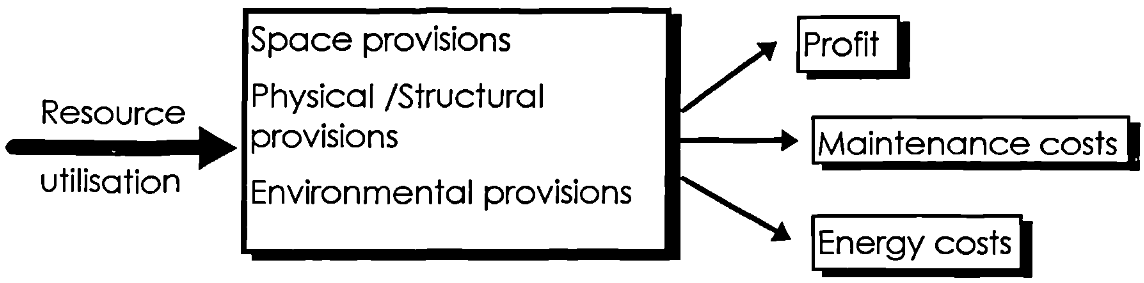


Figure 8.3: Building development as an economic activity.

Where resources are limited, optimisation of economic factors is also concerned with determining the optimum combination of the variables which affect cost to fit within the resource constraints whilst maximising the benefits.

The aim of this step is to make economic judgements that will seek to minimise development cost whilst maximising economic benefits. Implicit within the economic judgements are value judgements. For instance deciding on the level of specification or deciding to incur low initial costs at the expense of high future running costs are all forms of value judgements. Other value judgements include deciding on what building element or provision to spend disproportionately on at the expense of others. For instance, should air-conditioning be of a higher priority than say external appearance? These value judgements are however different from those required in steps 5 and 6. In the private commercial sector, property specifications are to a large extent determined by economic considerations rather than some deeply held psychological values of decision makers. The exception may be owner occupiers who may decide to add some elements of luxury to suit their tastes and preferences.

Judgements about the levels of the transformable variables or condition state variables are made at this stage. It is assumed that in the private sector these levels are again more informed by economic facts and assumptions rather than tastes and preference. Of course there may exceptions in the case of owner occupiers. Once economic judgements are made about the transformable variables, they do not form part of the subjective value maximisation exercise that follow. Their effects are subsumed within the attribute, profit.

Profit is determined by development costs and development value, which depends on rental income and yield. Expressed mathematically:

Profit = f{development cost, rental income, yield}, but development cost, rental income and yield all depend on the specification of space, external appearance, structure and indoor environment. Thus profit is directly or indirectly related to specification of space, structure, fabric and internal. Optimisation is therefore about striking a balance between development costs, which is determined by the building specification; and rental income and yield which partly depend on the quality of the building.

The optimisation exercise as described above would yield particularly the economic factors of the development: profit, estimated annual maintenance costs and estimated annual energy costs. It would also result in the confirmation of the values of the physical characteristics of the building and the levels of provisions to be made as covered in steps 1 to 3.

8.5.5 Dominance Analysis

After going through steps 1 to 4 of the decision model, the levels of the decision attributes for the rehabilitation and the redevelopment options would be known (figure 8.2). The attributes are:

X_1 - profit (% of development cost);

X_2 - annual maintenance costs (£/m^2 of gross floor area);

X_3 - annual energy costs (£/m^2 of treated floor area);

X_4 - gross floor plate area (m^2);

X_5 - floorplate width (m);

X_6 - floor to floor height (m);

X_7 - floor load capacity (kN/m^2); and

X_8 - parking spaces (in either % site development ratio or 1 car space per 'y' m^2 of gross area).

The dominance analysis involves inspecting the level of each attribute that each decision option has and determining if one option totally dominates the other. Recalling from chapters three (section 3.8.3) and four (section 4.2), a dominant option is one that is at least equally desirable as its nearest rival on all attributes, except one, over which it is superior.

Dominance analysis requires the decision maker to carry out two tasks:

1. to indicate the direction of preference on the scale of each attribute: is more preferred to less or vice versa?; and
2. to construct a pay-off matrix which lists the achievements against the decision options when evaluated over the attributes.

Assuming that only two alternatives are available to the decision maker (ie. rehabilitation and redevelopment), the pay-off matrix for the building renewal problem is as shown in Table 8.2. The entries x_{iRH} and x_{iRD} are the levels of attribute X_i for the rehabilitation and the redevlopment option respectively. The direction of preference for each attribute can be stated simply as "more preferred to less" or "less preferred to more".

Table 8.2: Pay-off matrix for commercial property renewal

Attributes	Rehabilitation option (RH)	Redevelopment option (RD)	Direction of preference
X_1 ~ profit	x_{1RH}	x_{1RD}	
X_2 ~ maintenance cost	x_{2RH}	x_{2RD}	
X_3 ~ energy costs	x_{3RH}	x_{3RD}	
X_4 ~ floorplate area	x_{4RH}	x_{4RD}	
X_5 ~ floorplate width	x_{5RH}	x_{5RD}	
X_6 ~ floor to floor height	x_{6RH}	x_{6RD}	
X_7 ~ floor load capacity	x_{7RH}	x_{7RD}	
X_8 ~ parking spaces	x_{8RH}	x_{8RD}	

If, on inspecting the pay-off matrix as constructed in Table, 8.2, one option totally dominates the other, the dominant option is the preferred option according to the values of the decision maker. The problem then would be solved. It can be seen that the values of the variables: ***profit, maintenance costs*** and ***energy costs*** are only estimated values. These are the uncertain variables in the problem. In performing the dominance analysis, sensitivity analysis ought to be carried out to determine how realistic the estimated values are and how different values would affect the decision.

As in most real life problems, it may be difficult to do well on all attributes for one option. For instance, the requirement for adequate car parking for the redevelopment option may conflict with the wish for larger area of accommodation or the wish for reduced energy costs may conflict with the wish to minimise development costs. If, on inspecting the pay-off matrix, there is no dominant option, the next stage of the model would be to choose the option that maximises the subjective values of the decision maker. This is explained below.

8.5.6 Maximisation of Subjective Values

The subjective value of each competing decision option (ie. rehabilitation and redevelopment) is given in chapter four (section 4.2) as:

$V(\mathbf{X}) = \sum w_i v_i(x_i)$, where,

w_i = the relative importance weight of attribute X_i ;

$v_i(x_i)$ = the value or utility score of the level x_i of attribute X_i ; and

$V(\mathbf{X})$ = the subjective value of the option under consideration.

The purpose of this step in the decision model is to select the option that maximises the subjective value of the decision maker as defined above. This entails the following tasks:

1. ranking the attributes $X_1, X_2, X_3, \ldots, X_8$ in order of importance;

2. deriving relative importance weights for the attributes $X_1, X_2, X_3, \ldots, X_8$ in accordance with the rankings above;
3. defining for each attribute, $X_1, X_2, X_3, \ldots X_8$, the range of acceptability (ie. maximum and minimum levels, x_{imax} and x_{imin});
4. constructing single attribute value and utility functions over the attributes; and
5. selecting the alternative that maximises the decision maker's subjective value.

These procedures are adequately described in chapter three.

At this juncture, it is appropriate to discuss the shapes of utility functions and their implications for the risk attitudes of decision makers. Decision makers are thought to exhibit three risk behaviours in any decision situation (Pratt, 1964). These are risk aversion, risk neutrality and risk proneness. These risk attitudes are best defined with an illustration.

Decision makers are usually presented with two levels of an attribute when constructing utility functions by indifference methods (see chapter three). Let us assume that a decision maker is presented with the levels x_{ia} and x_{ib} of attribute X_i with $x_{ia} > x_{ib}$. For the sake of the illustration, let us assume that the decision maker prefers more of attribute X_i to less. If the two levels of X_i are presented in a 50-50 lottery, the expected value of the lottery is:

$x_{iE} = 0.5\, x_{ia} + 0.5 x_{ib}$ or $1/2\, (x_{ia} + x_{ib})$.

In the circumstances described above, the decision maker is said to be risk-averse if he prefers the expected value of the lottery to the lottery itself. On the other hand, if he prefers the lottery to the expected value, he is said to be risk-prone. If the decision maker is indifferent between the lottery and the expected value of the lottery, he is said to be risk neutral.

The risk attitudes of decision makers, as illustrated above, have been used to derive generic utility and value functions (Keeney, 1992: pp. 143-

146). If the levels x_{ia} and x_{ib} of attribute X_i are thought of as the maximum and minimum acceptable levels of the attribute, then according to utility measurement rules (refer chapter 3), $u(x_{ia}) = 1.0$ and $u(x_{ib}) = 0$. For the decision maker who is risk neutral, $u(x_{iE}) = 0.5u(x_{ia}) + 0.5u(x_{ib}) = 0.5$. A decision maker who is risk-averse over the attribute under consideration would value x_{iE} more than 0.5 and one who is risk-prone would value it less than 0.5. These give rise to the family of curves illustrated in figure 8.4 that characterises risk aversion, risk proneness and risk neutrality.

The generic forms of utility and value functions illustrated above are:

for risk aversion:	$u(x) = a + b(-e^{-cx})$	- concave;
for risk neutrality:	$u(x) = a + b(cx)$	- linear; and
for risk proneness:	$u(x) = a + b(e^{cx})$	- convex.

where,

- the constants a, b > 0 and ensures that the utility or value function is scaled between 0 and 1; and
- the parameter 'c' in the risk-averse and risk-prone equations measure the degree of risk-proneness or risk-aversion of the decision maker. In the linear function, 'c' is either +1 or -1 depending on whether more of the attribute is preferred to less or vice versa.

In the value-based building renewal decision framework, as created in this research, all the attributes are certain except profit, maintenance costs and energy costs. According to the convention of utility theory, value functions would be constructed over the certain attributes and utility functions over the uncertain attributes.

The value functions over the certain attributes (ie. floor to floor height, floorplate area, floorplate width, floor load capacity and car parking spaces) are likely to be, but not necessarily, linear. The shapes of the

Utility functions for the uncertain attributes (ie. profit, energy cost and maintenance cost) are likely to be either concave or convex.

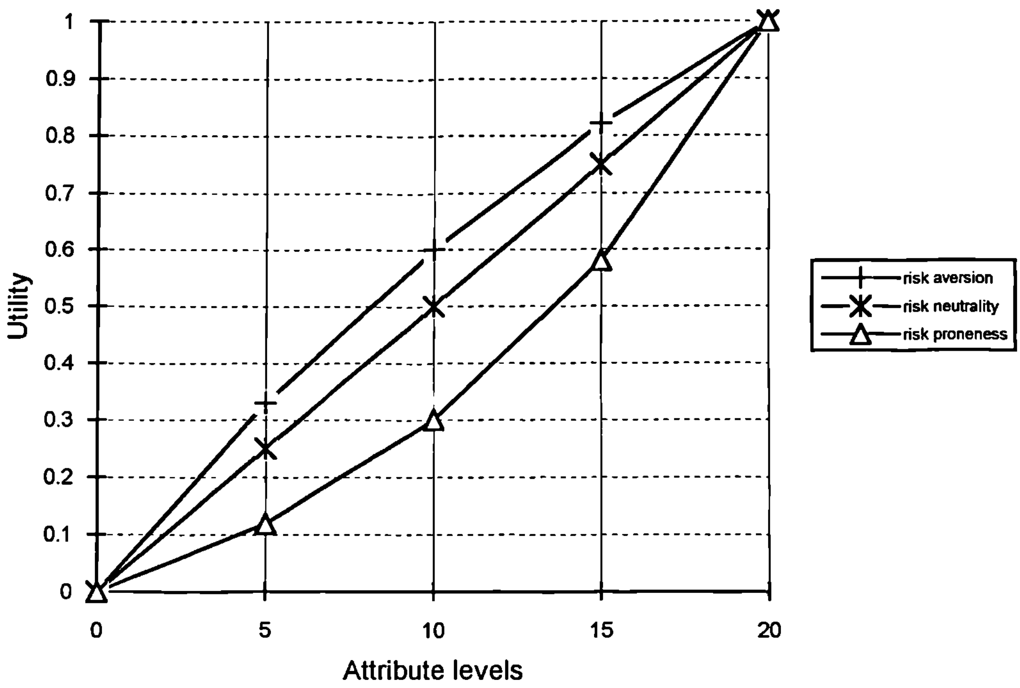


Figure 8.4: Risk attitudes and shapes of utility curves

8.6 Application of the Model to a Hypothetical Case Study

A developer has just acquired an old office building in a city in the East Midlands of the UK. His aim is to carry out cosmetic refurbishment for now, whilst waiting for the market to pick up when he planned to demolish and rebuild. In spite of this aim, the developer is open to the idea of carrying out major refurbishment (rehabilitation) if it can be shown that his objectives are met by this option. The model created above is applied to this situation to recommend a course of action.

8.6.1 Description of the Existing Building and Site

The existing five-storey building, used to be the offices of the local DHSS. It was built in the mid 1960s and has a total gross internal floor area of 5500 m^2 with a net lettable area of 4700 m^2. A typical floor plan is shown in figure 8.5 below. The floor to floor height is 3.85m for the bottom storey and 3.35m for the upper storeys. The floorplate width is 12.2m at each level.

The building site, which is approximately rectangular in shape, measures 68m x 45m (area - 3060m^2). It is located at a corner formed by the junction between two roads. The road facing the longer wing of the L-shaped building is a wide and busy road whilst the shorter side of the L overlooks a relatively quiet side street. The enclosed sides of the L look onto a 45-space car park serving the building.

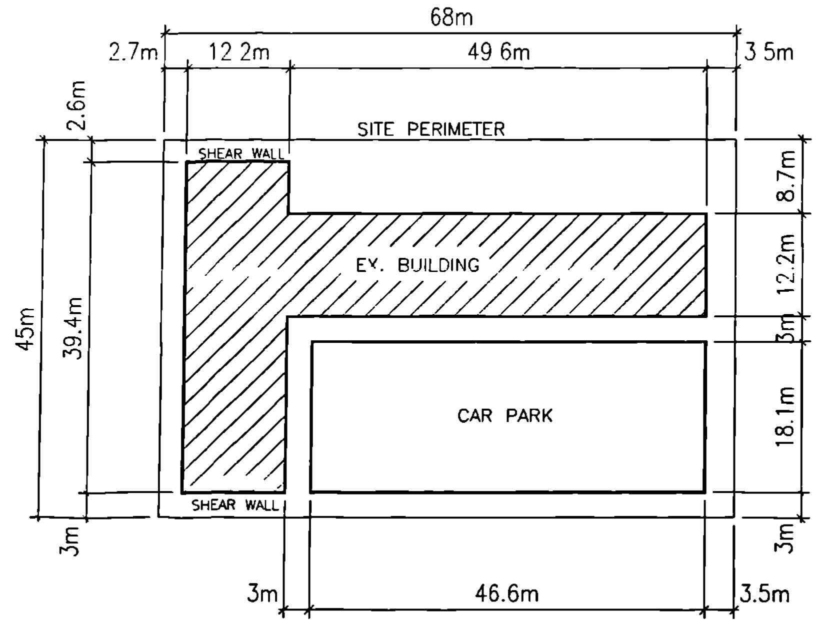


Figure 8.5: Typical floor plan - existing building

The external building elevation is clad in non load-bearing precast concrete panels with single glazed openable windows. At two gable ends are 300mm thick shear walls which incorporate window openings. The roof is of in-situ concrete slab, 115mm thick with insulation and waterproofing membrane on top.

The internal building services are very basic. There is no air handling of any kind with thermal comfort relying on natural ventilation. During the summer months, when it is very humid, this is supplemented by table top fans depending on the comfort of occupants. The building is heated by perimeter radiators. There are two eight-passenger lifts serving all five floors.

To resolve this problem, the existing building and a proposed new building are evaluated in accordance with the steps of the new value-based decision model.

8.6.2 Proposals for Existing Building

Space specification

The floor-to-floor height is inadequate to provide for modern requirements of raised floors and ceiling zones. Any service upgrade has to fit around the existing spaces. The proposal is to remove the 50mm screed on the upper floors resulting in floor-to-floor height of 3400mm. This will allow the introduction of 150mm raised access floors on all floors and chilled ceilings whose space requirements are not as much as for air-conditioning.

The floorplate widths are to be extended on each side by 700mm. This will increase the total gross internal floor area from 5500 m^2 to 6250 m^2 and net lettable area from 4700 m^2 to 5100 m^2. By extending the floors in this way, space can be found for a service distribution zone around the perimeter. These proposed changes do not affect the 45 car spaces available.

Specification of indoor conditions and services

It is quite apparent that the existing services do not meet modern requirements of dealing with increased heat loads from increased use of IT equipments and density of occupation. The floor to floor heights are not however adequate to accommodate air-conditioning. This therefore only leaves the option of installing integrated chilled ceilings with the lighting recessed within the ceiling.

