BALANCING FINANCIAL AND STRATEGIC ASPECTS OF REAL PROPERTY PORTFOLIO MANAGEMENT

by

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Abstract

Real property portfolio management (RPPM) can contribute to the effective management of corporate real estate which is owned by firms not principally involved in real estate investment. Unlike commercial real estate management, which is entirely profit-centered, the primary focus of RPPM is the relationship between financial issues and corporate strategic needs. Accordingly, this thesis proposes a management system which maintains a clear picture of ~~corporate~~ the total corporate real estate portfolio structure and which balances financial and strategic aspects of RPPM.

This thesis has five chapters. Chapter 1 states the objectives of the thesis. Chapter 2 provides an overview of the total RPPM process in order to clarify the relationship between its financial, strategic, and organizational management aspects. Chapter 3 reviews the practical application of financial portfolio theory to RPPM. It is shown that while financial portfolio theory is not directly applicable to RPPM, the portfolio management concept provides a basis for quantitative approach to RPPM. The benefits of diversification in form of ownership are also discussed. Chapter 4 proposes a methodology for both quantitative and qualitative evaluation of strategic aspect of corporate real estate in relation to its financial aspect, and for structuring of the corporate real estate portfolio. Emphasis is placed on use value as the most characteristic value for corporate real estate. The option pricing model is proposed as the best method for quantitative determination of use value. Chapter 5 reviews key discussions and major findings, and recommends themes and topics for future research.

Thesis Supervisor: Dr. Ranko Bon
Thesis Reader: Dr. Fred Moavenzadeh
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Chapter 1 Introduction

Between 4 and 7 billion square feet of building space are
owned by corporate America. Most of these corporations are
not primarily real estate investors, and they deal in real
estate in order to provide a space for their principal
activities. The typical corporation owns properties worth
about 25% of its assets and even some corporations believe
that the actual fair market value of their holdings are
several times greater than the booked asset value of the
entire corporation (Zeckhauser and Silverman,1981, 2).
However, such a huge amount of corporate real estate is
severely undermanaged according to three recent American and
European surveys (Zeckhauser and Silverman 1981; Veale 1989;
and Avis, et al. 1989). It is reasonable to conclude, based
on these facts, that corporate real estate management is
badly in need of improvement, and further that improvements
in this area would significantly benefit corporate management
as a whole. Therefore, corporate real estate management, or,
in more specific terminology "real property portfolio
management" (RPPM)[1], has become an area of intensive research
in recent years (see Bon 1987 and 1990, Veale 1988).

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[1] Several terminologies are used to describe this process (see Bon 1990,
note 1). While the term "RPPM" is used to emphasize "portfolio"
considerations and the operational aspect of management, the term
"corporate real estate management" is also used throughout to describe
the full range of activities involved in RPPM.

The specific purpose of this thesis is to propose a systematic RPPM process focused on balancing its financial and strategic aspects, the two key management aspects of RPPM. The main part of the thesis concentrates on two major issues; first, the application of proven financial theories as a standard means of financial side corporate property management; and second, the systematic and on-going assessment of corporate real estate portfolio structure in relation to the strategic value of corporate properties.

A primary reason for the inefficient management of corporate real estate is that properties are not accumulated for investment purposes but mainly for operational or strategic reasons. Therefore, the prevailing management attitude toward corporate real estate tends to be cost-centered rather than profit-centered. On the other hand, commercial real estate management is clearly profit-centered; it entails careful monitoring of detailed physical and financial data in order to accurately evaluate a property's performance and to ensure a profit.[1]

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[1] It should be remarked that this distinction between cost-centered and profit-centered accounting processes is not the main reason for undermanagement of corporate real estate, according to Veale, (1988 13-14). Corporations which do not have separate accounting for real estate, in other words, those is not conscious of real estate performance, tend to undermanage their properties. The point I emphasize here is that, on the basis of recognition of the potential profitability of corporate real estate, the profit-centered attitude is more helpful to induce careful control of RPPM.

Because corporate real estate is acquired mainly for the
purpose of operating the main business of the corporation, it
tends to be viewed only as an unavoidable expense. This
cost-centered concept of corporate real estate management is
especially prevalent among new and developing firms, but, too
often, this viewpoint continues to be held by firms after
they have become well established and have accumulated an
extensive real estate portfolio. Clearly then, the efficient
management of corporate property is not given adequate
attention by new and established firms alike.

In addition, corporate real estate management is not in the
main stream of corporate activities in terms of basic
operation, human resource allocation, budget allocation, and
so on. In fact, if a firm's activities are categorized into
"line" or center of profit-making activities and "staff" or
supporting activities, corporate real estate management is
usually included in the staff category. However, once a
firm's properties become a significant asset, this rather
general organizational structure becomes an obstacle to the
development of an effective management system.

Finally, and most importantly, for a number of reasons,
systematic procedures are difficult to develop in corporate
real estate management; and consequently, no consistent
methodology has been developed to date. The difficulty of
establishing a management methodology is largely due to the

fact that there is no one, dominant factor which controls the decision-making process in this area. In the case of commercial real estate management, where efforts are directed to producing profits, management decisions--such as risk-return analysis--are the common focus of concern. On the other hand, a comprehensive management system for corporate real estate has to include many related categories such as corporate strategy, financial management, organizational structuring, human resource management, and so on. It is therefore essential that corporate real estate managers have a clear picture of the relationship between the several factors affecting the value of corporate real estate. At the same time, acquiring this overview is not an easy task and is often done poorly, if at all.

In practice, firms usually start to recognize the importance of corporate real estate management when business conditions force them to reduce costs and modify resource allocation. In extreme cases, a firm will recognize the value of its own real estate only at the point when the need to generate cash requires liquidation of assets. At this point, the firm finally recognizes its accumulated real estate assets and begins to consider its effective management. However, when interest in corporate real estate management begins only at the point of crisis, decision-making which is likely to affect the firm's survival will be impaired by inadequate or incorrect data. Clearly then, it is in a firm's best

interest to maintain an accurate assessment of the value of

its corporate property as well as to monitor and control how

this value is affected by other areas of corporate activity.

One major program goal of this two-phase management system is

the use of quantitative analysis to maximize both the

utilization of and the profit earned from a firm's real

properties. Both the application of financial theories and

systematic portfolio evaluation will require that all

decisions made regarding acquisition, disposition, and

conversion of a single property take the firm's entire

property portfolio into account. Consequently, the success

of this kind of portfolio approach to decision-making depends

upon the maintenance of accurate financial data pertaining to

all existing properties. Using this approach will therefore

assure that quantitative analysis will provide the basis for

the efficient management of corporate real estate, as it does

for all other corporate functions, thus assuring a consistent

and profitable management system.

Another financial theory which can be implemented in

conjunction with portfolio theory is the option pricing

model.   The real estate decision-making process can be

modeled in terms of contingent claims; therefore,

theoretically, the option pricing model has the capability of

evaluating the contingencies of different scenarios within a

specific time frame and could be useful in determining the

potential value of properties, especially when the timing of a decision is crucial. Furthermore, one of the major reasons that a corporation acquires the properties is to have flexibility for their modification should the need arise in the future. This potential value is referred to as a component of the use value of the property. Use value is difficult to evaluate by the conventional discount cash flow method. The option pricing model on the other hand provides the best means of evaluating this type of flexibility and can be implemented in conjunction with portfolio methodology.