Integrated chilled ceilings consist of ceiling tiles containing capillary tubes filled with chilled water. They work by cooling the air which is displaced upwards towards the ceiling. They do not perform very well in static air conditions. It is therefore proposed to combine them with mechanical displacement ventilation which will displace air towards the ceiling. Heating is to be provided by perimeter radiators.

The electrical supply is considered adequate but the cabling will be completely stripped out and re-installed.

The two eight-passenger lifts are to be completely overhauled including respraying of the doors and internal refurbishment of the lift cars.

Physical and structural specification

The external concrete panel-clad facade is polluted by traffic fumes and suffering from chlorination and carbonation problems. Besides this, the fabric has poor U-values and the net window area is not enough to make maximum use of daylighting. The proposal is to replace the concrete cladding panels with a curtain walling system with double glazed low-emissivity glass. The gable shear walls, which are to be retained, are to be given fungicidal treatment and then overclad with an aluminium system.

There are no 'tell tale' signs of structural deterioration. The basic structure is therefore assumed to be sound. Contingency funds are to be set aside however to cater for any problems that may be hidden from view.

The floor load-bearing capacity of 3 kN/m^2 is adequate for office use. This is in the light of the British Council of Offices' (BCO) *Specification for Urban Offices* which recommends 2.5 kN/m^2. One 7.6m x 5.25m bay in the roof is however to be strengthened to house a plant room.

Apart from the strengthening of the roof slab over the plant room, the only structural work required is to do with the extension of the floors. This will involve the bolting of outward cantilever beams to the columns at the floor and roof levels and extension of the floor, roof and ground-bearing slabs to suit.

Optimisation of economic factors

At this stage, the scheme would have to be costed. The costs will include such costs as building costs (which depends on provisions discussed above), land costs, external works, professional fees and finance charges. If the total cost were to exceed available resources, the building specification and other cost components ought to be altered till a match is established with available resources. Another exercise is to examine the viability of the scheme in terms of the correlation between the specification and returns. The returns, according to the value-based decision framework are profit (which depends on yield and rental income), maintenance and energy costs.

It is assumed for this hypothetical illustration that the specification described above represents the optimum provisions. The economics of the scheme is investigated in figure 8.6. The cost data used are adapted from cost data by QS company Davis Langdon and Everest.

Figure 8.6: Profit calculation for the Rehabilitation option

<u>Estimated Development Costs</u>		
Construction costs	**£**	**Total £**
Limited demolitions	150 000	
Rehabilitation - 6250m^2 @ £600/m^2	3 750 000	
Contingency (10% of rehabilitation cost)	375 000	
External works	50 000	
Planning, Building regulations fees, survey work, say 1%	45 000	
Professional fees @ 12%	525 000	
Finance costs @ 9% p. a (based on 50% of 18 months construction period)	330 000	5 225 000
Site/ existing building purchase		
Purchase price	2 750 000	
Acquisition costs and fees @ 2%	55 000	
Finance costs @ 9% p. a for 18 months	380 000	3 185 000
Marketing and Letting fees		100 000
Void Period		
Finance costs @ 9% p. a (9 months loss of rent)		575 000
Total Development Cost		9 100 000
<u>Estimated Net Development Value</u>		
Anticipated rental income - 5100m^2 @ £140/m^2	£714 000	
Time to purchase at 7% yield p. a	14.3 years	
Net Development Value (NDV)		£ 10 200 000
Developer's Profit (NDV - Total Development Cost)		**£1 100 000 (12%)**

Maintenance costs and energy costs are usually published in cost data for various building services and external fabric types for different ages and hours of operation. For the sake of this exercise it is assumed that the annual expenditure on maintaining the new building fabric and the services as well as on energy usage is £35/m^2.

Table C2.6: Combined relative frequencies for responses to Functional variables among Investors

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Condition of services	66.7	22.2	11.1	55.6	44.4	0.0	64	28	8
Accommodation size	88.9	11.1	0.0	88.9	11.1	0.0	89	11	0
Ease of circulation	33.3	66.7	0.0	55.6	44.4	0.0	39	61	0
Floor to floor height	55.6	44.4	0.0	77.8	22.2	0.0	61	39	0
Accessibility	77.8	22.2	0.0	77.8	22.2	0.0	78	22	0
Internal sub-divisions	11.1	88.9	0.0	0.0	100.0	0.0	8	92	0
Security	44.4	44.4	11.1	22.2	77.8	0.0	39	53	8
Flexibility of use	44.4	55.6	0.0	55.6	44.4	0.0	47	53	0
Image/prestige	44.4	33.3	22.2	44.4	55.6	0.0	44	39	16
Architectural merit	11.1	77.8	11.1	22.2	77.8	0.0	14	78	8
Historical significance	0.0	44.4	55.6	0.0	77.8	22.2	0	53	47
Adaptable to use new technology	55.6	44.4	0	66.7	22.2	11.1	58	39	3

Figure 8.8: Profit calculation for the New build option

Estimated Development Costs		
Construction costs	**£**	**Total £**
Demolitions and enabling works	750 000	
Building costs - 7050m^2 @ £1150/m^2	8 110 000	
External works	150 000	
Planning, Building regulations fees, site survey, say 2%	160 000	
Professional fees @ 10%	920 000	
Finance costs @ 9% p. a (based on 50% of 18 months construction period)	680 000	10 770 000
Site/ existing building purchase		
Purchase price	2 750 000	
Acquisition costs and fees @ 2%	55 000	
Finance costs @ 9% p. a for 18 months	380 000	3 185 000
Marketing and Letting fees		100 000
Void Period		
Finance costs @ 9% p. a (9 months loss of rent and 3 months rent free period)		1 265 000
Total Development Cost		15 320 000
Estimated Net Development Value		
Anticipated rental income - 5900m^2 @ £200/m^2	£1 180 000	
Time to purchase at 7% yield p. a	14.3 years	
Net Development Value (NDV)		£ 16 850 000
Developer's Profit (NDV - Total Development Cost)		£1 530 000 (10%)

Due to the air-conditioning, the annual expenditure on maintenance and energy usage would be higher for the new building. It is therefore assumed that this expenditure is £60/m^2.

8.6.4 Dominance Analysis

The rehabilitation and redevelopment options are compared to determine if one option totally dominates the other when assessed over the attributes.

Table 8.3: Pay-off matrix showing attribute levels

Attribute	Rehabiltation option	New build option	Direction of preference
x_1 ~profit (%)	12	10	more preferred to less
x_2 ~ maintenance and energy cost (£/m²)	35	60	less preferred to more
x_3 ~ floorplate area (m²)	1250	1400	more preferred to less
x_4 ~ floorplate width (m)	13.6	18	more preferred to less
x_5 ~ floor to floor height (mm)	3400	4000	more preferred to less
x_6 ~ floor load capacity (kN/m²)	3.0	7.0	more preferred to less
x_7 ~ on-site car parking (1 space per y m²)	y = 140	y = 150	less preferred to more

The pay-off matrix indicates that no option totally dominates the other. It shows the rehabilitation option to be superior over the attributes: profit, maintenance and energy costs as well as on-site car parking. The new build option on the other hand is superior over the attributes: floorplate area, floorplate width, floor to floor height and floor load-bearing capacity. It would seem the next step is to assess the options in terms of how they maximise the subjective value of the decision maker. However, if the decision maker were to decide that the attributes over which one option is superior are trivial, the pay-off matrix can still be used to select the optimum action. In this illustration, it is assumed that none of the attributes is trivial.

8.6.5 Maximisation of subjective values

Three tasks are required here (refer to chapter three) which are:

1. ranking and weighting of the attributes;
2. construction of value and utility functions over the acceptable ranges of the attributes; and
3. computation of the subjective value of each option according to the model: $V(\mathbf{X}) = \Sigma w_i v_i(x_i)$.

It is assumed that the decision maker ranks and weights the attributes as shown in Table 8.4 below, using direct rating techniques (chapter three).

Table 8.4: Attribute weights

Attribute	Ranking	Relative weights	Normalised weights
x_1 ~ profit	1	100	0.30
x_2 ~ maintenance and energy costs	7	10	0.05
x_3 ~ floorplate area	4	40	0.10
x_4 ~ floorplate width	4	40	0.10
x_5 ~ floor to floor height	3	60	0.15
x_6 ~ floor load capacity	2	70	0.20
x_7 ~ on-site car parking	6	30	0.10
	TOTAL	350	1.00

Next, the following ranges are assumed for the attributes over which the value and utility functions are constructed:

- profit - from 0% to 20%;
- maintenance and energy costs - from £20/m^2 to £75/m^2;
- floorplate area - from 700m^2 to 2000m^2;

- floorplate width - from 10m to 18m;
- floor to floor height - from 2800mm to 4100mm;
- floor load-bearing capacity - from 2.5 kN/m² to 10 kN/m²; and
- on-site car parking - from 1 car space per 30m² to 1 per 200m².

The assumed value and utility functions constructed over the attributes are shown below in figure 8.9.

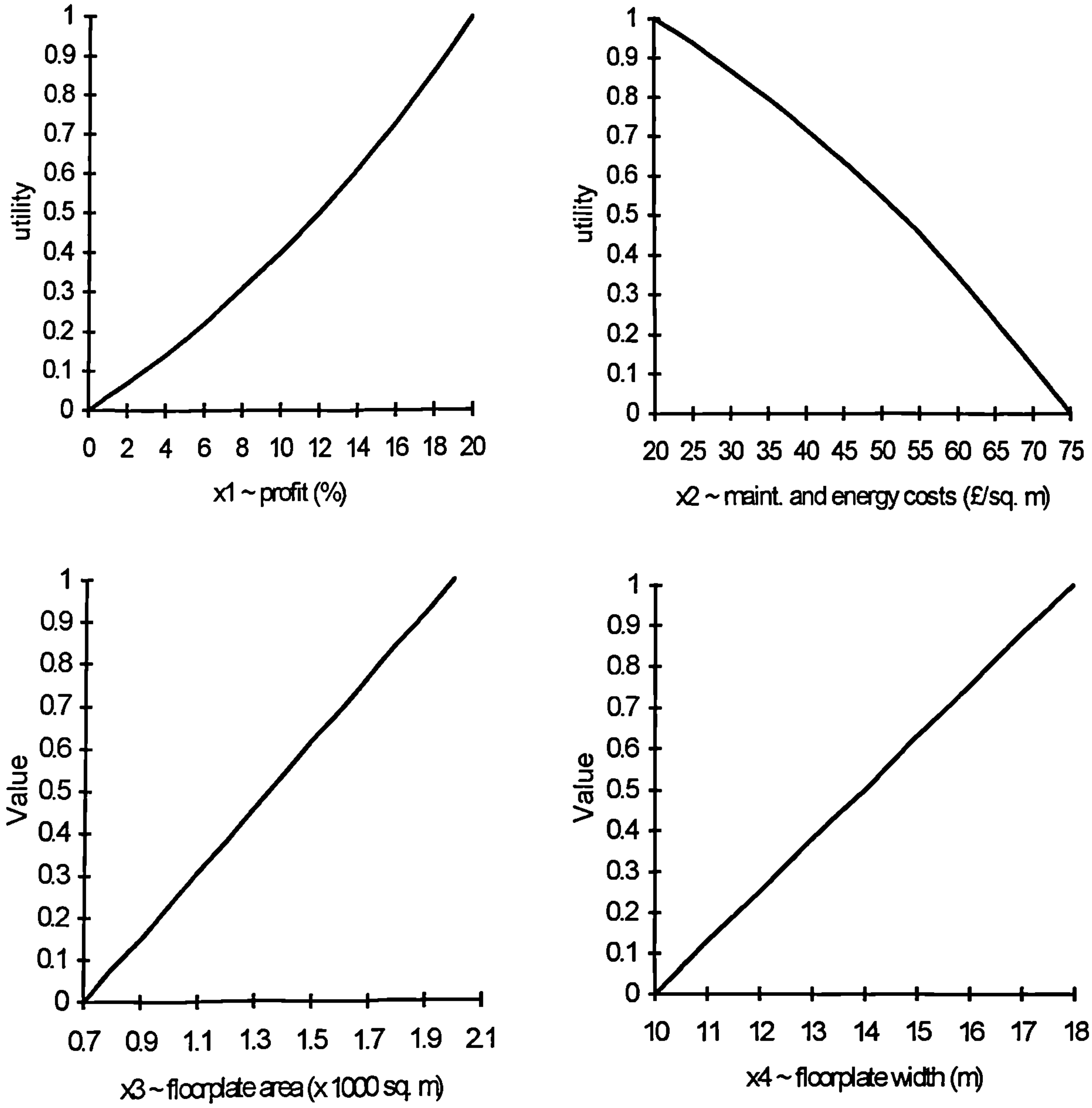
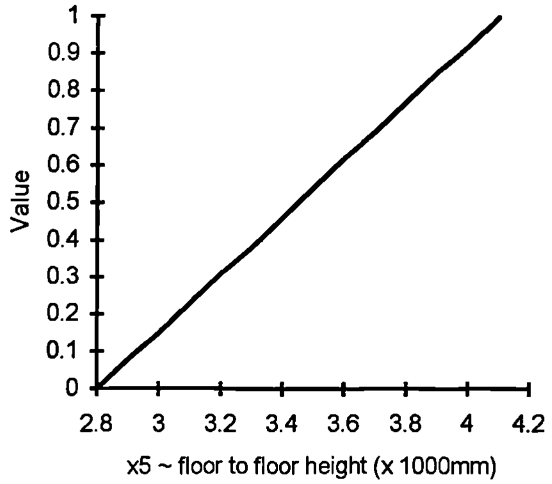
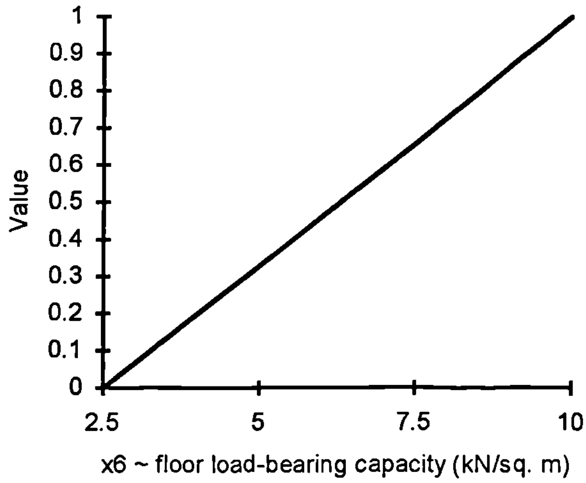


Figure 8.9: Assumed value and Utility functions





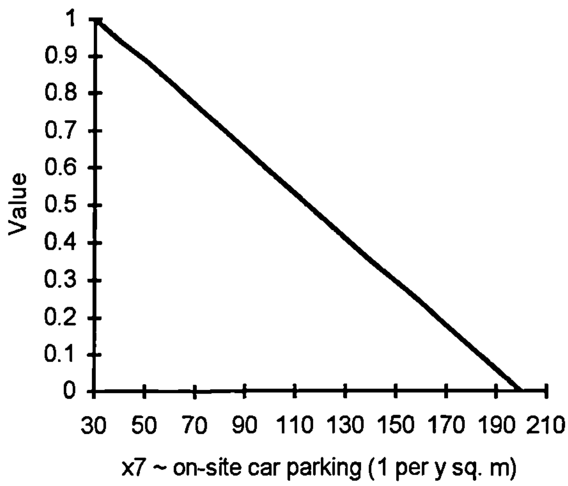


Figure 8.9 (cont'd): Assumed utility and value curves

With the assumed attribute levels (Table 8.3), weightings (Table 8.4) and the utility and value functions, the subjective values of the two decision options can be calculated as folows:

Rehabilitated option

$V(\mathbf{X}) = 0.30 \times u(x_1) + 0.05 \times u(x_2) + 0.10 \times v(x_3) + 0.10 \times v(x_4) + 0.10 \times v(x_5) + 0.15 \times v(x_6) + 0.20 \times v(x_7)$

$= 0.30 \times 0.50 + 0.05 \times 0.80 + 0.10 \times 0.42 + 0.10 \times 0.45 + 0.15 \times 0.46 + 0.20 \times 0.07 + 0.10 \times 0.35 = 0.395$

New build option

$$V(\mathbf{X}) = 0.30 \times 0.40 + 0.05 \times 0.35 + 0.10 \times 0.54 + 0.10 \times 1.00 + 0.15 \times 0.92 + 0.20 \times 0.60 + 0.10 \times 0.29 = 0.578.$$

Thus according to the assumed subjective values of the decision maker, the preferred option in this case study is demolition and redevelopment.

It is to be noted that several assumptions went into the determination of the uncertain variables. For instance, assumptions had to made concerning rents, building costs, yield, void period and construction period. There is the need therefore to carry out sensitivity analysis before selecting the final option. The ability to computerise this whole decision process will facilitate this sensitivity analysis.

CHAPTER NINE

CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

Many property investors and financiers are known to have reservations concerning the investment performance of rehabilitated properties. This is due to the complexities and uncertainties introduced by low rental income, higher yields and relatively shorter leases identified with secondhand properties.

The attitude described above is thought to be changing (Coupland, 1997) as more and more successful refurbishment and rehabilitation schemes are reported in the property and business press. The major factors that have transformed attitudes include the following:

- the changing economics of refurbishment schemes since the last economic recession. Many occupiers have become aware of the impact the properties they occupy have on their businesses in terms of space efficiency, rental and running costs as well as maintenance costs. As a result downward pressure has been brought to bear on rents and other occupancy costs (see chapter five). Refurbished properties which can offer facilities comparable to modern buildings but at a fraction of new build rents have thus become attractive to occupiers seeking to reduce costs.
- the recent innovations in building services and communication technology is making it possible to service older buildings (often with inadequate space provisions for services) to the same level as new buildings. An example is chilled ceiling which does not require the same ceiling zone as air-condition systems. This is creating investment value in buildings that might otherwise have remained unlet.

- the large volume of unlet space following the last boom and bust cycle. Most of these buildings were speculative developments. Now, with the economy having recovered, building owners are having to refurbish to become competitive in the market.

Despite this favourable picture, it is apparent that no consistent and formal framework exists to aid rehabilitate-redevelop decisions on existing commercial properties. This is the situation that has been addressed by the research reported in this thesis.

Some of the comments in journals and magazines attributed to developers and investors justifying rehabilitation over redevelopment include the following: *"for us, it was the size of the floorplate that did it"; "the building had immensely strong floorplate";* and *"the building enjoys a higher plot ratio that would not be entertained by Planners today"*. These are but a few of the issues that determine decision actions but the drawback is that they did not reside in any framework. The current research has therefore created a decision framework that took all these issues into consideration (see chapters one and two). This was not only just to highlight the issues involved but also to aid consistent and transparent decision making.

The first step in the research was to study and understand buildings as valuable objects (chapters one and two). What was established from this was that there are different interest groups impacted by development of buildings. These interests are mainly derived from owning and occupying buildings. There are also other interests derived from concerns about the effect of buildings on society and the environment.

In the private sector, the main actors who interact to determine what is built, where and when are investors, occupiers, developers and statutory bodies acting on behalf of local and central governments. Each of these actors evaluate buildings on different and often conflicting criteria. To these actors, buildings can serve as shelters, cultural symbols, part of the built environment, symbols of image and prestige and economic investment, among others. The consequence of all these is to make it difficult to establish a unique set of criteria to evaluate buildings.

A number of past theoretical models and frameworks devised by professionals operating in both the public and private sectors were reviewed (chapter two). None of these models were deemed adequate to address the decision at hand. The inadequacies stemmed from the fact that the models were either only preoccupied with economic factors or lacked sufficient objectivity to aid consistent decision making.

Based on the study of the nature of buildings mentioned above, it was concluded that the building renewal decision problem is a conflicting multi-criteria one in which doing well on one criteria may imply doing badly on others. In this situation, the type of model that is adequate to resolve the renewal decision problem is based on multiattribute utility theory (MAUT). In creating the decision framework, the work done for the USA - CERL by Coskunoglu and Moore (Coskunoglu and Moore, 1990) was used as a starting base for improvement. Since the problem was identified as one of satisfying the values of decision makers, the principles of value-focused thinking was applied in the creation of the framework (chapter three).

The prerequisite for creating the value-based building renewal model was to determine the value objectives of the main private sector actors who influence building development decisions. This led to the definition of the aims of the research, which were:

- determining the value objectives of the principal actors who influence property development in the private sector. In this study, information was sought from decision makers from property development and investment companies.

- determining the critical variables that indicate the achievement of these value objectives.
- determining the external factors that affect the achievement of the objectives; and from these,
- creating an appropriate value-based model to aid renewal decisions.

The conclusions of the research are summarised in this chapter by addressing the research objectives listed above. The chapter also discusses the special circumstances of the research and how they affect the findings. Recommendations are also made concerning the use of the model and the sort of databases that would need to be set up to provide ready data to feed into the model. Finally, a lot of assumptions have been made throughout the thesis, which have gone untested. These give the direction of further research that may be carried out to enhance the use of the model. These are suggested as a conclusion to the chapter.

9.2 Value Objectives of the Main Actors

The research addressed two main questions broader than the immediate one of how to decide between rehabilitation and redevelopment. These were about the reasons why buildings are developed and why existing buildings are renewed.

Answering the first question led to the examination of the value objectives of the main private sector actors (ie. developers, investors and occupiers) who influence property development. The behaviour of these actors are in turn influenced by public sector regulations and the aims of property financiers. Answering the second question required that the value objectives identified from the first question be applied to the building renewal situation to isolate the objectives of building renewal. The two questions were answered in the first instance through extensive secondary data search (chapters five and six). The reasons uncovered in this way were tested for their influence on property development and investment decisions in the primary research (chapter seven).

The value objective of the private property developer is to make profit. The developer's profit is determined from the difference between capitalisation value, which depends partly on the workings of the market and the specification of the building; and development cost. To maximise profit therefore, the developer aims to maximise rental income whilst minimising development cost.

The property investor is also in the market to make profit, this time from the capital appreciation of properties and rental income. The value objective of the investor is therefore concerned with minimising risks to both income receipts and capital values. He thus prefers good specification buildings, in prime locations which are less susceptible to obsolescence. He also prefers properties with good quality tenant covenant such as the conventional 'UK institutional lease', which is usually for 25 years, of the FRI kind, with 5-yearly upwards only reviews.

The occupier is concerned with the functionality of buildings, such as the flexibility afforded by the internal configuration and the indoor services. The occupier is also concerned with occupancy costs, including rent, rates, insurance, maintenance and running costs. To avoid encumbering themselves with inflexible buildings, occupiers are also thought to nowadays prefer shorter leases with break clauses. This of course conflicts with the objective of the investor who is after security of income and hence longer leases.

The value objectives of the property financier is to make profit from the interest and fees charged on loans granted. The main preoccupation of the financier is therefore to ensure that the original capital is recoverable and that interest payments can be met and are current. Property financiers therefore act to ensure that: they lend to developers and investors with proven track record; they lend on properties whose rental income are enough to cover interest payments and if possible some capital repayments; they fund development of properties which are prelet; and for existing buildings, they finance the acquisition of buidlings with reputable sitting tenants who are unlikely to default on rent payments.

The aim of public sector regulation of development stems from the duty to protect the welfare of society. Thus with a number of tools available to it, the public sector acts to encourage desirable development whilst discouraging undesirable ones.

The range of issues that concern the principal actors as summarised above can be classified into four generic issues: economic, functional, physical/ structural and environmental. Thus the value objectives of the main actors who influence property development and investment are to maximise economic, functional, physical/ structural and environmental performance of properties.

These value objectives, when applied to building renewal implies seeking improvements along the dimensions mentioned above. The chosen option from rehabilitation and redevelopment is the one that delivers these improvements better.

The decision makers surveyed (chapter seven) agreed with these generic classification of property performance. Almost all of them were able to assign importance weights to reflect their relative importance in development and investment decisions. These weights differed between the performance dimensions. They also differed between developers and investors based on the modal and mean importance weights. The differences in the mean weights were however not significant when extended over the entire population of developers and investors.

As a measure of behaviour, the mode is deemed a more appropriate indicator than the mean. The disadvantage with the mode though is that any conclusions reached apply to the survey sample only and cannot be extended to cover the entire population of developers and investors. The modal weights show that the most important performance objective to the developers and investors is economic followed by functional, physical/ structural and environmental in descending order. The developers however rated economic objectives higher than the investors (modal weights of 50 against 40). The investors on the other hand rated functional performance higher than the developers (modal weights of 30 against 20). This highlights the basic difference between developers and investors. Investors with long term outlook are as much concerned about functional issues as economic issues. This is the only way to keep sitting tenants or to attract new ones. Developers with typically short term outlook place much more emphasis on economic considerations than functional.

The mean importance weights are probably meaningless in the context of the research unless all developers or investors are being viewed as single decision units. The usefulness of the mean and the confidence interval is however in terms of the trend of importance they help to indicate. By this trend, both developers (D) and investors (I) rate the relative importance of the generic objectives from the most to the least important as:

1. economic (mean weight: D, 47-60; I, 40-59);
2. functional (mean weight: D, 18-24; I, 20-31);
3. physical/ structural (mean weight: D, 12-17; I 11-18); and
4. environmental (mean weight: D, 9-14; I, 8-14).

The overlaps of the intervals for each generic performance dimension among the two sub-groups suggest no significant differences between developers and investors in terms of the mean importance weights. They show clearly that the most important issues to developers and investors are economic and functional. There is a debate, however, as to which of physical/ structural objective and environmental objective is the more important.

The conclusion to draw is that in dealing with properties, developers and investors are primarily preoccupied with economic and functional issues. Physical, structural and environmental issues, though important, are secondary issues that are only determined to suit the functional requirements of buildings subject to the economics of the situation.

9.3 Critical Indicators of the Performance Objectives

Following on from the last section, the decision action chosen in the rehabilitation-redevelop decision space is guided by the improvements that can be achieved in the economic, functional, physical/ structural and environmental performance. This requires that each option be evaluated along the generic dimensions of property performance. The evaluation can, however, be carried out over quantifiable indicators underlying the generic dimensions.

From the nature of buildings (chapter two) it is difficult to establish a unique and exhaustive set of indicators to evaluate all buildings. There are however critical indicators that are common to all situations. The indicators and issues critical to each of the four dimensions of property performance were identified through the research (chapter 7).

The critical economic indicators include development cost, saleability or lettability, profitability, rental value and income growth potential. The rest are maintenance costs, operating costs and site value. The functional indicators critical to property development and investment decisions include the condition of services, the size of accommodation, floor to floor height and accessibility. The rest are flexibility of use and adaptability to use new technology. According to the research, the indicators critical to the assessment of the physical and structural performance of properties are the condition of structure, the condition of the external building fabric and their durability. Also for assessing the environmental performance of buildings, the critical indicators were identified as: aesthetics, indoor health and comfort and environmental pollution. Therfore in the building rehabilitate-replace decision space, the option chosen in each situation depends on the performance over these indicators.

9.4 External Factors that Affect Property Performance

Property development and investment take place in a constrained, risky and uncertain environment. The constraints can come from within and without the decision maker's organisation.

Internal constraints and their effects are known from the outset and can be taken into consideration in decision making. External constraints can, on the other hand, introduce risks if their effects are not known at all. They can also introduce uncertainties if their effects are not known in time. Internal and external constraints affect decision inputs by restricting the range of options available to decision makers.

Besides the constraints, there are other external factors that introduce risks and uncertainties by their effects on the outcome of decisions. These are factors that affect demand and supply and property life cycles.

For a better and informed decision making, the effect of constraints and other external factors ought to be considered. The research therefore set out to identify the major factors that concern developers and investors.

The major external factor that concern developers is planning control. Also of major concern to developers are changes in legislation, changes in locational factors and changes in user requirements. Taxation, the state of the economy, the cost of capital and changes in government policy also cause concern among developers but not to the same degree as those already mentioned. The developers surveyed seemed to be able to differentiate between changes in user requirements and changes in tastes and standards, probably viewing the latter as being extravagant but not essential. Thus whilst changes in user requirements are higher up in the list of developer concerns, changes in tastes and standards appeared to cause the least concern.

The major concerns to investors are planning control, changes in legislation, changes in locational factors, changes in user requirements and changes in government poilcy. Of major concern to investors as well, though not to the same degree as those listed above, are competition from newer or modernised properties, the state of the economy, taxation and the cost of capital. The factor that appeared to cause the least concern among investors is demographic changes.

9.5 The Value-based Building Renewal Decision Framework

The underlying hypotheses to the value-based building renewal decision framework created in chapter 8 are:

1. that property owners, users, and non-users have certain requirements stemming from their value objectives that they expect from buildings;
2. that rational decision makers when faced with a decision problem will choose the option that maximises their value objectives, and hence
3. when faced with the problem of deciding between rehabilitation of an existing building and demolition and rebuilding, decision makers will select the option that better improves the requirements leading to the maximisation of their values.

From these hypotheses, the appropriate framework is a multiattribute utility model that evaluates the options on the critical performance issues. This is the framework created in chapter 8.

Some of the critical indicators are just issues that are not quantifiable. The determinants that underlie these critical issues were identified by the exploration of the causal and influential relationships between the issues using factual knowledge established in the property development and investment industries. Through this exercise, the determinants of the building renewal decision problem are identified as:

- development or investment profit;
- energy costs;
- maintenance costs;
- floor to floor height;
- floor load-bearing capacity;
- floorplate area;
- floorplate width; and
- on-site car parking spaces.

The subjective values of the decision maker in each case is thus to be assessed over these determinants (attributes) to arrive at the preferred option.

Two tasks are required of decision makers before selecting the preferred option. These are the optimisation of economic factors relevant to the situation under consideration followed by maximisation of the subjective values of the decision maker.

The economic optimisation stage translates into four interrelated steps recommended by the research. These are:

1. space specification including floorplate area and width, floor to floor height and on-site car parking requirements.

2. specification of the indoor environment and services including the specification of ambient temperature, ventilation rates and lighting levels leading to the selection of mechanical and electrical plant and equipment.
3. physical and structural specification including the specification of the external building fabric (ie. roof covering, walls, doors and windows), structure type and material and load-bearing capacity of suspended slabs.
4. optimisation of the economic factors which involves matching the specification in steps 1 to 3 to available resources. It also involves the assessment of the outputs from the specification in terms of rental value, future maintenance costs and future energy costs. From this step, the specification can be finalised.

For the existing building, the scope for changing some of the physical attributes may be limited. There may be circumstances, however, where the scope to replace the external fabric, extend the floorplates and to strengthen the floor slabs exist.

The subjective value maximisation translates into two steps: dominance analysis and the determination of the utility or value of the options under consideration. For each attribute, the decision maker is expected to state whether more is preferred to less or vice versa. The levels of the attributes possessed by the rehabilitated and redevelopment options are tabulated in a pay-off matrix. If, consistent with the stated direction of preference, one option is superior over all attributes, that option is the preferred one and the problem is solved. This is the essence of the dominance analysis.

If no option dominates the other, the options have to be evaluated according to the additive multiattribute value model:

$V(\mathbf{X}) = \sum w_i v_i (x_i)$, where,

w_i - relative importance weight of attribute, X_i, ($\sum w_i = 1.0$);

x_i - the level of attribute Xi possessed by an option; and

$v_i(x_i)$ - the subjective value of level x_i of attribute X_i read off a value or utility curve reflecting the preference of the decision maker.

9.6 Comments on the Quality of the Research

In chapter four, the strengths and weaknesses of the various survey methods were highlighted. The judgement was made that the strengths of postal survey - wide geographical coverage and larger sample size due to its relatively low cost, outweighed its weaknesses. Postal survey was therefore adopted. The nature of the investigations required some communication with the survey subjects. This inevitably introduces the risk of bias. Because the questionnaire was to be self-administered, it had to be highly structured. This has the potential of biasing the responses. This risk was balanced by the provision of spaces for additional responses to be supplied.

One other disadvantage of the postal survey, as far as the findings were concerned, was the inability to probe respondents as to the reasons behind some of their responses. In this situation, face to face interviews would have been superior.

The main fieldwork problem encountered during the research was the reluctance on the part of many of the companies contacted to cooperate. These were predominantly property investment companies. It therefore took two independent samples and follow-ups to get the 52 returns on which the research findings are based. Despite the efforts to increase returns, there is an 'under-representation' of property investors in the returns.

The limitations above do not however detract from the usefulness of the framework created due to the following reasons:

- the investment companies who returned the questionnaires are what, in the UK, can be considered as the 'big players'. They are all companies listed on the stock market whose activities are widely reported in the property press. Therefore whatever opinion they express are likely to be among the most authoritative and relevant in the investment market. This thus makes the responses supplied by the investors in the survey sample valid.
- the critical indicators determined were 'pooled' from the responses from both investors and developers. The 'under representation' of investors is therefore compensated for by the responses from the developers.
- finally, the framework created is a value-based one. It is therefore not only about the final decision determinants but also essentially about the demonstration of an approach. By employing this approach, the framework can be expanded to take in more attributes or contracted by deleting those irrelevant to a particular situation.

9.7 Recommendations on the Use of the Framework

The value-based decision framework created through this research is meant primarily for professional advisors who advise on property development and investment issues. It could also be useful to property owners and managers and their agents.

Even though the research focused on private sector developers and investors who are usually motivated by direct financial gains, the framework can be adapted to suit other different situations.