However, a note of caution should be raised here. It is important to bear in mind that financial theories, like portfolio theory and the option pricing model, are investment tools and that corporate real estate is primarily a non-investment activity. Therefore, any attempt to apply these theories to corporate real estate portfolio management must from the beginning be a selective and carefully controlled process. Specifically, it is crucial to the success of the application to determine the precise problem which is being addressed, which aspect of the theory is applicable, and what the limits of its application are. Therefore, the first issue I will focus on in this thesis is the determination of the specific problem which the application of financial theory is intended to solve.

The second point which I will focus on is how to simplify the representation of a corporate real estate portfolio and maintain a clear picture of its structure. As mentioned before, corporate real estate management is affected by several other areas of corporate activity. Therefore, corporate real estate decisions must take into account each corporation's specific needs, policies, developmental stage, as well as other factors. For example, the product cycle of a specific business is closely related to the strategic importance of corporate properties; therefore, building life cycle should be considered in relation to product cycle of the corporate business. The first task in developing a management system is to understand the structure of the portfolio and its relationship to other parts of the corporate picture, such as strategic and financial issues.

When we review the process of accumulation of the corporate real estate portfolio, it is clear that real estate is acquired for purely business purposes in the early stages of corporate growth. Until the corporation has reached a certain level, corporate real estate performs only a supporting function. However, as the company develops, the function of corporate real estate changes and its importance as a corporate asset is established. At this point, the real estate portfolio becomes important in its own right, and its proper management starts to depend upon an effective means of

assessing its precise value in relation to other corporate
assets and corporate goals

The key factor for structuring the corporate real estate
portfolio is corporate strategy. The corporation's original
motivation for acquiring property is always based on
strategic or business needs. On the other hand, the main
incentive to initiate corporate real estate management is
usually based on the profit motive. Therefore, this conflict
is a key characteristic of corporate real estate management.
When the corporation decides to liquidate its real estate,
its value is determined just as value is determined in
commercial real estate. Understandably, buyers are not
concerned with a property's strategic importance. Therefore,
the corporation must maintain separate assessments of the
financial and the strategic value of its real estate.

And finally, the appropriate structure of the real estate
portfolio will become clear and its utilization and profit-
potential will be maximized when a system is developed which
clearly shows the all-important relationship between a
property's financial and strategic values. Therefore, the
key to establishing a successful RPPM methodology is finding
a way to effectively balance the financial and strategic
aspects of corporate real estate. The principal intention of
this thesis is to emphasize the importance of this balanced
approach to RPPM.

This thesis proceeds with following four chapters. Chapter 2 provides an overview of the total concept and process of RPPM. Objectives of RPPM are clarified and distinctions are made between long-term and shot-term goals. The general activities areas of RPPM are explained in order to make the relationship between financial and strategic issues clear. Organizational considerations for both the relationship between the RPPM division and other management divisions and the formation of the RPPM division itself are also discussed. Finally, several key RPPM activities are discussed in detail.

Chapter 3 investigates the application of financial portfolio theories to real estate portfolio in order to identify effective financial management tools for RPPM. Three main topics are discussed: (1) the portfolio theory which is most applicable to real estate portfolio management; (2) the diversification categories which are most appropriate within the real estate portfolio, and (3) the problems and constraints inherent in the application of financial portfolio theories to the domain of RPPM.

Chapter 4 focuses on the strategic aspects of RPPM. In order to assess the strategic value of corporate real estate, a method for determining the structure of corporate real estate portfolio is proposed, emphasizing the following issues: (1) determination of corporate development stage; (2)

determination of strategic value of corporate properties; (3)
determination of other key values, such as use value of
corporate properties; and (4) systematic option selection for
alternative use.

Chapter 5 summarizes the key discussions and main findings of
the thesis and concludes with recommendations for future
research in RPPM.

Chapter 2 Overview of Real Property Portfolio Management Procedures

This chapter describes the overall framework of real property portfolio management (RPPM) along with its key management issues. RPPM is a relatively new concept and consists of several related aspects which can be explained as follows: (1) objectives; (2) general framework; (3) organizational considerations; and (4) key activities.

2-1 Main objectives of real property portfolio management

The emergent needs of RPPM are suggested by several recent surveys (Zeckhauser and Silverman 1981; Veale. 1989; and Avis, et al. 1989) all of which indicate that real estate owned by a corporation which is not in the real estate development business is recognized as part of the operational costs and that the prevailing attitude toward real estate management is quite reactive, i.e., management takes action after problems develop or when a counter measure is inevitably required. Naturally, under these circumstances the actions taken tend to be last-minute, stop-gap efforts and are therefore ineffective. Veale (1989,15) claims that the effectiveness of corporate real estate management depends on the attitude of top management, and corporations controlled by a top management which believes in the value and importance of real estate performance within the organization are likely to manage their real estate

effectively. This implies that the reactive management
attitude stems from a lack of recognition of the value of
corporate real estate. Therefore, a fundamental objective of
RPPM is to identify the importance of corporate real estate,
and consequently, to change management activity from passive
to active. An active management attitude naturally
encourages the long-term perspective of corporate real estate
management, and the close coordination of daily RPPM
activities with the top level of management. This change
would allow the corporation to capitalize on opportunities
which could create more effective resource allocation and
result in more profitable operation of the corporation. The
urgent need is to devise a systematic management process
which can be applied to a diverse array of corporate
settings.

With this kind of general background, RPPM can realize its
important long-term objectives, which are to maximize
utilization of the corporate real estate portfolio and to
provide a decision-support system which can offer necessary
and sufficient information to high level decision makers.
But in order to achieve these objectives, several
intermediate goals have to be reached. Three of these key
short-term RPPM goals are described below.

- Establishing a space accounting system and determining
  which data should be maintained on a constant basis.

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The first step of RPPM is to collect the information
pertaining to each property in the portfolio and to determine
which indicators best describe the performance of the
portfolio. This requires constant monitoring of the data in
the real property portfolio. Because the amount of data
required is so vast,.haphazard data collection could be
labor-intensive and costly. Therefore, it is quite important
to first specify which data are potentially important for
RPPM.

In terms of financial control, all corporations maintain cash
flow data, and their systems are well-developed and well-
regulated. In this main business accounting system, the real
property of the corporation is usually reported as non-
current assets, and merely its book value appears on the
accounting record. However, RPPM intends to establish a more
detailed data tracking system related to real property.[1]   A
few such space accounting systems are already developed for
this purpose. One good example is INSITE (Institutional
Space Inventory Technique) developed by the Office of
Facilities Management Systems of M.I.T. This data base
system is operated on a mainframe computer and is capable of
handling all M.I.T. properties, which consist of 135

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[1]The terminology "space accounting" does not imply the recording of only
  monetary value as in conventional accounting, but rather the recording
  of physical performance data such as area of space, completion date,
  history of renovation, energy conservation, and more qualitative data
  including condition of properties, furniture, and so on.

buildings, 27,000 rooms, and 264,000 pieces of furniture and equipment. This system is also used by about thirty outside organizations, including several universities and corporations, and provides statistical information for top levels of management. Although the system itself is well-organized and advanced, as pertains to M.I.T., INSITE does not maintain detailed cost data which is allocated to a specific building or space. Such detailed cost data is in many cases key information for evaluating building performance in both RPPM and the decision-making process. The reason M.I.T. does not maintain cost data is that the top management of M.I.T. decided to ignore cost data at the initial stage of INSITE operations because it was decided that the time and cost for data collection would be excessive. Top management, not a real property manager, was responsible for this decision.[1]

Even though the requirements and needs of RPPM have subtle differences between different corporations, there is a need for some common data which are essential to all corporations. The final selection of the data might depend on each

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[1]While this initial decision is quite influential on the total management perspective, it is not my intention to imply that M.I.T.'s INSITE is ineffective. Although this decision has limited the potential capability of the data base system, it is accepted by the top management and INSITE works well in this context. What I emphasize here is that the initial decision and planning of the framework of RPPM is crucial to the final outcome; therefore it is important to have a clear picture of the total management system and corporate requirements for RPPM.

corporation's management style, but from the outset RPPM

framework should be designed to review all relative

information and its importance. In short, in order to

accurately determine which data are needed, corporate goals

must be clearly understood and the RPPM framework should be

designed to meet them.