Taking owner-occupiers, for instance, who profit indirectly through the activities or business their properties support, the direct profit attribute may not be appropriate. In this situation, it can be replaced by the ratio of increased investment value to development cost. Where it would be difficult to calculate investment value, development cost can replace profit in the framework.

The current research did not show 'architectural merit' and 'historical significance' as critical issues. In some circumstance, especially involving public sector bodies and amenity and conservation groups, these may be critical issues. In these circumstances, architectural and historical experts can be assembled to create subjective scales over these attributes which can then be incorporated into the framework.

The decision framework is intended to aid quick decision making and the ability to consider several decision options in a given situation. This aim would be achieved if sufficient database linking rents, maintenance and energy costs to different building specifications exists. This is a challenge to the industry as a whole and individual operators and companies.

It can be said that decision frameworks are created as aids to decision making but it is problem owners who make decisions. It may therefore be that after going through the steps of the framework, the recommended option could be rejected by the decision maker. If this happens, it does not detract from the potential of the framework. It may be that the true value objectives of the decision maker have been missed or the decision maker does not want to articulate them. Users of the framework should therefore endeavour to probe into the critical determinants of any situation before any analysis is carried out.

9.8 General Conclusions

The potential of the value-based building renewal decision framework was demonstrated when it was applied to a hypothetical case study (chapter 8). Not only did it provide a step by step approach to a complex problem, but it also forced one to think about all the relevant issues. The strength of the framework though comes from the fact that after considering a whole host of issues, the problem is reduced to evaluating competing options over seven or eight attributes. This retains the scope of issues to be considered without making the process cumbersome.

Property developers and investors are often accused of not paying enough attention to the needs of their consumers, in this case occupiers. The model, among its strengths, ensures that issues of critical concern to developers, investors and occupiers all reside within a single framework. Further, the framework does not only highlight the critical issues, but by reducing the problem to one of assessing performance over quantifiable attributes, it also ensures consistent and transparent decision making.

In general, the contribution of the research is in the reduction of the building renewal problem into one of: optimising economic factors and maximising the values of impacted interests. In this respect, the research demonstrates the application of contemporary management decision techniques: value-focused thinking, to building development and investment. It has shown that building development and investment decisions are as much about values as they are about economics. As property matures as an investment asset, more and more of the methods applied in dealing with other investment media would have to be adopted. This research is an effort in that direction.

To summarise, the research has:

1. reduced the building renewal decision problem to one of assessing competing options over eight quantifiable attributes. This ensures a transparent and consistent decision making process. It also makes it possible to computerise the whole process.
2. provided an insight into the building renewal decision process by highlighting the critical issues inolved.
3. demonstrated the application of formal decision analysis methods to the building renewal problem. This is consistent with the considerable

efforts being made by property researchers to bring property portfolio management into line with other conventional investment assets such as shares and gilts.

The final thing that can be said about the potential of the decision framework created through this research is the fact that through all its stages it actively involves the owner of the problem. This may be a building owner or someone acting on his behalf. The whole exercise is about discovering and exploring the value objectives of the problem owner. This is an improvement on the situation where solutions are 'imposed' by so called experts using so called best practices. This reduces the likelihood of recommended actions being rejected.

9.9 Further Work

The next logical step from the creation of the value-based building renewal framework is to test the model on a 'live' project. This will highlight any problems that are likely to be encountered in using the model. This will then enable the model to be refined.

Following the model refinement, computerisation of the procedures involved is also another seemingly obviouas step. This is where the potential of the framework can be exploited to the full. This will allow fast evaluation of different options of rehabilitation and redevelopment with different specifications. A project that undertakes to complete this exercise will surely enhance the use of the model.

The basic assumption that underlies value-focused thinking is that decision makers choose decision options that maximises their values. Whilst the current research managed to identify the critical issues that determine building renewal decisions, no explicit linkage was established between these issues and some higher value objectives. It would be enlightening in a face to face setting to observe how the values held by decision makers translate into their requirements from buildings. This could be a pointer for future research.

There are other implicit assumptions made in the creation of the decision framework reported in this thesis. On the face of it, these assumptions seemed logical and reasonable but they will all the same benefit from some light shedding, if they have not already been researched into. These assumptions include the following:

1. property rental values depend on space, physical/ structural and indoor specification of properties.
2. on-site car parking provisions have influence on the rent obtainable from properties.
3. maintenance and energy costs depend on the specification of the external building fabric and the type of indoor services.

These could provide directions for future research that can lead to the establishment of relevant databases to facilitate the use of the value-based building renewal decision framework, as created here.

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APPENDIX A

QUESTIONNAIRE

Respondent # ....

BUILDING PERFORMANCE SURVEY

SECTION A: ABOUT THE RESPONDENT

1. What is your job title? ....

2. What role does your title entail? (*please briefly state*)

   ....

   ....

   ....

3. In connection with your company's building development activities, which of the following best describes your role?

   ☐ ultimate decision maker on development issues.

   ☐ part of the decision making unit on development issues.

   ☐ Advisor to development decision making unit

   ☐ other, ...
   (***please state***)

SECTION B: BUILDING PERFORMANCE

Aspects of building performance, which guide building development and/or acquisition decisions can broadly be classified as economic, physical/ structural, environmental as well as functional. I would like to ask some questions on this.

4. In assessing the economic performance of a building to guide your development/acquisition decisions , which of the following variables would you consider in all cases, in some cases and not at all? (***please tick as appropriate***)

	in all cases	in some cases	not at all
development cost	☐	☐	☐
effect on portfolio already held	☐	☐	☐
saleability	☐	☐	☐

Q.4 - (cont'd)

	in all cases	in some cases	not at all
profitability	☐	☐	☐
rental value	☐	☐	☐
capital growth potential	☐	☐	☐
income growth potential	☐	☐	☐
operating costs (***including heating, lighting etc.***)	☐	☐	☐
maintenance costs (***including repairs, cleaning etc.***)	☐	☐	☐
depreciation	☐	☐	☐
site value	☐	☐	☐
any others?			
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐

5. In assessing the physical/structural performance of an existing building, which of the following variables would you definitely consider, might consider or not consider at all?

	definitely consider	might consider	not consider at all
structural condition	☐	☐	☐
condition of fabric	☐	☐	☐
fire resistance	☐	☐	☐
durability	☐	☐	☐

Q.5 - (cont'd)

any others?

....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐

6. In assessing the functional performance of a building to guide your development/acquisition decisions, which of the following variables would you consider in all cases, in some cases and not at all? (***please tick as appropriate***)

	in all cases	in some cases	not at all
condition of services	☐	☐	☐
size of accommodation (eg. floor plate size)	☐	☐	☐
horizontal and vertical circulation	☐	☐	☐
floor-to-floor height	☐	☐	☐
accessibility	☐	☐	☐
internal sub-divisions	☐	☐	☐
security	☐	☐	☐
flexibility to adapt to new uses	☐	☐	☐
image/prestige	☐	☐	☐
architectural merit	☐	☐	☐
historical significance	☐	☐	☐
ability to adapt to use new technology	☐	☐	☐

Q.6 - (cont'd)

any others?

	in all cases	in some cases	not at all
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐

7. In assessing the environmental performance of an existing building, which of the following variables would you definitely consider, might consider or not consider at all? (***please tick as appropriate***)

	definitely consider	might consider	not consider at all
effect of building on locality	☐	☐	☐
aesthetics	☐	☐	☐
internal health and comfort	☐	☐	☐
pollution (***eg. waste disposal***)	☐	☐	☐
energy/resource conservation	☐	☐	☐
any others?			
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐

8. As they affect your development/acquisition decisions, please rank in order of importance the aspects of building performance as identified in this section by sharing 100 points between them. (***the most important aspect getting the highest score in descending order***)

economic performance ....

functional performance ....

engineering performance ....

environmental performance ....

9. What external influences (ie. outside your company's control) could affect the performance of a building? (***please tick all applicable ones***)

- ☐ taxation (***eg. land tax, development tax , VAT etc.***)
- ☐ legislation (***eg. conservation, health & safety, rent control etc.***)
- ☐ planning controls
- ☐ changes in locational factors (***eg. local infrastructure, transport links, etc.***)
- ☐ the state of the economy as they affect supply & demand
- ☐ shifts in industrial and work practices
- ☐ population movement
- ☐ urban decay
- ☐ changes in government policy
- ☐ changing user requirements
- ☐ competition from newer and modernised buildings
- ☐ changes in social tastes and standards
- ☐ financial and fiscal incentives (***eg. grants and tax bonuses***)

Q.9. - (cont'd)

☐ the cost of capital

any
others?

☐ ....

☐ ....

☐ ....

☐ ....

☐ ....

☐ ....

SECTION C: ABOUT YOUR COMPANY

This section will help me classify your responses according to the different categories of interests in property development.

10.How will you classify the ownership of your company?

☐ private ☐ public

☐ public/private partnership ☐ other, ...
....

11.From your company's development activities and objectives, how will you classify it? (***if you are engaged in more than one activity, please tick your major activity***)

☐ developer ☐ investor

☐ other, ...

THE END

THANK YOU FOR COMPLETING THE QUESTIONNAIRE.

PLEASE RETURN THE COMPLETED QUESTIONNAIRE IN THE ADDRESSED ENVELOPE PROVIDED.

APPENDIX B

CODING NOTES AND TABULATION

BUILDING PERFORMANCE SURVEY
CODING NOTES

Q.1 Job Title

A - Building/ Development/ Investment Surveyor

B - Managing Director

C - Financial/ Commercial Controller/ Manager

D - Development/ Investment Manager/ Director.

E - Property/ Building/ Estate Manager/Director.

F - Other

Q.2 Job responsibility

A - Managing Developments/Investments

B - Raising funds for developments/ Investments.

C - Drawing up company policy and day to day running of business.

D - Identification of Development/ Investment opportunities.

E - Other.

Q.3 Decision capacity

A - Ultimate decision maker

B - Part of the decision making unit.

C - Advisor to decision making unit.

D - Other

Q.4 (a) - (l) etc. Variables considered in assessing building economic performance.

A - Definitely consider.

B - Might consider.

C - Not consider at all.

Q.5 (a) - (e) etc. Variables that will be considered in assessing physical/structural performance.

A - Definitely consider.

B - Might consider.

C - Not consider at all.

Q.6 (a) - (l) etc. Variables that are considered in assessing functional performance

A - Definitely consider.

B - Might consider.

C - Not consider at all.

Q.7 (a) - (e) Variables that are considered in assessing environmental performance.

A - Definitely consider.

B - Might consider.

C - Not consider at all.

Q.8 Weighting of economic, functional, physical/structural and environmental aspects of building performance in development and investment decisions.

Actual weights entered.

Q.9 External factors that could affect building performance.

A - Could affect

B - Could not affect

Q.10 Company ownership

A - Private

B - Public

C - Public/ Private partnership

D - Other

Q.11 Main company activity

A - Developer

B - Investor

C - Other

SAMPLE A

Table B1: Coded Responses for Economic variables

Respondent Characteristics							Variables										
Respondent #.	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Aspect weight	Development cost	Effect on portfolio	Saleability	Profitability	Rental value	Capital growth potential	Income growth potential	Operating costs	Maintenance costs	Depreciation	Effect on site value
1	D	E	B	A	A	35	A	B	A	A	A	C	B	B	B	C	A
2	E	A	B	A	B	70	A	C	A	A	A	A	A	A	A	C	A
3	A	A	B	A	B	75	A	A	A	A	B	B	B	B	B	C	B
4	A	D	B	A	A	50	A	A	A	B	A	A	A	B	B	B	B
5	C	B	B	A	A	60	A	C	A	A	B	B	B	B	B	C	A
6	A	A	C	C	B	30	A	B	A	A	A	A	A	A	A	A	A
7	B	C	A	A	A	30	A	B	C	A	A	C	A	B	B	C	B
8	B	A	A	A	A	50	A	C	A	A	A	C	C	B	B	C	A
9	D	A	B	A	A	25	A	C	A	A	A	C	C	A	A	C	A
10	D	A	B	A	B	50	A	A	A	A	A	A	A	B	B	C	B
11	E	A	B	A	A	50	A	A	A	A	A	B	B	B	B	C	B
12	D	A	B	A	B	40	A	B	B	A	A	B	A	A	A	B	C
13	A	E	B	A	B	40	A	A	B	A	A	B	B	A	A	B	A
14	B	C	A	A	A	80	A	C	A	A	A	A	A	B	B	B	A
15	B	C	A	A	B	44	A	B	A	B	A	B	B	B	B	C	A
16	B	A	A	A	A	25	A	B	A	A	B	B	B	B	C	C	A
17	C	B	B	A	A	80	A	A	A	A	A	A	A	A	A	A	B
18	A	A	A	A	A	80	A	C	A	A	A	B	A	A	B	C	A
19	D	A	B	A	A	40	A	A	A	A	B	B	B	B	B	B	A
20	B	C	A	A	A	50	A	B	A	A	B	B	B	B	B	C	B
21	F	E	B	A	A	60	A	A	A	A	B	C	C	A	B	B	A
22	B	A	A	A	A	40	A	C	A	A	A	C	C	C	C	C	A
23	E	A	C	A	A	70	A	A	A	A	A	A	A	A	A	A	A
24	F	E	B	A	B	40	A	B	A	A	A	B	A	B	B	B	A
25	D	E	B	A	A	30	A	C	A	A	A	B	A	C	C	C	A

Table B1: Coded Responses for Economic variables

Respondent Characteristics							Variables										
Respondent #.	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Aspect weight	Development cost	Effect on portfolio	Saleability	Profitability	Rental value	Capital growth potential	Income growth potential	Operating costs	Maintenance costs	Depreciation	Effect on site value
26	C	B	B	A	A	60	A	B	A	A	A	A	A	B	B	C	A
27	C	B	B	A	A	70	A	A	A	A	A	A	A	B	B	A	A
28	B	C	A	A	A	60	A	A	B	A	B	B	B	A	B	A	C
29	E	A	A	A	B	40	A	B	A	A	A	B	B	B	B	B	A
30	D	A	C	A	A	50	A	B	A	A	A	A	A	B	B	C	B

Table B2: Coded Responses for Functional variables

Respondent characteristics							Variables											
Respondent No.	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Condition of services	Accommodation size	Circulation	Floor-to-floor height	External Accessibility	Internal sub-divisions	Security	Flexibility for new uses	Image/prestige	Architectural merit	Historical significance	Ability to use new tech.
1	D	E	B	A	A	25	A	A	B	A	A	B	B	B	B	B	C	A
2	E	A	B	A	B	10	A	A	B	A	A	A	A	A	B	B	C	A
3	A	A	B	A	B	10	B	A	B	B	B	B	B	B	B	B	B	B
4	A	D	B	A	A	20	B	A	B	A	A	B	B	B	B	B	B	A
5	C	B	B	A	A	15	A	A	A	A	A	A	A	B	A	B	C	B
6	A	A	C	C	B	40	A	A	B	A	A	B	B	A	A	B	C	A
7	B	C	A	A	A	25	A	A	B	A	B	C	C	B	B	A	C	B
8	B	A	A	A	A	30	A	A	B	A	A	B	C	A	A	A	B	A
9	D	A	B	A	A	25	A	A	A	A	A	A	B	A	A	A	B	A
10	D	A	B	A	B	25	C	A	B	B	A	B	B	B	B	B	C	B
11	E	A	B	A	A	30	B	B	B	B	A	B	B	B	A	A	B	C
12	D	A	B	A	B	40	A	A	A	A	A	B	A	B	A	B	B	A
13	A	E	B	A	B	30	A	A	B	B	B	B	A	A	A	B	B	A
14	B	C	A	A	A	5	A	A	A	A	A	B	B	B	B	B	B	B
15	B	C	A	A	B	17	A	B	A	A	A	B	A	B	C	B	C	B
16	B	A	A	A	A	25	A	A	B	A	A	B	B	A	B	B	B	B
17	C	B	B	A	A	7	A	A	X	A	A	A	A	B	A	B	B	A
18	A	A	A	A	A	10	B	A	C	B	C	B	B	B	C	C	C	B
19	D	A	B	A	A	45	A	A	B	B	B	B	A	A	B	B	C	B
20	B	C	A	A	A	20	B	A	A	B	A	B	B	A	B	B	B	B
21	F	E	B	A	A	20	A	A	C	B	A	A	C	A	B	B	C	C
22	B	A	A	A	A	20	C	C	B	A	A	B	B	B	A	A	B	B
23	E	A	C	A	A	20	A	A	A	A	A	A	B	A	B	B	B	A
24	F	E	B	A	B	30	A	A	A	A	A	B	B	A	C	C	C	A

Table B2: Coded Responses for Functional variables

Respondent characteristics							Variables											
Respondent No.	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Condition of services	Accommodation size	Circulation	Floor-to-floor height	External Accessibility	Internal sub-divisions	Security	Flexibility for new uses	Image/prestige	Architectural merit	Historical significance	Ability to use new tech.
25	D	E	B	A	A	30	B	A	A	A	A	B	B	A	B	B	B	B
26	C	B	B	A	A	10	A	A	A	A	A	B	A	A	A	B	B	A
27	C	B	B	A	A	10	A	A	B	B	A	B	B	A	A	A	A	A
28	B	C	A	A	A	30	B	B	B	B	B	B	B	B	A	C	C	C
29	E	A	A	A	B	40	B	A	B	B	A	B	C	B	A	A	B	B
30	D	A	C	A	A	25	A	A	A	A	A	A	A	B	A	B	B	A

Table B3: Coded Responses for Physical/ structural variables

Respondent Characteristics							Variables			
Respondent No.	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Structural condition	Condition of fabric	Fire resistance	Durability
1	D	E	B	A	A	20	A	B	A	A
2	E	A	B	A	B	10	A	A	B	B
3	A	A	B	A	B	10	A	A	B	B
4	A	D	B	A	A	15	A	A	B	B
5	C	B	B	A	A	15	X	X	X	X
6	A	A	C	C	B	20	A	A	A	A
7	B	C	A	A	A	20	A	A	C	B
8	B	A	A	A	A	10	A	A	B	B
9	D	A	B	A	A	25	A	A	A	A
10	D	A	B	A	B	15	A	A	B	A
11	E	A	B	A	A	10	A	B	B	B
12	D	A	B	A	B	10	A	A	B	A
13	A	E	B	A	B	15	A	A	A	A
14	B	C	A	A	A	10	A	A	A	B
15	B	C	A	A	B	28	A	A	B	A
16	B	A	A	A	A	25	A	A	B	B
17	C	B	B	A	A	6	A	A	B	A
18	A	A	A	A	A	5	A	A	B	B
19	D	A	B	A	A	10	A	B	B	B
20	B	C	A	A	A	20	A	B	B	B
21	F	E	B	A	A	10	A	A	B	B
22	B	A	A	A	A	20	X	X	X	X
23	E	A	C	A	A	5	A	A	A	A
24	F	E	B	A	B	20	A	A	A	B
25	D	E	B	A	A	20	A	A	A	A
26	C	B	B	A	A	25	A	A	B	A
27	C	B	B	A	A	10	A	A	A	A
28	B	C	A	A	A	5	B	B	C	B
29	E	A	A	A	B	10	A	A	B	B
30	D	A	C	A	A	20	A	A	B	B

Table B4: Coded responses for Environmental variables

Respondent characteristics							Variables				
Respondent #	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Effect on locality	Aesthetics	Internal health/comfort	Pollution	Energy/Resource conserv.
1	D	E	B	A	A	20	A	A	A	A	A
2	E	A	B	A	B	10	C	B	A	A	A
3	A	A	B	A	B	5	B	B	A	B	B
4	A	D	B	A	A	15	B	B	B	B	B
5	C	B	B	A	A	10	A	A	A	B	A
6	A	A	C	C	B	10	B	B	B	B	B
7	B	C	A	A	A	25	A	A	A	B	B
8	B	A	A	A	A	10	B	A	B	C	B
9	D	A	B	A	A	25	A	A	A	A	A
10	D	A	B	A	B	10	B	B	B	B	B
11	E	A	B	A	A	10	B	A	B	A	B
12	D	A	B	A	B	10	A	A	A	A	A
13	A	E	B	A	B	15	A	A	A	A	A
14	B	C	A	A	A	5	A	A	B	B	B
15	B	C	A	A	B	11	B	B	B	A	A
16	B	A	A	A	A	25	B	B	B	B	B
17	C	B	B	A	A	7	B	B	B	A	B
18	A	A	A	A	A	5	B	B	C	B	B
19	D	A	B	A	A	5	B	B	B	B	B
20	B	C	A	A	A	10	B	B	A	A	B
21	F	E	B	A	A	10	C	A	A	C	B
22	B	A	A	A	A	20	X	X	X	X	X
23	E	A	C	A	A	5	A	B	A	A	A
24	F	E	B	A	B	10	B	B	A	A	B
25	D	E	B	A	A	20	B	B	B	B	B
26	C	B	B	A	A	5	A	B	A	B	B
27	C	B	B	A	A	10	A	A	A	A	A
28	B	C	A	A	A	5	A	A	A	C	B
29	E	A	A	A	B	10	C	A	B	B	C
30	D	A	C	A	A	5	B	A	A	B	B

Table B5: External Factors that can Affect Performance

Respondent characteristics						Factors													
Respondent #	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Taxation	Health/safety legislation	Planning controls	Locational factors	State of the economy	Shifts in industrial prac.	Population movement	Urban decay	Government policy	User requirements	Competition from other props.	Tastes and standards	Financial/fiscal incentives	The cost of capital
1	D	E	B	A	A	A	A	A	A	A	A	A	B	A	A	B	B	A	A
2	E	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
3	A	A	B	A	B	A	A	A	A	A	B	B	B	A	A	A	B	B	A
4	A	D	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5	C	B	B	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A
6	A	A	C	C	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
7	B	C	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B	B	A
8	B	A	A	A	A	B	A	A	A	A	B	B	A	B	B	A	B	B	B
9	D	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	B	A	A
10	D	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
11	E	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A	B	A
12	D	A	B	A	B	A	A	A	A	A	A	B	B	A	A	A	A	B	A
13	A	E	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
14	B	C	A	A	A	A	A	A	A	A	B	A	B	A	A	B	B	B	A
15	B	C	A	A	B	A	A	A	A	B	B	B	B	A	A	A	B	A	B
16	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
17	C	B	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A
18	A	A	A	A	A	B	A	A	B	B	A	B	B	B	A	A	B	A	B
19	D	A	B	A	A	A	A	A	A	A	A	A	A	B	A	A	B	B	A
20	B	C	A	A	A	A	B	A	A	A	B	B	A	A	A	B	B	B	B
21	F	E	B	A	A	A	A	A	B	B	B	A	B	B	A	B	A	A	A
22	B	A	A	A	A	B	A	A	A	A	B	B	B	B	A	B	B	B	B
23	E	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
24	F	E	B	A	B	B	A	A	A	A	A	A	A	A	A	A	A	B	B
25	D	E	B	A	A	B	B	A	A	B	B	A	B	A	B	B	A	A	B
26	C	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
27	C	B	B	A	A	A	A	A	A	A	A	B	B	A	B	B	B	A	A
28	B	C	A	A	A	B	A	A	A	A	B	B	A	B	A	B	A	B	A

Table B5: External Factors that can Affect Performance

Respondent characteristics						Factors													
Respondent #	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Taxation	Health/safety legislation	Planning controls	Locational factors	State of the economy	Shifts in industrial prac.	Population movement	Urban decay	Government policy	User requirements	Competition from other props.	Tastes and standards	Financial/fiscal incentives	The cost of capital
29	E	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
30	D	A	C	A	A	A	A	A	A	A	A	B	B	A	A	A	B	B	B

SAMPLE B

Table B6: Coded Responses for Economic variables

Respondent Characteristics							Variables										
Respondent No.	Job title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Development cost	Effect on portfolio	Saleability	Profitability	Rental value	Capital growth potential	Income growth potentia	Operating costs	Maintenance costs	Depreciation	Effect on site value
1	D	D	B	A	A	30	B	A	B	A	B	B	B	B	A	B	B
2	D	A	B	A	A	70	A	B	A	A	A	B	B	B	B	B	B
3	D	A	A	A	B	45	A	B	A	A	A	B	B	B	B	B	A
4	D	A	B	A	B	50	A	B	A	A	A	A	A	B	B	C	B
5	B	C	A	A	A	40	A	B	B	A	B	B	B	B	B	B	A
6	B	C	A	A	A	50	A	B	A	A	A	B	B	B	B	C	B
7	E	A	B	A	A	50	A	B	A	A	A	A	A	B	B	B	A
8	A	A	B	A	A	60	A	B	B	A	A	A	A	B	B	B	B
9	A	A	B	A	B	25	A	A	A	A	A	A	A	A	A	A	B
10	B	C	A	A	A	25	A	B	A	A	A	B	B	C	B	C	B
11	D	D	B	A	B	25	A	A	A	A	A	A	A	A	A	A	A
12	B	C	A	A	A	40	A	B	B	A	A	B	B	A	A	B	A
13	E	A	B	A	B	100	A	A	A	A	A	A	A	A	A	A	A
14	D	A	B	A	A	100	A	B	A	A	A	A	A	A	A	A	A
15	B	C	A	A	A	56	A	B	A	A	A	B	B	B	B	B	A
16	B	C	A	A	A	80	A	C	A	A	A	A	A	C	C	C	A
17	E	A	B	A	B	45	A	B	A	A	A	B	B	B	A	A	C
18	D	A	B	A	B	50	A	A	A	A	A	A	A	A	A	B	A
19	B	C	B	A	B	80	A	A	A	A	A	A	A	A	A	A	B
20	B	C	A	A	A	80	A	B	A	A	A	A	A	A	A	A	A
21	D	A	B	A	A	50	A	A	A	A	A	A	A	B	B	B	A
22	F	E	B	A	B	40	A	B	A	A	B	B	B	B	B	C	B

Table B7: Coded Responses for Functional variables

Respondent characteristics							Variables											
Respondent No.	Job title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Condition of services	Accommodation size	Ease of circulation	Floor-to-floor height	External Accessibility	Internal sub-divisions	Security	Flexibility for new uses	Image/prestige	Architectural merit	Historical significance	Ability to use new tech.
1	D	D	B	A	A	30	A	A	A	A	A	A	B	B	B	B	B	B
2	D	A	B	A	A	20	A	B	B	B	A	C	B	B	B	B	B	B
3	D	A	A	A	B	40	B	A	B	A	A	B	B	B	B	B	B	B
4	D	A	B	A	B	30	B	A	A	A	A	B	B	A	A	B	C	A
5	B	C	A	A	A	20	A	A	B	B	B	B	C	A	B	B	B	A
6	B	C	A	A	A	20	A	A	A	A	A	B	B	A	B	B	C	B
7	E	A	B	A	A	25	B	A	B	A	A	B	B	A	A	B	C	A
8	A	A	B	A	A	20	B	B	B	B	A	B	C	A	B	C	C	A
9	A	A	B	A	B	25	A	A	A	A	A	B	A	A	A	B	B	A
10	B	C	A	A	A	30	B	A	A	A	A	B	B	A	B	B	B	B
11	D	D	B	A	B	25	A	A	A	A	A	B	B	B	A	A	B	A
12	B	C	A	A	A	30	A	A	A	A	A	B	B	B	B	B	B	B
13	E	A	B	A	B	0	A	A	A	A	A	B	A	A	B	A	B	A
14	D	A	B	A	A	0	A	A	A	A	A	A	A	A	A	A	B	A
15	B	C	A	A	A	22	A	A	A	A	A	A	A	B	A	A	B	A
16	B	C	A	A	A	10	A	A	A	A	A	C	C	C	A	A	C	A
17	E	A	B	A	B	23	B	B	B	B	B	B	B	B	B	B	C	C
18	D	A	B	A	B	30	A	A	B	A	A	B	B	A	B	B	B	A
19	B	C	B	A	B	10	A	A	A	A	A	B	B	A	A	B	B	A
20	B	C	A	A	A	10	A	A	A	A	A	A	A	A	A	A	B	A
21	D	A	B	A	A	20	B	A	A	A	A	B	B	A	A	B	B	A
22	F	E	B	A	B	30	B	A	B	B	B	B	B	B	B	B	B	B

Table B8: Coded responses for physical/structural variables

Respondent Characteristics							Variables			
Respondent No.	Job Title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Structural condition	Condition of fabric	Fire resistance	Durability
1	D	D	B	A	A	30	A	A	A	A
2	D	A	B	A	A	5	A	B	A	A
3	D	A	A	A	B	10	A	A	B	B
4	D	A	B	A	B	10	A	A	B	A
5	B	C	A	A	A	20	A	A	B	B
6	B	C	A	A	A	20	A	A	B	A
7	E	A	B	A	A	15	A	A	A	A
8	A	A	B	A	A	10	A	A	A	B
9	A	A	B	A	B	25	A	A	A	A
10	B	C	A	A	A	20	A	B	C	C
11	D	D	B	A	B	25	A	A	A	A
12	B	C	A	A	A	20	A	A	A	A
13	E	A	B	A	B	0	A	A	A	A
14	D	A	B	A	A	0	A	A	A	A
15	B	C	A	A	A	11	A	A	B	A
16	B	C	A	A	A	10	A	A	B	A
17	E	A	B	A	B	18	A	A	B	B
18	D	A	B	A	B	15	A	A	B	A
19	B	C	B	A	B	5	A	A	A	A
20	B	C	A	A	A	5	A	A	A	A
21	D	A	B	A	A	20	A	A	A	B
22	F	E	B	A	B	20	A	A	B	B

Table B9: Coded responses for Environmental variables

Respondent characteristics							Variables				
Respondent No.	Job title	Job responsibility	Decision capacity	Company ownership	Activity class	Objective weight	Effect on locality	Aesthetics	Internal health/comfort	Pollution	Energy/Resource conserv.
1	D	D	B	A	A	10	A	B	A	A	A
2	D	A	B	A	A	5	B	B	C	B	B
3	D	A	A	A	B	5	C	C	B	A	B
4	D	A	B	A	B	10	C	A	A	B	B
5	B	C	A	A	A	20	B	A	A	A	B
6	B	C	A	A	A	10	B	A	B	B	A
7	E	A	B	A	A	10	B	B	A	A	B
8	A	A	B	A	A	10	B	C	A	A	A
9	A	A	B	A	B	25	B	B	A	A	A
10	B	C	A	A	A	25	A	A	A	A	A
11	D	D	B	A	B	25	B	A	A	A	A
12	B	C	A	A	A	10	B	B	A	B	A
13	E	A	B	A	B	0	B	A	A	A	A
14	D	A	B	A	A	0	A	A	A	A	A
15	B	C	A	A	A	11	A	A	A	A	A
16	B	C	A	A	A	0	A	A	B	B	C
17	E	A	B	A	B	14	A	B	B	B	B
18	D	A	B	A	B	5	B	B	B	B	B
19	B	C	B	A	B	5	A	B	A	A	B
20	B	C	A	A	A	5	A	A	A	A	A
21	D	A	B	A	A	10	A	A	B	B	B
22	F	E	B	A	B	10	B	A	B	B	B

Table B10: External Factors that can Affect Performance

Respondent characteristics						Factors													
Respondent No.	Job title	Job responsibility	Decision capacity	Company ownership	Activity class	Taxation	Health/safety legislation	Planning controls	Locational factors	State of the economy	Shifts in industrial prac.	Population movement	Urban decay	Government policy	User requirements	Competition from other props.	Tastes and standards	Financial/fiscal incentives	The cost of capital
1	D	D	B	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A
2	D	A	B	A	A	B	A	A	A	A	B	B	A	A	A	B	A	B	A
3	D	A	A	A	B	A	A	A	A	A	B	B	A	A	A	A	A	A	A
4	D	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	A
6	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
7	E	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	B	A	A
8	A	A	B	A	A	A	A	B	A	A	B	B	B	B	A	A	B	A	A
9	A	A	B	A	B	A	A	A	A	A	B	A	A	A	A	B	B	B	A
10	B	C	A	A	A	B	A	A	A	B	B	B	B	B	A	B	B	B	B
11	D	D	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
12	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
13	E	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
14	D	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
15	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	B
17	E	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	B	A	A
18	D	A	B	A	B	A	A	A	A	A	A	B	A	A	A	A	B	A	A
19	B	C	B	A	B	A	A	A	A	A	A	A	A	A	A	B	B	A	A
20	B	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
21	D	A	B	A	A	A	A	A	A	A	A	B	B	A	A	A	B	A	A
22	F	E	B	A	B	A	A	A	A	A	B	B	A	A	A	A	A	A	A

APPENDIX C

ANALYSIS OF RESPONSES TO VARIABLES

C.1: ECONOMIC PERFORMANCE

Relative frequencies

Table C1.1: Response distribution for Economic variables among Developers: Sample A

Variables	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Development cost	21	0	0	21	100.0	0.0	0.0	100.0
Effect on portfolio	8	6	7	21	38.1	28.6	33.3	100.0
Saleability/ lettability	19	1	1	21	90.5	4.8	4.7	100.0
Profitability	20	1	0	21	95.2	4.8	0.0	100.0
Rental value	15	6	0	21	71.4	28.6	0.0	100.0
Capital growth potential	7	8	6	21	33.3	38.1	28.6	100.0
Income growth potential	10	7	4	21	47.6	33.3	19.1	100.0
Operating costs	6	13	2	21	28.6	61.9	9.5	100.0
Maintenance costs	3	15	3	21	14.3	71.4	14.3	100.0
Depreciation	4	4	13	21	19.0	19.1	61.9	100.0
Site value	14	6	1	21	66.7	28.6	4.7	100.0