• Selecting tools to construct a decision support system

Weak management attitude is also related to lack of reliable

decision-making methodology for corporate real estate

management. According to a 1987 M.I.T.survey, the

uncertainty of corporate real estate management and lack of

management methodology are closely correlated (see Table 2-

1).

Table 2-1 Uncertainty vs. Availability of Information
(Veale, 1989, 18)

	"I do not have sufficient information or methodology to clearly evaluate the physical performance or use effectiveness of my buildings"		
"Uncertainty and unpredictability of future real estate markets, economic conditions, and organizational space needs greatly reduces my capacity to effect optimal real estate solutions."		Agree	Disagree
	Agree	66%	22%
	Disagree	33%	78%

Therefore, development of a decision support system--as a methodology for corporate real estate management--should be emphasized in order to achieve effective management of corporate real estate.

The final decision-support system does not consist of simple calculations but rather a combination of data from several interrelated sources. It is necessary to develop a method of converting raw data into concise indicators which can evaluate real property performance effectively. This method may come from several related areas of RPPM and might be made up of both quantitative and qualitative analytic tools. Quantitative analysis is most likely to come from financial statistical data analysis. Qualitative analysis may be derived from the strategic and organizational areas. Each analytic tool generates several different indicators and the relation between these indicators must be clearly defined.

• <u>Establishing an efficient information exchange method between top management and the real property portfolio manager</u>

While the short-term objectives of RPPM focus on the problems of corporate real estate management, it is also important to use care in forming an organization which can carry out the mission efficiently. This organizational issue is also pointed out by the three surveys cited earlier (Zeckhauser and Silverman 1981; Veale. 1989; and Avis, et al. 1989).

Because the original purpose of corporate real estate is to provide necessary services for the corporate business, it is not likely to be the main business concern of the corporation. As mentioned earlier, this is a main reason for the undermanagement of corporate real estate, and it results in a weak organizational structure. Consequently, real estate management is often excluded from the decision-making process by top management even though it often has the most up-to-date information. Because real estate management is considered as a low ranking section in a corporation, there is a huge gap between top management and the real estate management division in terms of information exchange and decision control. If the top management does not recognize the importance of RPPM and the division which carries out RPPM, the practical application of RPPM will be in jeopardy. On the other hand, if RPPM can proceed under the initiative of the top management, the activities of the RPPM division will be readily supported by the other internal corporate divisions. In short, this organizational issue is critically important at the execution stage of RPPM.

(A detailed discussion about organizational formation of the RPPM appears in section 2-3).

2-2 Activity area of RPPM

The RPPM activities area is divided into three major components as follows; (1) physical management, (2) financial management, and (3) organizational use. This categorization

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is based on "Real Property Portfolio Management" prepared by

Bon, et al. in 1987.

Table 2-2 Activities of RPPM

Activity category	*Physical management*	*Financial management*	*Organizational use*
Major activities	Maintenance Energy/Control Repair/Replacement	Acquisition Value assessment Cost control Tax/Depreciation Cash flow control Capital budgeting Lease contract	Planning/Design Inventory control Furnishing
General observed data	Specification of properties Condition of properties Completion date Date of works	Costs (Initial construction/ maintenance/repair/ replacement/ conversion/others) Values (market/book/ insurance/ replacement) Time schedule (lease structure/ taxation Income stream Budget allocation External econmic condition	Satisfactory level of workers Space requirement for operation Strategic importance

Source: M.I.T. 1987 "Real Property Portfolio Management" p7

2-2-1 Physical management

Physical management mainly consists of conventional

facilities management work, i.e., daily property management.

It can be also defined as the operational management of the

property. In this area, unlike conventional facilities
management, the RPPM division helps to support and implement
the project feasibility study as well as the design,
construction, operation, maintenance, repair, renovation and
termination of the project based on the data which can be
collected through daily operation of the properties. Data
which is collected through this activity mainly consists of
the physical specifications of the properties.

2-2-2 Financial management

Financial management has close links with corporate financial
management. At the primary stage of RPPM, when its function
is not yet clearly established, financial information on
corporate real estate is dispersed throughout corporate
financial activities. As a result, even some important
information such as the market value of the property is often
completely ignored. The financial management function in
RPPM assumes the role of collecting all these data and
evaluating the financial performance of the properties. In
this way, RPPM functions as the interface between corporate
real estate management and corporate financial management.

Corporate real estate financial data can be categorized as
follows: (1) cost, (2) income from operation, (3) value, (4)
time structure, (5) corporate financial information, and (6)
external economic conditions. These data are basic

information for the financial analysis of corporate real estate.

2-2-3 Organizational use

Organizational use covers the relationship between a property's performance and the "human factor." Because the characteristics of properties affect productivity and worker morale, the quality of the work area is an important issue. The main organizational use function is to adjust the corporate needs of the property to property specifications. It is responsible for integration of the user's needs into the property's performance.

Much of the data in this category is closely related to the "human factor" and therefore highly qualitative For example, employee satisfaction with the working environment is a subjective issue. Although statistical data analysis techniques are helpful in assessing data quantitatively, the direct relationship between the physical specifications of properties and the human reaction to them is not an easy task.

The strategic importance of properties used for the corporate business is another key information area related to organizational use, and is a distinctive characteristic of corporate real estate.

2-3 Organizational considerations

One of three short-term objectives of RPPM, establishing an efficient information exchange method between top management and the real property manager is the key aspect at the execution stage of the RPPM. In order to achieve this objective, the organizational position of a division which executes RPPM--the RPPM division--within a corporation should be carefully considered, along with formation of the RPPM division itself.

2-3-1 Position of the RPPM division in a corporation

There are three key organizational issues concerning the RPPM division. The first point is to secure periodic meetings for the exchange of important information between top management and the RPPM division. Corporate real estate comprises a major corporate asset; therefore, actions related to the disposition or conversion of real estate are always under the control of top management. In order to support top management's decision-making with vital information derived from RPPM analyses, comprehensive data for top management should be prepared by the RPPM division.

Secondly, mutual communication between the RPPM division and other management divisions is essential. A large portion of data which are necessary for the analysis done by the RPPM division are sometimes collected from other management divisions. For example, property book values, tax and

depreciation data, and cash flow generated by real estate are
usually kept by the financial management division. Future
corporate strategy which is planned by the strategic
management division is also important information for RPPM.
And the needs of current and future users of the business
space are estimated by the organizational management
division. All of this information is basic data for planning
the acquisition and disposition of corporate properties. It
is therefore quite evident that smooth communication between
these management divisions is important for the collection of
internal data.

Finally, the RPPM division should have primary control of
real estate management transactions. If, for example, the
financial management division controls the financial issues
of real estate, and if other divisions have the same control
over other specific functions that relate to real estate, the
RPPM division will become ineffectual; therefore, in the
management of corporate real estate, other divisions should
assume supporting roles vis-a-vis the RPPM division, and the
RPPM division should assume the primary responsibility of
supporting final decisions made by top management regarding
properties.

The position of the RPPM division and inter-division
information exchange flow is shown in Figure 2-3. If each of
these key organizational procedures are carried out, the

directing of all needed information to the RPPM division will
be assured and the position of the RPPM division within the
corporate structure will be firmly established.
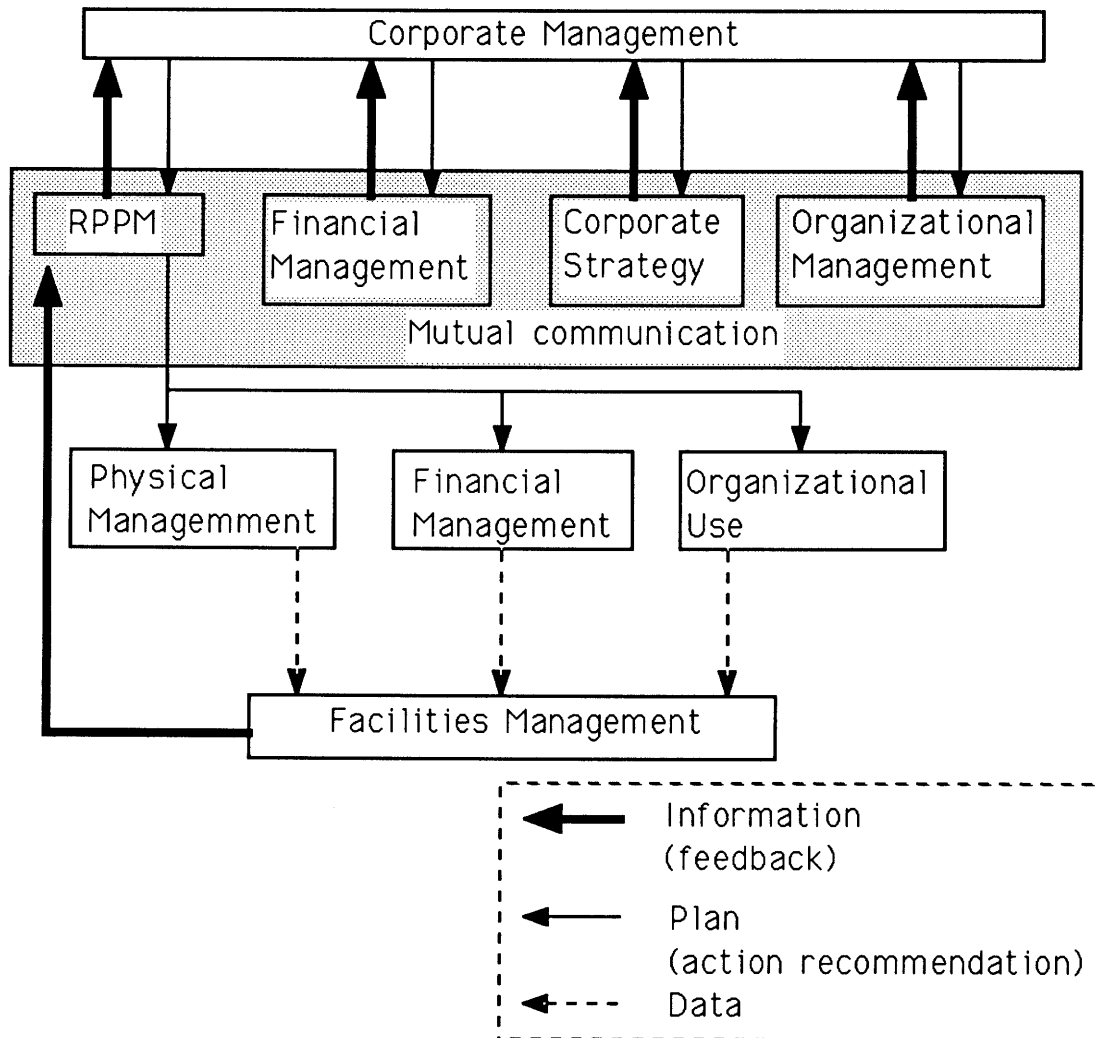

Figure 2-3 Relationship between the RPPM division
and other management divisions

2-3-2 Formation of the RPPM division

In order to form an effective RPPM division, the organization
of the division itself needs careful attention. In

particular, the initial division formation has great impact
on the effectiveness of RPPM within the corporation.

The three divisions which are potential choices for forming
the core of the RPPM division are: 1) facilities management;
2) asset or financial management; and 3) entrepreneurial real
estate management (based on Silverman, 1987, 18-19).

1) Facilities management

One possibility is that facilities management become the core
of the RPPM division. Every corporation which has a fairly
large real estate portfolio must have an effective facilities
management division. This division has the closest
relationship to the management of properties and to their
condition and performance. Because it is directly related to
the physical management of RPPM, it occupies the best
position for collecting physical data on the properties.
Also, the facilities management division will have experience
in project management which is one aspect of RPPM. In fact,
facilities management is the most common choice for the core
of the RPPM division.

However, the main problem which occurs when the RPPM division
is formed around the facilities management division is that
of poor communication with top management. Because the
facilities management division is directly involved in daily
property maintenance and control of the properties, it is

usually considered a low or middle level of management, and consequently it does not draw the attention of top management. If the RPPM division fails to get the recognition of top management because of the low recognition accorded to facilities management, this will adversely affect the status of the RPPM division. Therefore, if the RPPM division is based in the facilities management division, the channel of information exchange with the top management should be carefully established.

2) <u>Asset or financial management</u>

The asset management or financial management division are both closer to the financial management of RPPM than facilities management. Although these divisions are not directly connected to corporate real estate management, they have the advantage, because of their position in the corporate structure, to communicate more easily with top management. Another advantage of these divisions is that they have a wider perspective on economic conditions and market trends. An ideal formation for the RPPM division would be based upon a cooperative action of the asset management or financial management division and the facilities management division.

3) <u>Entrepreneurial real estate management</u>

This formation is very similar to the profit-based formation of commercial real estate management. It is of course

suitable for a real estate development project which is
clearly interested in profit-making. A purely profit-
centered management attitude will have the advantage of
gaining recognition for corporate real estate management and
of creating effective management methods. But if the profit-
making inclination is over-emphasized, the friction between
profit-maximization and strategic use of the property will
necessarily detract from efficient operation of the business.

2-4 Key activities of RPPM

While every RPPM activity should be carefully designed, there
are crucial activities which require specific attention.
These key activities of RPPM are the following: 1) data
analysis in the context of corporate management; 2)
development of an active management approach; and 3)
emphasis on portfolio approach.

1) Data analysis in the context of corporate management

While the main purpose of RPPM is to maximize the utilization
of the corporate property, it should be emphasized that this
is not a simple task. Maximization does not necessarily mean
maximum return from the corporate real estate itself. On the
contrary, pure maximization of profits from the corporate
real estate operation sometimes conflicts with the main
business of the corporation. Therefore, the RPPM division
has to manage two contradictory purposes. One is to provide
strategic services to the corporation in the form of the

allocation of required space. The other is profit-making
from the corporate real estate operation itself. As cited
earlier, presently corporate real estate management is
severely biased in favor of service, and, as a result,
profit-making and managerial efficiency are ignored. When
fully developed, RPPM should reflect an effective balance
between service and profit motives.

To establish this balance in the RPPM operation, the RPPM
division should always pay attention to both financial
information and the strategic needs or users' needs of
corporate real estate. It is relatively easy to collect
financial side information because most of the information
can be described quantitatively. On the other hand,
strategic and users' needs are hard to analyze objectively.
Therefore, decisions regarding strategic needs should always
be made at the highest management level and only on the basis
of detailed, comprehensive data provided by the RPPM
division. The gathering of this data will be facilitated by
the active information exchange between the RPPM division and
top management and the other management divisions.
Furthermore, because the financial side and strategic side
often do not seek the same solution to a problem, the RPPM
division should keep a neutral position between top
management concerns and a specific user's needs.