Table C1.2: Response distribution for Economic variables among Developers: Sample B

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Development cost	12	1	0	13	92.3	7.7	0.0	100.0
Effect on portfolio	2	10	1	13	15.4	76.9	7.7	100.0
Saleability/ lettability	9	4	0	13	69.2	30.8	0.0	100.0
Profitability	13	0	0	13	100.0	0.0	0.0	100.0
Rental value	11	2	0	13	84.6	15.4	0.0	100.0
Capital growth potential	6	7	0	13	46.2	53.8	0.0	100.0
Income growth potential	6	7	0	13	46.2	53.8	0.0	100.0
Operating costs	3	8	2	13	23.1	61.5	15.4	100.0
Maintenance costs	4	8	1	13	30.8	61.5	7.7	100.0
Depreciation	2	8	3	13	15.4	61.5	23.1	100.0
Site value	8	5	0	13	61.5	38.5	0.0	100.0

Table C1.3: Combined relative frequencies for responses to Economic variables among Developers

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Development cost	100.0	0.0	0.0	92.3	7.7	0.0	98	2	0
Effect on portfolio	38.1	28.6	33.3	15.4	76.9	7.7	32	41	27
Saleability/Lettability	90.5	4.8	4.7	69.2	30.8	0.0	85	11	3
Profitability	95.2	4.8	0.0	100.0	0.0	0.0	96	4	0
Rental value	71.4	28.6	0.0	84.6	15.4	0.0	75	25	0
Capital growth potential	33.3	38.1	28.6	46.2	53.8	0.0	37	42	21
Income growth potential	47.6	33.3	19.1	46.2	53.8	0.0	47	39	14
Operating costs	28.6	61.9	9.5	23.1	61.5	15.4	27	62	11
Maintenance cost	14.3	71.4	14.3	30.8	61.5	7.7	19	69	13
Depreciation	19.0	19.1	61.9	15.4	61.5	23.1	18	30	52
Site value	66.7	28.6	4.7	61.5	38.5	0.0	65	31	3

Combined frequency = 6.54/8.8 x entry A + 2.26/8.8 x entry B

eg. for development cost, combined frequency for "all cases" = 6.54/8.8 x 100 + 2.26/8.8 x 92.3 = 98.022

Table C1.4: Response distribution for Economic variables among Investors: Sample A

Variables	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Development cost	9	0	0	9	100.0	0.0	0.0	100.0
Effect on portfolio	3	5	1	9	33.3	55.6	11.1	100.0
Saleability/ lettability	7	2	0	9	77.8	22.2	0.0	100.0
Profitability	8	1	0	9	88.9	11.1	0.0	100.0
Rental value	8	1	0	9	88.9	11.1	0.0	100.0
Capital growth potential	3	6	0	9	33.3	66.7	0.0	100.0
Income growth potential	5	4	0	9	55.6	44.4	0.0	100.0
Operating costs	4	5	0	9	44.4	55.6	0.0	100.0
Maintenance costs	4	5	0	9	44.4	55.6	0.0	100.0
Depreciation	1	4	4	9	11.1	44.4	44.5	100.0
Site value	6	2	1	9	66.7	22.2	11.1	100.0

Table C1.5: Response distribution for Economic variables among Investors: Sample B

Variable	Frequency				Relative frequency (%)			
	All cases	Some cases	Not at all	Total	All cases	Some cases	Not at all	Total
Development cost	9	0	0	9	100.0	0.0	0.0	100.0
Effect on portfolio	5	4	0	9	55.6	44.4	0.0	100.0
Saleability/ lettability	9	0	0	9	100.0	0.0	0.0	100.0
Profitability	9	0	0	9	100.0	0.0	0.0	100.0
Rental value	8	1	0	9	88.9	11.1	0.0	100.0
Capital growth potential	6	3	0	9	66.7	33.3	0.0	100.0
Income growth potential	6	3	0	9	66.7	33.3	0.0	100.0
Operating costs	5	4	0	9	55.6	44.4	0.0	100.0
Maintenance costs	6	3	0	9	66.7	33.3	0.0	100.0
Depreciation	5	2	0	7	55.6	22.2	22.2	100.0
Site value	4	4	1	9	44.4	44.4	11.2	100.0

Table C1.6: Combined relative frequencies for responses to Economic variables among Investors

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Development cost	100.0	0.0	0.0	100.0	0.0	0.0	100	0	0
Effect on portfolio	33.3	55.6	11.1	55.6	44.4	0.0	39	53	8
Saleability/Lettability	77.8	22.2	0.0	100.0	0.0	0.0	84	16	0
Profitability	88.9	11.1	0.0	100.0	0.0	0.0	92	8	0
Rental value	88.9	11.1	0.0	88.9	11.1	0.0	89	11	0
Capital growth potential	33.3	66.7	0.0	66.7	33.3	0.0	42	58	0
Income growth potential	55.6	44.4	0.0	66.7	33.3	0.0	58	42	0
Operating costs	44.4	55.6	0.0	55.6	44.4	0.0	47	53	0
Maintenance cost	44.4	55.6	0.0	66.7	33.3	0.0	50	50	0
Depreciation	11.1	44.4	44.5	55.6	22.2	22.2	23	39	39
Site value	66.7	22.2	11.1	44.4	44.4	11.2	61	28	11

Combined frequency = 6.54/8.8 x entry A + 2.26/8.8 x entry B

eg. for effect on portfolio, combined frequency for "some cases" = 6.54/8.8 x 55.6 + 2.26/8.8 x 44.4 = 52.724

Table C1.7: Chi-square significance tests between Developers and Investors over economic variables

H_0: Response distribution and sub-group type are not related (ie. responses are not significantly different between developers and investors)

H_a: Response distribution and sub-group type are related (ie. responses are significantly different between developers and investors).

At 5% significance level, if $p < 0.05$, reject H_0 (ie. if $p < 0.05$, the responses are significantly different)

1. Development cost

actual observation

Response	Developer	Investor
In all cases	98	100
In some cases	2	0
Not at all	0	0

expected observation

Response	Developer	Investor
In all cases	99	99
In some cases	1	1
Not at all	0	0

p = 0.886974312

2. Effect on portfolio

actual observation

Response	Developer	Investor
In all cases	32	39
In some cases	41	53
Not at all	27	8

expected observation

Response	Developer	Investor
In all cases	35.5	35.5
In some cases	47	47
Not at all	17.5	17.5

p = 0.001895693

3. Saleability/Lettability

actual observation

Response	Developer	Investor
In all cases	85	84
In some cases	11	16
Not at all	3	0

expected observation

Response	Developer	Investor
In all cases	84.1	84.9
In some cases	13.4	13.6
Not at all	1.5	1.5

p = 0.343691229

4. Profitability

actual observation

Response	Developer	Investor
In all cases	96	92
In some cases	4	8
Not at all	0	0

7. Income growth potential

actual observation

Response	Developer	Investor
In all cases	47	58
In some cases	39	42
Not at all	14	0

expected observation

Response	Developer	Investor
In all cases	52.5	52.5
In some cases	40.5	40.5
Not at all	7.0	7.0

p = 0.0004848

8. Operating costs

actual observation

Response	Developer	Investor
In all cases	27	47
In some cases	62	53
Not at all	11	0

expected observation

Response	Developer	Investor
In all cases	37.0	37.0
In some cases	57.5	57.5
Not at all	5.5	5.5

p = 0.0001926

9. Maintenance cost

actual observation

Response	Developer	Investor
In all cases	19	50
In some cases	69	50
Not at all	13	0

expected observation

Response	Developer	Investor
In all cases	34.7	34.3
In some cases	59.8	59.2
Not at all	6.5	6.5

p = 3.126E-07

10. Depreciation

actual observation

Response	Developer	Investor
In all cases	18	23
In some cases	30	39
Not at all	52	39

H_0: Response distribution and sub-group type are not related (ie. responses are not significantly different between developers and investors)

H_a: Response distribution and sub-group type are related (ie. responses are significantly different between developers and investors).

At 5% significance level, if $p < 0.05$, reject H_0 (ie. if $p < 0.05$, the responses are significantly different)

expected observation

Response	Developer	Investor
In all cases	94.0	94.0
In some cases	6.0	6.0
Not at all	0.0	0.0

p = 0.233660534

5. Rental value

actual observation

Response	Developer	Investor
In all cases	75	89
In some cases	25	11
Not at all	0	0

expected observation

Response	Developer	Investor
In all cases	82.0	82.0
In some cases	18.0	18.0
Not at all	0.0	0.0

p = 0.009973821

6. Capital growth potential

actual observation

Response	Developer	Investor
In all cases	37	42
In some cases	42	58
Not at all	21	0

expected observation

Response	Developer	Investor
In all cases	39.5	39.5
In some cases	50.0	50.0
Not at all	10.5	10.5

p = 6.53572E-06

expected observation

Response	Developer	Investor
In all cases	20.4	20.6
In some cases	34.3	34.7
Not at all	45.3	45.7

p = 0.1623561

11. Site value

actual observation

Response	Developer	Investor
In all cases	65	61
In some cases	31	28
Not at all	3	11

expected observation

Response	Developer	Investor
In all cases	62.7	63.3
In some cases	29.4	29.6
Not at all	7.0	7.0

p = 0.0886529

Table C1.8: Criticality Indices (CRIs) for economic variables among developers and investors

Variable	Developers				Investors			
	All cases	Some cases	Not at all	CRI	All cases	Some cases	Not at all	CRI
Development cost	98	2	0	99.0	100	0	0	100.0
Effect on portfolio	32	41	27	52.8	39	53	8	65.4
Saleability/Lettability	85	11	3	90.8	84	16	0	91.8
Profitability	96	4	0	98.2	92	8	0	95.9
Rental value	75	25	0	87.4	89	11	0	94.5
Capital growth potential	37	42	21	57.7	42	58	0	70.9
Income growth potential	47	39	14	66.5	58	42	0	79.2
Operating costs	27	62	11	58.1	47	53	0	73.6
Maintenance cost	19	69	13	53.0	50	50	0	75.1
Depreciation	18	30	52	33.1	23	39	39	41.9
Site value	65	31	3	80.9	61	28	11	74.9

CRI for a variable = [2 x "all cases" + 1 x "some cases" + 0 x "not at all"] / 2

C2: FUNCTIONAL PERFORMANCE

Relative frequencies

Table C2.1: Response distribution for Functional variables among Developers: Sample A

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Condition of services	14	6	1	21	66.7	28.6	4.8	100.0
Accommodation size	18	2	1	21	85.7	9.5	4.8	100.0
Ease of circulation	8	10	2	20	40.0	50.0	10.0	100.0
Floor to floor height	14	7	0	21	66.7	33.3	0.0	100.0
Accessibility	17	3	1	21	81.0	14.3	4.8	100.0
Internal sub- divisions	6	14	1	21	28.6	66.7	4.8	100.0
Security	5	13	3	21	23.8	61.9	14.3	100.0
Flexibility of use	10	11	0	21	47.6	52.4	0.0	100.0
Image/ prestige	10	10	1	21	47.6	47.6	4.8	100.0
Architectural merit	6	13	2	21	28.6	61.9	9.5	100.0
Historical significance	1	13	7	21	4.8	61.9	33.3	100.0
Adaptable to use new technology	9	9	3	21	42.9	42.9	14.3	100.0

Table C2.2: Response distribution for Functional variables among Developers: Sample B

Variable	Frequency				Relative frequency (%)			
	All cases	Some cases	Not at all	Total	All cases	Some cases	Not at all	Total
Condition of services	9	4	0	13	69.2	30.8	0.0	100.0
Accommodation size	11	2	0	13	84.6	15.4	0.0	100.0
Ease of circulation	9	4	0	13	69.2	30.8	0.0	100.0
Floor to floor height	10	3	0	13	76.9	23.1	0.0	100.0
Accessibility	12	1	0	13	92.3	7.7	0.0	100.0
Internal sub- divisions	4	7	2	13	30.8	53.8	15.4	100.0
Security	3	7	3	13	23.1	53.8	23.1	100.0
Flexibility of use	8	4	1	13	61.5	30.8	7.7	100.0
Image/ prestige	6	7	0	13	46.2	53.8	0.0	100.0
Architectural merit	4	8	1	13	30.8	61.5	7.7	100.0
Historical significance	0	9	4	13	0.0	69.2	30.8	100.0
Adaptable to use new technology	8	5	0	13	61.5	38.5	0.0	100.0

Table C2.3: Combined relative frequencies for responses to Functional variables among Developers

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Condition of services	66.7	28.6	4.8	69.2	30.8	0.0	67	29	4
Accommodation size	85.7	9.5	4.8	84.6	15.4	0.0	85	11	4
Ease of circulation	40.0	50.0	10.0	69.2	30.8	0.0	47	45	7
Floor to floor height	66.7	33.3	0.0	76.9	23.1	0.0	69	31	0
Accessibility	81.0	14.3	4.8	92.3	7.7	0.0	84	13	4
Internal sub-divisions	28.6	66.7	4.8	30.8	53.8	15.4	29	63	8
Security	23.8	61.9	14.3	23.1	53.8	23.1	24	60	17
Flexibility of use	47.6	52.4	0.0	61.5	30.8	7.7	51	47	2
Image/prestige	47.6	47.6	4.8	46.2	53.8	0	47	49	4
Architectural merit	28.6	61.9	9.5	30.8	61.5	7.7	29	62	9
Historical significance	4.8	61.9	33.3	0.0	69.2	30.8	4	64	33
Adaptable to use new technology	42.9	42.9	14.3	61.5	38.5	0.0	48	42	11

Table C2.4: Response distribution for Functional variables among Investors: Sample A

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Condition of services	6	2	1	9	66.7	22.2	11.1	100.0
Accommodation size	8	1	0	9	88.9	11.1	0.0	100.0
Ease of circulation	3	6	0	9	33.3	66.7	0.0	100.0
Floor to floor height	5	4	0	9	55.6	44.4	0.0	100.0
Accessibility	7	2	0	9	77.8	22.2	0.0	100.0
Internal sub- divisions	1	8	0	9	11.1	88.9	0.0	100.0
Security	4	4	1	9	44.4	44.4	11.1	100.0
Flexibility of use	4	5	0	9	44.4	55.6	0.0	100.0
Image/ prestige	4	3	2	9	44.4	33.3	22.2	100.0
Architectural merit	1	7	1	9	11.1	77.8	11.1	100.0
Historical significance	0	4	5	9	0.0	44.4	55.6	100.0
Adaptable to use new technology	5	4	0	9	55.6	44.4	0.0	100.0

Table C2.5: Response distribution for Functional variables among Investors: Sample B

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Condition of services	5	4	0	9	55.6	44.4	0.0	100.0
Accommodation size	8	1	0	9	88.9	11.1	0.0	100.0
Ease of circulation	5	4	0	9	55.6	44.4	0.0	100.0
Floor to floor height	7	2	0	9	77.8	22.2	0.0	100.0
Accessibility	7	2	0	9	77.8	22.2	0.0	100.0
Internal sub- divisions	0	9	0	9	0.0	100.0	0.0	100.0
Security	2	7	0	9	22.2	77.8	0.0	100.0
Flexibility of use	5	4	0	9	55.6	44.4	0.0	100.0
Image/ prestige	4	5	0	9	44.4	55.6	0.0	100.0
Architectural merit	2	7	0	9	22.2	77.8	0.0	100.0
Historical significance	0	7	2	9	0.0	77.8	22.2	100.0
Adaptable to use new technology	6	2	1	9	66.7	22.2	11.1	100.0

Table C2.6: Combined relative frequencies for responses to Functional variables among Investors

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Condition of services	66.7	22.2	11.1	55.6	44.4	0.0	64	28	8
Accommodation size	88.9	11.1	0.0	88.9	11.1	0.0	89	11	0
Ease of circulation	33.3	66.7	0.0	55.6	44.4	0.0	39	61	0
Floor to floor height	55.6	44.4	0.0	77.8	22.2	0.0	61	39	0
Accessibility	77.8	22.2	0.0	77.8	22.2	0.0	78	22	0
Internal sub-divisions	11.1	88.9	0.0	0.0	100.0	0.0	8	92	0
Security	44.4	44.4	11.1	22.2	77.8	0.0	39	53	8
Flexibility of use	44.4	55.6	0.0	55.6	44.4	0.0	47	53	0
Image/prestige	44.4	33.3	22.2	44.4	55.6	0.0	44	39	16
Architectural merit	11.1	77.8	11.1	22.2	77.8	0.0	14	78	8
Historical significance	0.0	44.4	55.6	0.0	77.8	22.2	0	53	47
Adaptable to use new technology	55.6	44.4	0	66.7	22.2	11.1	58	39	3

Table C2.7: Chi-square significance tests between Developers and Investors over functional variables

H_0: Response distribution and sub-group type are not related (ie. responses are not significantly different between developers and investors)

H_a: Response distribution and sub-group type are related (ie. responses are significantly different between developers and investors).