2) Developing an active management approach

The long-term planning of building operation management and
the portfolio structure, both of which are characteristic of
RPPM, represent a major departure from the daily methods of
operation used by standard facilities management. For
example, the RPPM division performs daily operations under
the total plan of corporate real estate management and the
forecasts of future corporate requirements. This enables the
RPPM division to take optimal action at the best possible
time. For example, physical management is in charge of
decisions regarding the timing of the replacement of building
components. The general relationship between time and cost
of maintenance and replacement is shown below (Figure 2-4
based on Bon, 1988, 150).
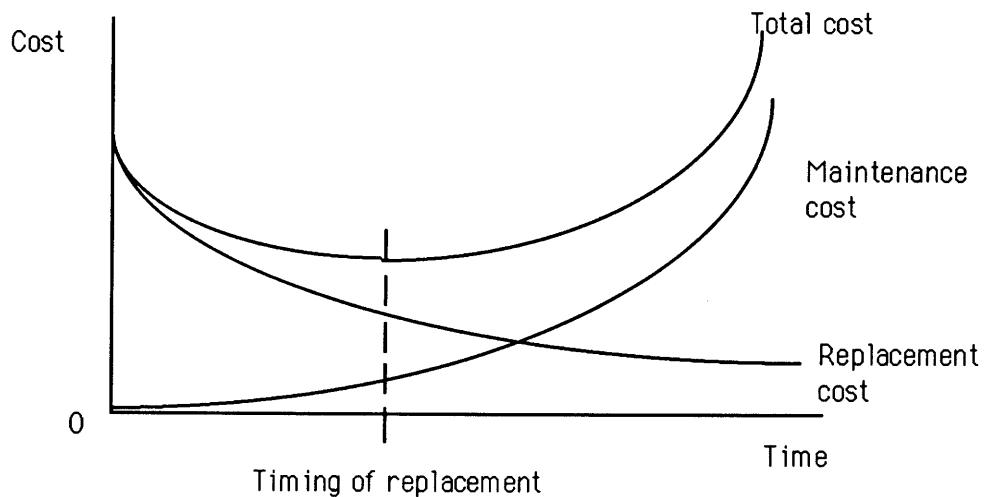
Figure 2-4 Optimal timing of replacement

As the figure shows, there is an optimal point for
replacement in terms of cost. A similar analysis can be done
for organizational use when, for example, the corporation

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desires to increase productivity by improving the quality of
the work environment while still keeping within budgetary
constraints. This relationship is shown in Figure 2-5.
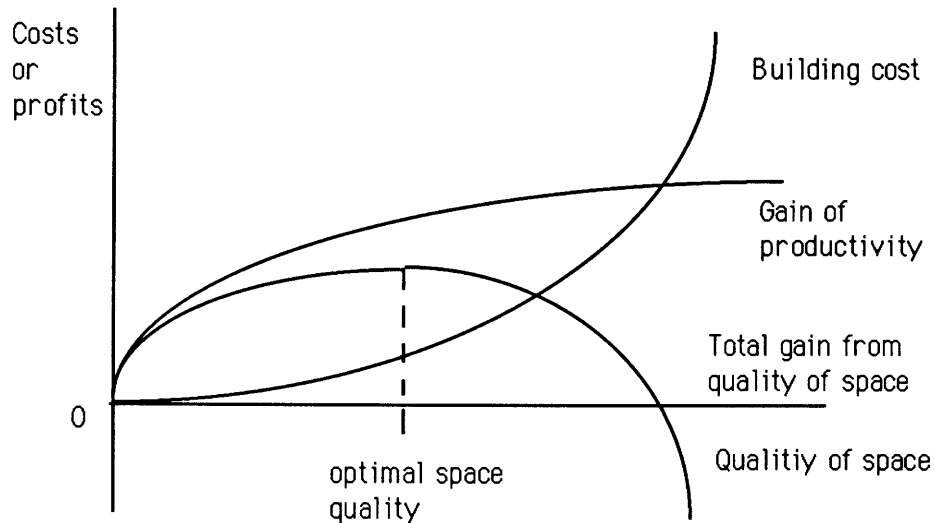
Figure 2-5 Optimal space quality

Just as there must be an equilibrium between productivity and
quality in terms of the difference between costs and profits,
there must also be similar relationship between productivity
and the flexibility of space, and between productivity and
office automation. In order to determine the optimal time
and conditions for these relationships, the RPPM division
must carry out two stages of activity. One is the assessment
stage and the other is action recommendation stage. In
assessment stage, the RPPM division collects and analyzes
existing data in order to understand what is happening to a
property based on trends shown in the data. The assessment
stage is the first stage of the RPPM division activities, and

data collected in assessment stage creates a solid foundation for decision-making on the basis of statistical analysis.

After the RPPM division has accumulated sufficient data through the assessment stage, the action recommendation stage follows. Based on the collected data, the action recommendation stage tries to forecast what is most likely to happen in the near future and to suggest what is the best action for the corporation in light of this forecast.

3) Emphasis on portfolio approach

The property-by-property approach tends to be a myopic, do-it-now reaction, and its time horizon is very short. Consequently, portfolio-based considerations are strongly emphasized in RPPM for the following reasons.

- Portfolio considerations allow statistical analysis of building performance and provide indications of future trends. Under this system, the management attitude becomes "Prevention is better than cure."
- In the portfolio context, actions taken on each property are considered on the basis of the total benefit of the portfolio. The portfolio approach thus produces a "smoothing" factor and a hedge for unexpected risk.[1]

  For example, Figure 2-4 and Figure 2-5 illustrate

[1]The term "smoothing" means that peculiarities affected by specific components of the portfolio disappear because the different characteristics of each portfolio component cancel each other out.

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individual equipment and space considerations. But we
can apply the same concept to the relationship between
aggregate costs and aggregate space or equipment for a
whole portfolio. In this case, the specific
characteristics of each piece of equipment or space
becomes less significant, and the result reflects
characteristics of the total portfolio (This concept is
described in detail in Bon, 1988,149-159 as the
replacement simulation model).

As mentioned earlier, the basic concept of portfolio
consideration is diversification; therefore, as the amount of
corporate real estate increases, portfolio consideration
becomes more appropriate and in fact essential. Moreover, In
a large corporate real estate portfolio, each property's
specific characteristics become less significant or cancel
each other out. As a result, the accuracy of predictions of
future trends will automatically increase and systematic
management procedures will be more easy to implement.

Finally, if the portfolio can be constructed on a selective
basis so as to control the incidence of diversify to a
reasonable extent, then the overall efficiency of the
management of the portfolio will necessarily increase.

2-5 Conclusions

This chapter, has briefly explained the framework of RPPM. While the long-term RPPM objective is to maximize utilization of corporate properties, its short-term objectives are follows: 1) establishing a building account system; 2) selecting tools for a decision support system; and 3) establishing an information exchange process between the RPPM division and top management. None of these objectives can be accomplished without careful monitoring and accumulation of data on operational activities. Constant efforts to accumulate data related to corporate real estate are a key for successful RPPM.
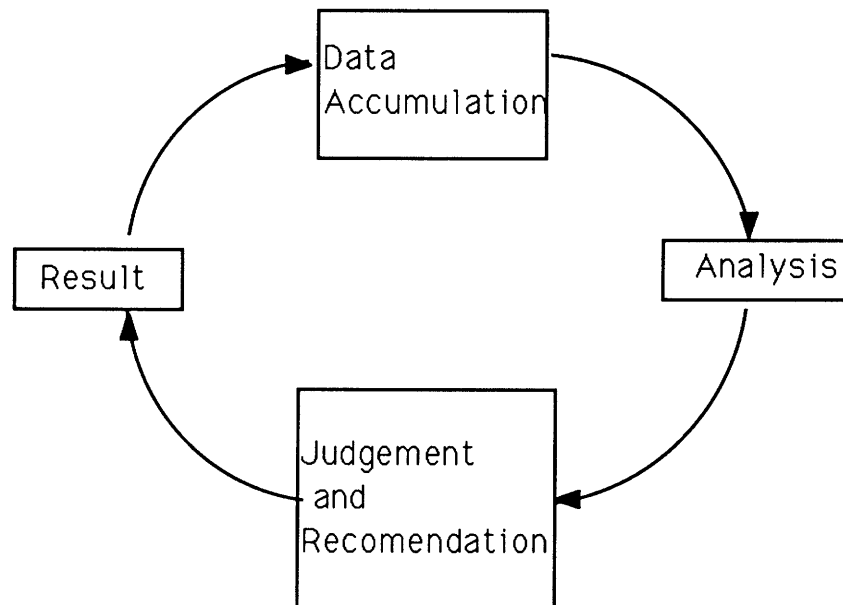
Figure 2-6 Feedback loop of RPPM

The organizational formation of RPPM division is also important in the execution of RPPM. The cycle which consists

of data accumulation, analysis, preparation of comprehensive information for top management, and feedback for subsequent actions is the fundamental activity loop of RPPM.

The key issue of RPPM is how to solve conflicts between the profit-maximization and strategic importance of corporate real estate. In the following chapters, these two aspects of corporate real estate are discussed in detail.

Chapter 3 Applications of financial portfolio theories

3-1 Introduction

This chapter discusses the financial aspect of RPPM through commercial real estate management procedures, focussing specifically on portfolio considerations. Although the financial management of corporate real estate is closely related to the financial management of commercial real estate, the objectives of commercial real estate management are much simpler than those of corporate real estate. In short, financial management is the dominant factor in commercial real estate management; it emphasizes profit-maximization through efficient operations and transactions. Therefore, in order to better understand the financial management of corporate real estate, it is important to review basic elements of commercial real estate portfolio management. Two main reasons to review commercial real estate management procedures are discussed below.

First, the primary distinction between "commercial" and "corporate" is that the former recognizes properties as an investment vehicle, and the latter does not. But corporate real estate can be defined as a very specific example of commercial real estate, because all properties belonging to corporate real estate are potential choices for transaction in the commercial real estate market.

Figure 3-1 illustrates the relationship between commercial real estate and corporate real estate. In the center of corporate real estate portfolio, there are properties which are defined as purely corporate real estate. They are key properties for the corporate main business, and the strategic importance of these properties outweighs their financial performance. Regardless of the monetary value of these properties, their strategic value is of primary importance to the corporation. On the opposite side described as the overlapping area between commercial and corporate real estate, are some parts of corporate properties which are held and operated for investment purposes. Properties in this category can be considered as commercial real estate within the corporate real estate portfolio, and commercial real estate management procedures are directly applicable to them.

Corporate real estate with some
commercial real estate characteristics

Commercial real estate
owned by the non-investor corporation

Pure corporate
real estate

Corporate
real estate

Commercial real estate
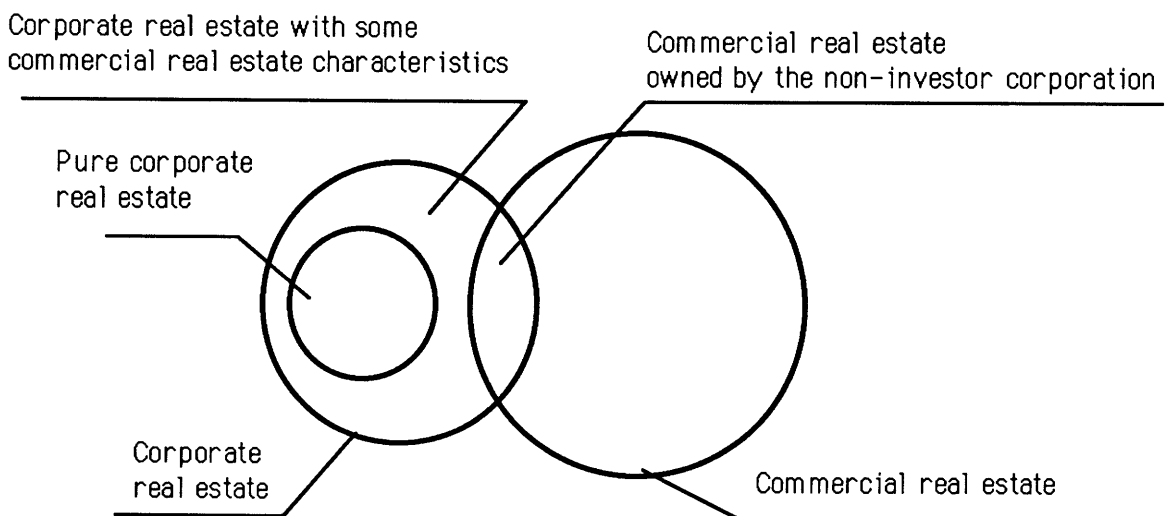
Figure 3-1 Commercial real estate and corporate real estate

Second, corporate real estate portfolio structure is changing all the time because the boundaries between pure commercial real estate, intermediate, and pure corporate real estate are not constant. A property in the pure corporate real estate category may be transformed into commercial real estate because of changes in corporate business conditions. For example, If a firm maintains an office building for its own use and leases part of the building to a third party, then the leased space becomes a "commercial" property. The developed corporation will often include this type of property in its extensive real estate portfolio. Another example is that of the corporate property whose strategic or non-commercial function becomes obsolete, at which point it should be considered for investment. In extreme cases, such as when a company faces liquidation of its properties, the monetary value of the property will be the main issue. Accordingly, when corporate real estate has to be offered in the commercial real estate market, the buyers' only concern is the property's market value, not its strategic value. When these situations occur forcing the corporation to focus on maximization of the underlying value of properties in question, an application of the commercial real estate portfolio management methodology is necessary and feasible within the framework of RPPM.

3-2 Principles of portfolio theory

In order to discuss the portfolio management of corporate real estate, I will first briefly review financial portfolio theories and related research on application of these theories to real estate portfolio management. These financial portfolio theories are developed based on microeconomic theory and the empirical approach to the financial security market.

3-2-1 Markowitz's diversification strategy

Harry M. Markowitz was the first to introduce portfolio considerations into the field of financial management (Markowitz 1952, 1959), and his model is the foundation of many modern portfolio theories. Markowitz's approach to portfolio structure is based on several assumptions which are characteristic of the workings of an efficient market. These assumptions are listed below.

1) All investors are single period expected utility of terminal wealth maximizers who choose among alternative portfolios on the basis of mean and variance of return.
2) Efficient market assumption, i.e., all investors have identical subjective estimates of the means, variances, and covariances of return among all assets. (The return of assets is described as normal distribution)
3) Quantities of all assets are given to all investors.

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4) There is no tax and transaction cost for investment.

Under these assumptions, we have to first calculate the portfolio's efficient frontier[1] on the return and covariance planes; and secondly, find an efficient portfolio structure which maximizes an investor's utility function.[2]   One simple way to apply this theory is to select a new asset which can provide a minimum covariance and maximum expected return within the existing portfolio structure.