At 5% significance level, if $p < 0.05$, reject H_0 (ie. if $p < 0.05$, the responses are significantly different)

1. Condition of services

actual observation

Response	*Developer*	*Investor*
In all cases	67	64
In some cases	29	28
Not at all	4	8

expected observation

Response	*Developer*	*Investor*
In all cases	65.5	65.5
In some cases	28.5	28.5
Not at all	6	6

p = 0.491747585

2. Size of accommodation

actual observation

Response	*Developer*	*Investor*
In all cases	85	89
In some cases	11	11
Not at all	4	0

expected observation

Response	*Developer*	*Investor*
In all cases	87	87
In some cases	11	11
Not at all	2	2

p = 0.761707564

3.Ease of circulation

actual observation

Response	*Developer*	*Investor*
In all cases	47	39
In some cases	45	61
Not at all	7	0

expected observation

Response	*Developer*	*Investor*
In all cases	42.8	43.2
In some cases	52.7	53.3
Not at all	3.5	3.5

p = 0.079075369

4. Floor to floor height

actual observation

Response	*Developer*	*Investor*
In all cases	69	61
In some cases	31	39
Not at all	0	0

7. Security

actual observation

Response	*Developer*	*Investor*
In all cases	24	39
In some cases	60	53
Not at all	17	8

expected observation

Response	*Developer*	*Investor*
In all cases	31.7	31.3
In some cases	56.8	56.2
Not at all	12.6	12.4

p = 0.0267792

8. Flexibility of use

actual observation

Response	*Developer*	*Investor*
In all cases	51	47
In some cases	47	53
Not at all	2	0

expected observation

Response	*Developer*	*Investor*
In all cases	49.0	49.0
In some cases	50.0	50.0
Not at all	1.0	1.0

p = 0.4694521

9. Image/prestige

actual observation

Response	*Developer*	*Investor*
In all cases	47	44
In some cases	49	39
Not at all	4	16

expected observation

Response	*Developer*	*Investor*
In all cases	45.7	45.3
In some cases	44.2	43.8
Not at all	10.1	9.9

p = 0.014769

10. Architectural merit

actual observation

Response	*Developer*	*Investor*
In all cases	29	14
In some cases	62	78
Not at all	9	8

Table C2.7: Chi-square significance tests between Developers and Investors over functional variables

H_0: Response distribution and sub-group type are not related (ie. responses are not significantly different between developers and investors)

H_a: Response distribution and sub-group type are related (ie. responses are significantly different between developers and investors).

At 5% significance level, if $p < 0.05$, reject H_0 (ie. if $p < 0.05$, the responses are significantly different)

expected observation

Response	*Developer*	*Investor*
In all cases	65.0	65.0
In some cases	35.0	35.0
Not at all	0.0	0.0

p = 0.235622887

5. Accessibility

actual observation

Response	*Developer*	*Investor*
In all cases	84	78
In some cases	13	22
Not at all	4	0

expected observation

Response	*Developer*	*Investor*
In all cases	81.4	80.6
In some cases	17.6	17.4
Not at all	2.0	2.0

p = 0.108818409

6. Internal sub-divisions

actual observation

Response	*Developer*	*Investor*
In all cases	29	8
In some cases	63	92
Not at all	8	0

expected observation

Response	*Developer*	*Investor*
In all cases	18.5	18.5
In some cases	77.5	77.5
Not at all	4.0	4.0

p = 3.13663E-06

expected observation

Response	*Developer*	*Investor*
In all cases	21.5	21.5
In some cases	70.0	70.0
Not at all	8.5	8.5

p = 0.0284395

11. Historical significance

actual observation

Response	*Developer*	*Investor*
In all cases	4	0
In some cases	64	53
Not at all	33	47

expected observation

Response	*Developer*	*Investor*
In all cases	2.0	2.0
In some cases	58.8	58.2
Not at all	40.2	39.8

p = 0.060669

12. Adaptable to use new technology

actual observation

Response	*Developer*	*Investor*
In all cases	48	58
In some cases	42	39
Not at all	11	3

expected observation

Response	*Developer*	*Investor*
In all cases	53.3	52.7
In some cases	40.7	40.3
Not at all	7.0	7.0

p = 0.0601719

Table C2.8: Criticality Indices (CRIs) for functional variables among developers and investors

Variables	Developers				Investors			
	All cases	Some cases	Not at all	CRI	All cases	Some cases	Not at all	CRI
Condition of services	67	29	4	81.9	64	28	8	77.8
Accommodation size	85	11	4	90.9	89	11	0	94.5
Circulation	47	45	7	70.0	39	61	0	69.5
Floor to floor height	69	31	0	84.7	61	39	0	80.7
Accessibility	84	13	4	90.2	78	22	0	88.9
Internal sub-divisions	29	63	8	60.9	8	92	0	54.1
Security	24	60	17	53.5	39	53	8	65.2
Flexibility of use	51	47	2	74.6	47	53	0	73.6
Image/prestige	47	49	4	71.8	44	39	10	63.9
Architectural merit	29	62	9	60.1	14	78	8	52.9
Historical significance	4	64	33	35.5	0	53	47	26.5
Adaptable to use new technology	48	42	11	68.6	58	39	3	77.8

CRI for a variable = [2 x "all cases" + 1 x "some cases" + 0 x "not at all"] / 2

C3: PHYSICAL/ STRUCTURAL PERFORMANCE

Relative frequencies

Table C3.1: Response distribution for Physical/structural variables among Developers: Sample A

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Structural condition	18	1	0	19	94.7	5.3	0.0	100.0
Condition of fabric	14	5	0	19	73.7	26.3	0.0	100.0
Fire resistance	6	11	2	19	31.6	57.9	10.5	100.0
Durability	7	12	0	19	36.8	63.2	0.0	100.0

Table C3.2: Response distribution for Physical/structural variables among Developers: Sample B

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Structural condition	13	0	0	13	100.0	0.0	0.0	100.0
Condition of fabric	11	2	0	13	84.6	15.4	0.0	100.0
Fire resistance	8	4	1	13	61.5	30.8	7.7	100.0
Durability	9	3	1	13	69.2	23.1	7.7	100.0

Table C3.3: Response distribution for Physical/structural variables among Investors: Sample A

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Structural condition	9	0	0	9	100.0	0.0	0.0	100.0
Condition of fabric	9	0	0	9	100.0	0.0	0.0	100.0
Fire resistance	3	6	0	9	33.3	66.7	0.0	100.0
Durability	5	4	0	9	55.6	44.4	0.0	100.0

Table C3.4: Response distribution for Physical/structural variables among Investors: Sample B

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Structural condition	9	0	0	9	100.0	0.0	0.0	100.0
Condition of fabric	9	0	0	9	100.0	0.0	0.0	100.0
Fire resistance	4	5	0	9	44.4	55.6	0.0	100.0
Durability	6	3	0	9	66.7	33.3	0.0	100.0

Table C3.5: Combined relative frequencies for responses to Physical/structural variables among Developers

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Structural condition	94.7	5.3	0.0	100.0	0.0	0.0	96	4	0
Condition of fabric	73.7	26.3	0.0	84.6	15.4	0.0	76	24	0
Fire resistance	31.6	57.9	10.5	61.5	30.8	7.7	39	51	10
Durability	36.8	63.2	0.0	69.2	23.1	7.7	45	53	2

Table C3.6: Combined relative frequencies for responses to Physical/structural variables among Investors

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Structural condition	100.0	0.0	0.0	100.0	0.0	0.0	100	0	0
Condition of fabric	100.0	0.0	0.0	100.0	0.0	0.0	100	0	0
Fire resistance	33.3	66.7	0.0	44.4	55.6	0.0	36	64	0
Durability	55.6	44.4	0.0	66.7	33.3	0.0	58	42	0

Table C3.7: Chi-square significance tests between Developers and Investors over Physical/structural variables

H_0: Response distribution and sub-group type are not related (ie. responses are not significantly different between developers and investors)

H_a: Response distribution and sub-group type are related (ie. responses are significantly different between developers and investors).

At 5% significance level, if $p < 0.05$, reject H_0 (ie. if $p < 0.05$, the responses are significantly different)

1. Structural condition

actual observation

Response	*Developer*	*Investor*
In all cases	96	100
In some cases	4	0
Not at all	0	0

expected observation

Response	*Developer*	*Investor*
In all cases	98	98
In some cases	2	2
Not at all	0	0

p = 0.775096962

2. Condition of fabric

actual observation

Response	*Developer*	*Investor*
In all cases	76	100
In some cases	24	0
Not at all	0	0

expected observation

Response	*Developer*	*Investor*
In all cases	88.0	88.0
In some cases	12.0	12.0
Not at all	0.0	0.0

p = 1.767E-07

3. Fire resistance

actual observation

Response	*Developer*	*Investor*
In all cases	39	36
In some cases	51	64
Not at all	10	0

expected observation

Response	*Developer*	*Investor*
In all cases	37.5	37.5
In some cases	57.5	57.5
Not at all	5	5

p = 0.003043392

4. Durability

actual observation

Response	*Developer*	*Investor*
In all cases	45	58
In some cases	53	42
Not at all	2	0

expected observation

Response	*Developer*	*Investor*
In all cases	51.5	51.5
In some cases	47.5	47.5
Not at all	1.0	1.0

p = 0.0877888

Table C3.8: Criticality Indices (CRIs) for physical/ structural variables among developers and investors

Variable	Developers				Investors			
	All cases	Some cases	Not at all	CRI	All cases	Some cases	Not at all	CRI
Structural condition	96	4	0	98.0	100	0	0	100.0
Condition of fabric	76	24	0	88.2	100	0	0	100.0
Fire resistance	39	51	0	64.7	36	64	0	68.1
Durability	45	53	2	71.6	58	42	0	79.2

CRI for a variable = [2 x "all cases" + 1 x "some cases" + 0 x "not at all"] / 2

Table E.6: Factors that affect property performance (% of Investors who they could)

Factor	Sample A	Sample B	Adjusted for probablity
Taxes	88.9	100	91.8
Legislation	100	100	100.0
Planning controls	100	100	100.0
Changes in locational factors	100	100	100.0
State of the economy	88.9	100	91.8
Shifts in work practices	77.8	66.7	74.9
Demographic changes	66.7	66.7	66.7
Urban decay	66.7	100	75.3
Changes in government policy	100	100	100.0
Changes in user requirements	100	100	100.0
Competition from newer and modernised buildings	100	77.8	94.3
Changes in social tastes and standards	77.8	55.6	72.1
Financial and fiscal incentives	66.7	88.9	72.4
Cost of capital	77.8	100	83.5

C4: ENVIRONMENTAL PERFORMANCE

Relative frequencies

Table C4.1: Response distribution for Environmental factors among Developers: Sample A

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Effect on locality	9	10	1	20	45.0	50.0	5.0	100.0
Aesthetics	11	9	0	20	55.0	45.0	0.0	100.0
Internal health and comfort	11	8	1	20	55.0	40.0	5.0	100.0
Pollution	7	10	3	20	35.0	50.0	15.0	100.0
Energy/ resource conservation	5	15	0	20	25.0	75.0	0.0	100.0

Table C4.2: Response distribution for Environmental factors among Developers: Sample B

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Effect on locality	7	6	0	13	53.8	46.2	0.0	100.0
Aesthetics	8	4	1	13	61.5	30.8	7.7	100.0
Internal health and comfort	9	3	1	13	69.2	23.1	7.7	100.0
Pollution	8	5	0	13	61.5	38.5	0.0	100.0
Energy/ resource conservation	8	4	1	13	61.5	30.8	7.7	100.0

Table C4.3: Frequency distribution for Environmental factors among Investors: Sample A

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Effect on locality	2	5	2	9	22.2	55.6	22.2	100.0
Aesthetics	3	6	0	9	33.3	66.7	0.0	100.0
Internal health and comfort	5	4	0	9	55.6	44.4	0.0	100.0
Pollution	5	4	0	9	55.6	44.4	0.0	100.0
Energy/ resource conservation	4	4	1	9	44.4	44.4	11.1	100.0

Table C4.4: Frequency distribution for Environmental factors among Investors: Sample B

Variable	Frequency			Total	Relative frequency (%)			Total
	All cases	Some cases	Not at all		All cases	Some cases	Not at all	
Effect on locality	2	5	2	9	22.2	55.6	22.2	100.0
Aesthetics	4	4	1	9	44.4	44.4	11.1	100.0
Internal health and comfort	5	4	0	9	55.6	44.4	0.0	100.0
Pollution	5	4	0	9	55.6	44.4	0.0	100.0
Energy/ resource conservation	3	6	0	9	33.3	66.7	0.0	100.0

Table C4.5: Combined relative frequencies for response to Environmental variables among Developers

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Effect on locality	45.0	50.0	5.0	53.8	46.2	0.0	47	49	4
Aesthetics	55.0	45.0	0.0	61.5	30.8	7.7	57	41	2
Internal health and comfort	55.0	40.0	5.0	69.2	23.1	7.7	59	36	6
Pollution	35.0	50.0	15.0	61.5	38.5	0.0	42	47	11
Energy/resource conservation	25.0	75.0	0.0	61.5	30.8	7.7	34	64	2

Table C4.6: Combined relative frequencies for responses to Environmental variables among Investors

Variable	Sample A			Sample B			Adjusted for probabilities		
	All cases	Some cases	Not at all	All cases	Some cases	Not at all	All cases	Some cases	Not at all
Effect on locality	22.2	55.6	22.2	22.2	55.6	22.2	22	56	22
Aesthetics	33.3	66.7	0.0	44.4	44.4	11.1	36	61	3
Internal health and comfort	55.6	44.4	0.0	55.6	44.4	0.0	56	44	0
Pollution	55.6	44.4	0.0	55.6	44.4	0.0	56	44	0
Energy/resource conservation	44.4	44.4	11.1	33.3	66.7	0.0	42	50	8

Table C4.7: Chi-square significance tests between Developers and Investors over Environmental variables

H_0: Response distribution and sub-group type are not related (ie. responses are not significantly different between developers and investors)

H_a: Response distribution and sub-group type are related (ie. responses are significantly different between developers and investors).