There are two potential problems in the application of the Markowitz model. First, it is a prolonged labor intensive task to accurately calculate covariance among all assets, especially a large number of assets. Second, it is necessary to determine an investor's utility function when using this model, and this is always a difficult task because of the high degree of variability involved. The Markowitz model is well known as the first systematic portfolio model, and it clarifies the relationship between microeconomics and financial theory. To my knowledge, there have not yet been any attempts to directly apply the Markowitz model to real estate portfolio management; but his concept of the fundamental relationship between return and covariance within the portfolio is basis of the discussion of all the portfolio

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[1]See appendix 1 for definition.
[2]Utility is the level of satisfaction that a person gets from consuming a good or undertaking an activity. A utility function describes the same satisfaction level in terms of a combination of different alternatives.

theories which follows. Furthermore, although the Markowitz model is difficult to use for practical application, it is constructed on minimal assumptions, and it fundamentally linked to basic microeconomics theory. Therefore, this model is always a good starting point for any extension and simplification of financial portfolio theory for applications to real estate portfolio.

3-2-2 Capital asset pricing model

The original capital asset pricing model (CAPM) was developed by Sharpe (1964), and Lintner (1965) based on the Markowitz model. Sharp and Lintner added the following assumptions to the Markowitz model and determined the following simple linear relationship between risk and return:

1) All investors can borrow or lend an unlimited amount at an exogenously given risk-free rate of interest (R_f) without restrictions on the short sales of any asset.

2) . All assets are perfectly divisible and perfectly liquid.

   (See appendix 1 for detailed explanation of CAPM and related terminologies)

Introducing capital market line which is defined by R_f and market portfolio, we do not have to concern ourselves with each investor's utility function. The final form of CAPM is

the simple linear equation composed of risk-free rate of interest (R_f), market portfolio return (R_m) and risk premium ($ß$). The ex-post version of CAPM is therefore as follows:

$$R_{pt}' = r_0 + r_1 ß + e$$

where

$$r_1 = R_m - R_f$$

R_{pt}' = the excess return on portfolio (p), $R_{pt} - R_f$

There have been many empirical tests of CAPM's performance mainly for common stocks, such as Blume and Friend (1973), Black, Jensen, and Sholes (1972), Miller and Sholes (1972), and Fama and Macbeth (1973). If CAPM is designed properly, the empirical result should meet the following criteria.

1) The intercept term, (r_0), should not be significantly different from zero.

2) Beta should be the only factor which explains the rate of return on risky assets.

3) The relationship between risk and return should be linear in beta.

4) The coefficient of beta, (r_1), should be equal to (R_m) - (R_f)

5) In the long run, the rate of return on the market portfolio should be greater than the risk-free rate.

The empirical results show that 2), 3), and 5) are tested correctly but (r_0) is significantly different from zero and slope, (r_1), is less than (R_m) - (R_f). The implication is that low beta securities earn more than the CAPM would predict and high beta securities earn less. Therefore, empirical test results suggest not only the applicability but also the imperfections of the CAPM in common stocks. For example, in his famous critique of the CAPM, Roll explained that the CAPM and efficient market assumption are not testable from empirical data (Roll, 1977). However, even though there is still some criticism of the CAPM, its simplicity and applicability are widely accepted, and it is in the main stream of portfolio theory.

It is important to note that all of the assumptions on which the CAPM is based are modified if not violated in actual use. This attests to the surprising superiority of the CAPM in that the original model remains robust in its various extensions. To cite a few salient examples, Fama (1970) demonstrated a multi-period version of CAPM; Merton (1970) developed a continuous time version of the model; Black (1972) has demonstrated zero-beta CAPM (relaxation of assumption of risk-free interest rate). In addition, Mayers (1972) shows the extension model which allows the existence of nonmarketable assets; Brennam's model (1970) can handle the existence of heterogeneous expectations and taxes. And

finally, Breeden (1979) shows consumption base CAPM (C-CAPM) considering macroeconomics factors.

Real estate portfolio selection has been extensively explored in several studies to investigate the applicability of the CAPM and its various extension models. Among these are Smith and Shulman (1976), Miles and Rice (1978). Brueggman, Chen and Thibodeau (1984), Curcio, Gaines and Webb (1981), and Friedman (1971) (his work is not exactly based on the CAPM but uses Sharpe's diagonal model and calculates an efficient set of portfolios on the basis of the Markowitz's efficient portfolio frontier). These studies show that real estate returns have high alpha value (i.e., difference between expected return and equilibrium expected return) and that real estate dominates portfolio selection among stocks and bonds. This result raises doubt as to applicability of the the pricing model to real estate because of the gap between the empirical results and actual portfolio selection.

Because the CAPM is widely used in the practical world and because of its simplicity and adaptability, much research in real estate still tries to determine the return and risk relation based on the CAPM, but until now, at least, the consensus of opinion on real estate portfolio selection based on CAPM consists of the following points:

1) The original CAPM does not describe real estate risk and return relation correctly using the present available data.

2) It is inappropriate to use common stock indices such as S & P 500 as a market bench mark for real estate.

3-2-3 Arbitrage pricing theory and multi-factor model

The arbitrage pricing theory (APT) was first proposed by Ross (1976). The APT assumes that asset returns are described by a multilinear factor model. The crux of the APT is that investors cannot generate profits without taking risks. The equilibrium of the expected return of assets is brought about by using a multi factor model on the condition that there are no arbitrage profits. (See Appendix-2 for further explanation.)

The most important characteristic of the APT is that it does not require a market portfolio for calculation. Because the APT is derived from a different approach than the CAPM, it provides a description of assets return which is more general than that provided by CAPM, although based on similar assumptions. In fact, The CAPM can be shown to be a more specialized version of the APT.

The advantages and disadvantages of the APT compared with the CAPM are summarized below.

Advantages

- The APT is a more general model than the CAPM; therefore it can potentially take more factors into account than the CAPM.
- The APT does not assume the existence of the market portfolio as does the CAPM.

Disadvantages

- It is very difficult to select which factors to use in APT, i.e., different factors might be used by different persons.
- Even if the factors used in the APT can be determined, the different data set might show different regression coefficients.

Existing applications of the APT to real estate portfolios are few. Brueggman, Chen, and Thibodean (1984) used the two-factor model based on GNP (gross national product) and CPI (consumer price index) in order to examine the inflation hedging potential of real estate investments. They concluded that real estate investment provided a good hedge against inflation. Titman and Warga (1986) compared the results using the CAPM and the five-factor model APT. They reached the conclusion that the five-factor model APT gave lower returns than those of the CAPM, and that the APT can potentially provide a more accurate measurement of risk-adjusted rates of return. But also they noted that because

of the high volatility of the data both methods are not
powerful enough to provide reliable evaluations of the real
estate portfolio.

Until now, even though the theoretical advantage of the APT
is widely accepted, the APT does not play a main role even in
security portfolio management. This is mainly because of the
difficulty of establishing a consensus on the general
factors. The generality of the APT is a potential advantage
but a practical disadvantage in the actual application to the
real estate portfolio.

3-3 Commercial real estate portfolio

In essence, commercial real estate is an asset for
investment; therefore, it is correct to assume that
investors' utility function can be a simplified risk-return
trade-off plane. Proceeding on this basic premise, the major
portfolio considerations for commercial real estate can be
categorized into following areas.

1) How to measure return (value) of real estate.

2) How to measure risk of real estate.

3) How to select the appropriate portfolio theory to apply
   toward real estate portfolio.