At 5% significance level, if $p < 0.05$, reject H_0 (ie. if $p < 0.05$, the responses are significantly different)

1. Effect on locality

actual observation

Response	*Developer*	*Investor*
In all cases	47	22
In some cases	49	56
Not at all	4	22

expected observation

Response	*Developer*	*Investor*
In all cases	34.5	34.5
In some cases	52.5	52.5
Not at all	13	13

p = 1.68175E-05

2. Aesthetics

actual observation

Response	*Developer*	*Investor*
In all cases	57	36
In some cases	41	61
Not at all	2	3

expected observation

Response	*Developer*	*Investor*
In all cases	46.5	46.5
In some cases	51.0	51.0
Not at all	2.5	2.5

p = 0.0032465

3. Internal health and comfort

actual observation

Response	*Developer*	*Investor*
In all cases	59	56
In some cases	36	44
Not at all	6	0

expected observation

Response	*Developer*	*Investor*
In all cases	57.8	57.2
In some cases	40.2	39.8
Not at all	3	3

p = 0.334315155

4. Pollution

actual observation

Response	*Developer*	*Investor*
In all cases	42	56
In some cases	47	44
Not at all	11	0

expected observation

Response	*Developer*	*Investor*
In all cases	49.0	49.0
In some cases	45.5	45.5
Not at all	5.5	5.5

p = 0.0014309

5. Energy/resource conservation

actual observation

Response	*Developer*	*Investor*
In all cases	34	42
In some cases	64	50
Not at all	2	8

expected observation

Response	*Developer*	*Investor*
In all cases	38.0	38.0
In some cases	57.0	57.0
Not at all	5.0	5.0

p = 0.045927016

Table C4.8: Criticality Indices (CRIs) for Environmental variables

Variable	Developers				Investors			
	All cases	Some cases	Not at all	CRI	All cases	Some cases	Not at all	CRI
Effect on locality	47	49	4	71.8	22	56	22	50.0
Aesthetics	57	41	2	77.3	36	61	3	66.6
Internal health/comfort	59	36	6	76.5	56	44	0	77.8
Pollution	42	47	11	65.3	56	44	0	77.8
Energy/ Resource conservation	34	64	2	66.2	42	50	8	66.6

CRI for a variable = [2 x "all cases" + 1 x "some cases" + 0 x "not at all"] / 2

APPENDIX D

Relative importance weights for the generic building performance dimensions

Table D1: Relative importance weights for the generic dimensions of building performance (Developers)

Resp. #	Economic	Functional	Physical	Environmental	Total
A1	35	25	20	20	100
A4	50	20	15	15	100
A5	60	15	15	10	100
A7	30	25	20	25	100
A8	50	30	10	10	100
A9	25	25	25	25	100
A11	50	30	10	10	100
A14	80	5	10	5	100
A16	25	25	25	25	100
A17	80	7	6	7	100
A18	80	10	5	5	100
A19	40	45	10	5	100
A20	50	20	20	10	100
A21	60	20	10	10	100
A22	40	20	20	20	100
A23	70	20	5	5	100
A25	30	30	20	20	100
A26	60	10	25	5	100
A27	70	10	10	10	100
A28	60	30	5	5	100
A30	50	25	20	5	100
B1	30	30	30	10	100
B2	70	20	5	5	100
B5	40	20	20	20	100
B6	50	20	20	10	100
B7	50	25	15	10	100
B8	60	20	10	10	100
B10	25	30	20	25	100
B12	40	30	20	10	100
B14	100	0	0	0	100
B15	56	22	11	11	100
B16	80	10	10	0	100
B20	80	10	5	5	100
B21	50	20	20	10	100

Table D2: Relative importance weights for the generic dimensions of building performance (Investors)

Resp. #	Economic	Functional	Physical	Environmental	Total
A2	70	10	10	10	100
A3	75	10	10	5	100
A6	30	40	20	10	100
A10	50	25	15	10	100
A12	40	40	10	10	100
A13	40	30	15	15	100
A15	44	17	28	11	100
A24	40	30	20	10	100
A29	40	40	10	10	100
B3	45	40	10	5	100
B4	50	30	10	10	100
B9	25	25	25	25	100
B11	25	25	25	25	100
B13	100	0	0	0	100
B17	45	23	18	14	100
B18	50	30	15	5	100
B19	80	10	5	5	100
B22	40	30	20	10	100

Table D.3: Frequency distribution and sample statistics of importance weight for economic performance

Developers

Weight interval	*Frequency*
20 - 29	3
30 - 39	4
40 - 49	4
50 - 59	9
60 - 69	5
70 - 79	3
80 - 89	5
More	1

Developer statistics	
Mean	53.70588235
Standard Error	3.266130793
Median	50
Mode	50
Standard Deviation	19.04465154
Sample Variance	362.6987522
Kurtosis	-0.405126484
Skewness	0.355031849
Range	75
Minimum	25
Maximum	100
Sum	1826
Count	34
Confidence Level(95.000%)	6.401489245

Investors

Weight interval	*Frequency*
20 - 29	2
30 - 39	1
40 - 49	8
50 - 59	3
60 - 69	0
70 - 79	2
80 - 89	1
More	1

Investor statistics	
Mean	49.38888889
Standard Error	4.663261285
Median	44.5
Mode	40
Standard Deviation	19.78454206
Sample Variance	391.4281046
Kurtosis	1.278158424
Skewness	1.222935404
Range	75
Minimum	25
Maximum	100
Sum	889
Count	18
Confidence Level(95.000%)	9.139810635

Table D.4: Frequency distribution and sample statistics of importance weights for Functional performance

Developers

Weight interval	*Frequency*
0 - 9	3
10 - 19	6
20 - 29	17
30 - 39	7
More	1

Developer statistics	
Mean	20.705882
Standard Error	1.5743767
Median	20
Mode	20
Standard Deviation	9.1801149
Sample Variance	84.27451
Kurtosis	0.5418773
Skewness	-0.0505754
Range	45
Minimum	0
Maximum	45
Sum	704
Count	34
Confidence Level(95.000%)	3.0857171

Investors

Weight interval	*Frequency*
0 - 9	1
10 - 19	4
20 - 29	4
30 - 39	5
More	4

Investor statistics	
Mean	25.277778
Standard Error	2.7956614
Median	27.5
Mode	30
Standard Deviation	11.860987
Sample Variance	140.68301
Kurtosis	-0.3647182
Skewness	-0.5607138
Range	40
Minimum	0
Maximum	40
Sum	455
Count	18
Confidence Level(95.000%)	5.4793875

Table D.5: Frequency distribution and sample statistics of importance weights for Physical/structural performance

Developers

Weight interval	*Frequency*
0 - 4	1
5 - 9	6
10 - 14	9
15 - 19	3
20 - 24	11
25 - 29	3
More	1

Developer statistics	
Mean	14.47058824
Standard Error	1.270980992
Median	15
Mode	20
Standard Deviation	7.411029022
Sample Variance	54.92335116
Kurtosis	-0.9088117
Skewness	0.036835124
Range	30
Minimum	0
Maximum	30
Sum	492
Count	34
Confidence Level(95.000%)	2.49107328

Investors

Weight interval	*Frequency*
4	1
9	1
14	6
19	4
24	3
29	3
More	0

Investor statistics	
Mean	14.77777778
Standard Error	1.740624851
Median	15
Mode	10
Standard Deviation	7.384845815
Sample Variance	54.53594771
Kurtosis	-0.3798336
Skewness	0.015161682
Range	28
Minimum	0
Maximum	28
Sum	266
Count	18
Confidence Level(95.000%)	3.411556967

Table D.6: Frequency distribution and sample statistics of importance weights for environmental performance

Developers

Weight interval	*Frequency*
0 - 4	2
5 - 9	10
10 - 14	13
15 - 19	1
20 - 24	4
More	4

Developer statistics	
Mean	11.117647
Standard Error	1.2372449
Median	10
Mode	10
Standard Deviation	7.2143153
Sample Variance	52.046346
Kurtosis	-0.3791859
Skewness	0.7432525
Range	25
Minimum	0
Maximum	25
Sum	378
Count	34
Confidence Level(95.000%)	2.4249518

Investors

Weight interval	*Frequency*
0 - 4	1
5 - 9	4
10 - 14	10
15 - 19	1
20 - 24	0
More	2

Investor statistics	
Mean	10.555556
Standard Error	1.4977592
Median	10
Mode	10
Standard Deviation	6.3544539
Sample Variance	40.379085
Kurtosis	1.7249241
Skewness	1.107168
Range	25
Minimum	0
Maximum	25
Sum	190
Count	18
Confidence Level(95.000%)	2.9355497

Table D.7: Relative importance weight for economic performance: comparision of sample variances and means between Developers and Investors

Sample variances: Developers versus Investors

H_0: developer variance = investor variance

H_a: developer variance is not equal to investor variance

At 5% significance level (ie. 0.025 for two-tailed test),

F-Test Two-Sample for Variances

	Investors	*Developers*
Mean	49.3888889	53.7058824
Variance	391.428105	362.698752
Observations	18	34
df	17	33
F	1.07920996	
P(F<=f) one-tail	0.41111304	
F Critical one-tail	2.20902763	

F-statistic < F_{crit}; therefore null hypothesis cannot be rejected.

(this implies no significant difference between sample variances)

Sample means: Developers versus Investors

H_0: developer mean = investor mean

H_a: developer mean is not equal to investor mean

At 5% significance level (ie. two-tailed test),

t-Test: Two-Sample Assuming Equal Variances

	Developer	*Investor*
Mean	53.7058824	49.3888889
Variance	362.698752	391.428105
Observations	34	18
Pooled Variance	372.466732	
Hypothesized Mean Difference	0	
df	50	
t Stat	0.76738214	
P(T<=t) one-tail	0.22323153	
t Critical one-tail	1.67590542	
P(T<=t) two-tail	0.44646306	
t Critical two-tail	2.00855993	

t-stat < t_{crit} (2 tail); therefore null hypothesis cannot be rejected

(this implies no significant difference between means)

Table D.8: Relative importance weight for functional performance: comparision of sample variances and means between Developers and Investors

Sample variances: Developers versus Investors

H_0: developer variance = investor variance

H_a: developer variance is not equal to investor variance

At 5% significance level (ie. 0.025 for two-tailed test),

F-Test Two-Sample for Variances

	Investors	*Developers*
Mean	25.277778	20.705882
Variance	140.68301	84.27451
Observations	18	34
df	17	33
F	1.6693423	
P(F<=f) one-tail	0.1014095	
F Critical one-tail	2.2090276	

F-statistic < F_{crit}; therefore null hypothesis cannot be rejected.
(this implies no significant difference between sample variances)

Sample means: Developers versus Investors

H_0: developer mean = investor mean

H_a: developer mean is not equal to investor mean

At 5% significance level (ie. two-tailed test),

t-Test: Two-Sample Assuming Equal Variances

	Investors	*Developers*
Mean	25.277778	20.705882
Variance	140.68301	84.27451
Observations	18	34
Pooled Variance	103.4534	
Hypothesized Mean Difference	0	
df	50	
t Stat	1.5420482	
P(T<=t) one-tail	0.0646839	
t Critical one-tail	1.6759054	
P(T<=t) two-tail	0.1293677	
t Critical two-tail	2.0085599	

t-stat < t_{crit} (2 tail); therefore null hypothesis cannot be rejected
(this implies no significant difference between means)

Table D.9: Relative importance weight for physical/ structural performance: comparision of sample variances and means between Developers and Investors

Sample variances: Developers versus Investors

H_0: developer variance = investor variance

H_a: developer variance is not equal to investor variance

At 5% significance level (ie. 0.025 for two-tailed test),

F-Test Two-Sample for Variances

	Developers	*Investors*
Mean	14.470588	14.777778
Variance	54.923351	54.535948
Observations	34	18
df	33	17
F	1.0071036	
P(F<=f) one-tail	0.5114573	
F Critical one-tail	2.4805402	

F-statistic < F_{crit}; therefore null hypothesis cannot be rejected.
(this implies no significant difference between sample variances)

Sample means: Developers versus Investors

H_0: developer mean = investor mean

H_a: developer mean is not equal to investor mean

At 5% significance level (ie. two-tailed test),

t-Test: Two-Sample Assuming Equal Variances

	Investors	*Developers*
Mean	14.777778	14.470588
Variance	54.535948	54.923351
Observations	18	34
Pooled Variance	54.791634	
Hypothesized Mean Difference	0	
df	50	
t Stat	0.1423716	
P(T<=t) one-tail	0.4436793	
t Critical one-tail	1.6759054	
P(T<=t) two-tail	0.8873587	
t Critical two-tail	2.0085599	

t-stat < t_{crit} (2 tail); therefore null hypothesis cannot be rejected
(this implies no significant difference between means)

Table D.10: Relative importance weight forenvironmental performance: comparision of sample variances and means between Developers and Investors

Sample variances: Developers versus Investors

H_0: developer variance = investor variance

H_a: developer variance is not equal to investor variance

At 5% significance level (ie. 0.025 for two-tailed test),

F-Test Two-Sample for Variances

	Developers	*Investors*
Mean	11.117647	10.555556
Variance	52.046346	40.379085
Observations	34	18
df	33	17
F	1.2889432	
P(F<=f) one-tail	0.2942443	
F Critical one-tail	2.4805402	

F-statistic < F_{crit}; therefore null hypothesis cannot be rejected.
(this implies no significant difference between sample variances)

Sample means: Developers versus Investors

H_0: developer mean = investor mean

H_a: developer mean is not equal to investor mean

At 5% significance level (ie. two-tailed test),

t-Test: Two-Sample Assuming Equal Variances

	Developers	*Investors*
Mean	11.11764706	10.55555556
Variance	52.04634581	40.37908497
Observations	34	18
Pooled Variance	48.07947712	
Hypothesized Mean Difference	0	
df	50	
t Stat	0.27810013	
P(T<=t) one-tail	0.391041153	
t Critical one-tail	1.675905423	
P(T<=t) two-tail	0.782082306	
t Critical two-tail	2.008559932	

t-stat < t_{crit} (2 tail); therefore null hypothesis cannot be rejected
(this implies no significant difference between means)

APPENDIX E

External that can affect property performance

Table E1: Response distribution for factors that can affect property performance among Developers: Sample A

Factor	Frequency		Total	Relative frequency (%)		Total
	can affect	cannot affect		can affect	cannot affect	(%)
Taxes	16	5	21	76.2	23.8	100.0
Legislation	19	2	21	90.5	9.5	100.0
Planning controls	21	0	21	100.0	0.0	100.0
Changes in locational factors	19	2	21	90.5	9.5	100.0
State of the economy	18	3	21	85.7	14.3	100.0
Shifts in work practices	13	8	21	61.9	38.1	100.0
Demographic changes	10	11	21	47.6	52.4	100.0
Urban decay	11	10	21	52.4	47.6	100.0
Changes in Government policy	15	6	21	71.4	28.6	100.0
Changes in user requirements	18	3	21	85.7	14.3	100.0
Competition from newer and modernised buildings	13	8	21	61.9	38.1	100.0
Changes in social tastes and standards	10	11	21	47.6	52.4	100.0
Financial and fiscal incentives	12	9	21	57.1	42.9	100.0
The cost of capital	15	6	21	71.4	28.6	100.0

Table E2: Response distribution for factors that can affect property performance among Developers: Sample B

Factor	Frequency		Total	Relative frequency (%)		Total (%)
	can affect	cannot affect		can affect	cannot affect	
Taxes	11	2	13	84.6	15.4	100.0
Legislation	13	0	13	100.0	0.0	100.0
Planning controls	12	1	13	92.3	7.7	100.0
Changes in locational factors	13	0	13	100.0	0.0	100.0
State of the economy	12	1	13	92.3	7.7	100.0
Shifts in work practices	10	3	13	76.9	23.1	100.0
Demographic changes	8	5	13	61.5	38.5	100.0
Urban decay	9	4	13	69.2	30.8	100.0
Changes in Government policy	11	2	13	84.6	15.4	100.0
Changes in user requirements	13	0	13	100.0	0.0	100.0
Competition from newer and modernised buildings	10	3	13	76.9	23.1	100.0
Changes in social tastes and standards	7	6	13	53.8	46.2	100.0
Financial and fiscal incentives	10	3	13	76.9	23.1	100.0
The cost of capital	11	2	13	84.6	15.4	100.0

Table E.3: Factors that affect property performance (% of Developers who think they coulc

Factor	Sample A	Sample B	Adjusted for probablity
Taxes	76.2	84.6	78.4
Legislation	90.5	100	92.9
Planning controls	100	92.3	98.0
Changes in locational factors	90.5	100	92.9
State of the economy	85.7	92.3	87.4
Shifts in work practices	61.9	76.9	65.8
Demographic changes	47.6	61.5	51.2
Urban decay	52.4	69.2	56.7
Changes in government policy	71.4	84.6	74.8
Changes in user requirements	85.7	100	89.4
Competition from newer and modernised buildings	61.9	76.9	65.8
Changes in social tastes and standards	47.6	53.8	49.2
Financial and fiscal incentives	57.1	76.9	62.2
Cost of capital	71.4	84.6	74.8

Table E.4: Response distribution for factors that can affect property performance among Investors: Sample A

Factor	Frequency		Total	Relative frequency (%)		Total (%)
	can affect	cannot affect		can affect	cannot affect	
Taxes	8	1	9	88.9	11.1	100.0
Legislation	9	0	9	100.0	0.0	100.0
Planning controls	9	0	9	100.0	0.0	100.0
Changes in locational factors	9	0	9	100.0	0.0	100.0
State of the economy	8	1	9	88.9	11.1	100.0
Shifts in work practices	7	2	9	77.8	22.2	100.0
Demographic changes	6	3	9	66.7	33.3	100.0
Urban decay	6	3	9	66.7	33.3	100.0
Changes in Government policy	9	0	9	100.0	0.0	100.0
Changes in user requirements	9	0	9	100.0	0.0	100.0
Competition from newer and modernised buildings	9	0	9	100.0	0.0	100.0
Changes in social tastes and standards	7	2	9	77.8	22.2	100.0
Financial and fiscal incentives	6	3	9	66.7	33.3	100.0
The cost of capital	7	2	9	77.8	22.2	100.0

Table E.5: Response distribution for factors that can affect property performance among Investors: Sample B

Factor	Frequency		Total	Relative frequency (%)		Total (%)
	can affect	cannot affect		can affect	cannot affect	
Taxes	9	0	9	100.0	0.0	100.0
Legislation	9	0	9	100.0	0.0	100.0
Planning controls	9	0	9	100.0	0.0	100.0
Changes in locational factors	9	0	9	100.0	0.0	100.0
State of the economy	9	0	9	100.0	0.0	100.0
Shifts in work practices	6	3	9	66.7	33.3	100.0
Demographic changes	6	3	9	66.7	33.3	100.0
Urban decay	9	0	9	100.0	0.0	100.0
Changes in Government policy	9	0	9	100.0	0.0	100.0
Changes in user requirements	9	0	9	100.0	0.0	100.0
Competition from newer and modernised buildings	7	2	9	77.8	22.2	100.0
Changes in social tastes and standards	5	4	9	55.6	44.4	100.0
Financial and fiscal incentives	8	1	9	88.9	11.1	100.0
The cost of capital	9	0	9	100.0	0.0	100.0