3-3-1 Return of real estate

The most commonly used measurement of real estate return is appraisal value, which consists of three main elements: (1) market value, (2) replacement value, and (3) income value. The appraisal value is assumed to include such problematic factors as property and land appreciation and depreciation; income cash flow; and construction cost appreciation and depreciation. Unlike stocks and bonds, real estate is not traded in the centralized market; therefore, the appraisal value is not strictly based on equilibrium price in the market, and it is sometimes claimed that it is affected by the speculation of each appraiser. In actual real estate transactions, a seller and buyer negotiate the price of the real estate based on several different appraisal values.

The major criticism of using the appraisal value of real estate focuses on the more ambiguous factors of appraisal value, the so-called "smoothing" by appraisers. Finance professionals point out that the appraisal value includes "noise" which is caused by appraisers' speculation on expected inflation rates, market trends and so on.

The large number of studies using the appraisal value, such as Miles and Esty (1982), Sojacy (1981), Brachman (1981), and Brueggeman, Chen and Thibodeau (1984), Ibbotson and Siegel (1984), is mainly due to the fact that the appraisal value is the most common value which can be used to estimate the

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unrealized appreciation and depreciation of real estate. Moreover, several publicly available data, such as CREFs (commingled real estate funds), FRC (Frank Russell Company) and the National Council of Real Investment Fiduciaries Property Index, which are based on the properties' appraisal value held in pension fund portfolios, and The Morguard Property Index, all provide annualized returns which include both income returns and unrealized appreciation in property value measured by regular property appraisals.

Another methodology uses some indices which give estimated appreciation and depreciation of either property value or income cash flow instead of the appraisal value. Home purchase index, construction cost index such as the ENR (Engineering News Record) cost index, and the Marshall Valuation Service construction cost index are used for estimating property value appreciation. NOI (Net Operating Income) Index is used for estimating net income appreciation. Ricks (1969), Friedman (1971), Robincheck, Cohn and Pringle (1972), Kelleher (1976), and Ibbotson and Fall (1979) use this methodology.

Hoag (1980) developed a unique and systematic measurement of property value by devising his own index and thereby avoiding direct use of the appraisal value. He divides factors which affect the price of real estate into five major components as follows: fundamental characteristics, national economic

concomitants, regional economic concomitants, local characteristics, and temporal characteristics. Each of these major components has several sub-categories. His price index is described by means of a linear regression model of these multiple factors.

A third and quite different approach to measurement of return is based on the use of share price of securitized real estate such as REITs (real estate investment trusts). The share price of equity REITs, (which take equity positions in real estate) give the shareholders income from the rents and capital gains of properties and are often observed as real estate return. The research of Davidson and Palmer (1978), Burns and Epley (1982), Smith (1976), and Miles and McCue (1982) used REITs return as real estate return. Because this approach essentially observes security prices in the market, it can eliminate fuzzy factors which are characteristic of the appraisal value approach. Moreover, this approach has much in common with stocks and bonds; therefore, it is relatively easy to apply financial treatment to the data. On the other hand, because this approach uses the share price of securitized real estate, its measurements of return of real estate itself are indirect even after the financial risk and the company's other idiosyncratic risks are successfully eliminated.

The following is a summary of the advantages and disadvantages of the three measurements of return discussed above.

Appraisal Value

    Advantages

- Most commonly used in the market

- Reasonably similar to actual market price

    Disadvantages

- "Smoothing" effect by appraiser

- Evaluation is dependent upon each specific appraiser usually available only on quarterly basis

Index Approach

    Advantages

- More systematic than appraisal value

- Needed data is available more frequently than appraisal value

- Eliminates "smoothing" effect

- Accessibility to computerized calculation (especially Hoag index)

    Disadvantages

- Difficult to evaluate all factors of value appreciation

- Difficult to apply ex-ante research

- If base data change, regression coefficient may also change (Hoag Index).

REITs Data Approach

Advantages

- Similarity to other securities data
- Market determined price
- Availability of data

Disadvantages

- Indirect measurement of actual return
- Data include intangible company risks and other specific factors
- Securitized real estate and unsecuritized real estate are essentially different

Based on the data discussed above, my conclusion is that the appraisal value approach is the most practical measurement for unsecuritized real estate return. In essence, I agree with the following summary provided by Hoag:

> Since the fundamental descriptions include cash flows, property type and location, all the raw elements are available for the equivalent of an income capitalization appraisal. ... Since construction cost indexes are included, the data for replacement cost appraisal are also provided. ... Clearly then, a sufficient amount of information is available for an appraiser to make judgement of value. This type of fundamental analysis is

accomplished on a daily basis by security analysts in the stock market. Appraisers and security analysts use fundamental information to establish the value of their respective investment. (1987,572)

3-3-2 Risk of real estate

Almost all the researchers surveyed calculated the volatility of return and defined it as the risk of real estate on the assumption that all investors are only concerned with the maximization of their utility function with regard to mean and variance of return. Accordingly, only standard deviation or variance and coefficient of variation (i.e., standard deviation/mean of return) are calculated. Some research which concerns portfolio contribution of assets calculates the correlation coefficient between real estate and other investment classes. Because all these figures are calculated on the basis of return of real estate data, risk measurement is solely dependent upon what type of return measurement is applied.

3-3-3 Diversification category

A basic concept of portfolio theory is the reduction of unsystematic risk through diversification. Therefore, if we consider diversification within real estate, is it beneficial to construct a real estate portfolio? Miles and McCue (1984), and Hartzell, Heckman, and Miles (1986) have investigated this problem and have found that 85 to 90% of

the risk of real estate is nonsystematic risk. This figure
is quite high compared to the 20% of AAA rank bonds and 65%
of common stocks (McEnally and Boadman,1979). The high
nonsystematic risk indicates that the great potential
advantage of portfolio selection through diversification.

Miles and McCue (1984) studied diversification benefits using
property type (industrial, office, retail, residential, and
hotel/motel); geographical region (East, Midwest, South,
West); property size; and lease structure. Hartzell,
Heckman, and Miles used the same categories along with SMSA
(standard metropolitan statistical area) growth rate. Their
general findings are, as might be expected, that all of these
diversification categories reduce the risk of return of real
estate. Although Hartzell, Heckman, and Miles (1986)
suggested a combination of property type, SMSA growth rate,
and lease structure offering efficient diversification, their
conclusion emphasized that these diversification categories
are not efficient enough if we consider the cost of
diversification. Even if the properties in the portfolio are
similar in type, size, and geographical region, the amount of
unsystematic risk can be significantly reduced due to the
individual characteristics of each property.

High unsystematic risk suggests that the correlation of
return even within the same category is low. Moreover, the
risk of real estate return is affected considerably by many

subtle factors such as design, transportation access, more specific location, and age of property. Clearly then, the categories used for these studies are too broad to accurately assess the dominant factors of unsystematic risk. While any diversification category can reduce the risk of real estate return, the key issue of real estate portfolio is the trade-off between benefits from diversification and the cost of diversification.

3-4. Problems of application to real estate portfolio

The many empirical studies on real estate return emphasize three major findings, as listed below.

1) Real estate offers higher risk-adjusted returns than stocks and bonds.
2) Real estate offers an attractive inflation hedge while stocks and bonds do not.
3) Real estate offers an attractive diversification opportunity for investors in stocks and bonds.

The argument against these findings are concentrated into three categories as explained by Lusht (1988, 96).

1) The empirical data are correct, but they are drawn exclusively from the post-World War II upside of a long cycle.

2) Data problems have forced reliance on proxies for
return and risk which bias the results.

3) The findings are based on models which are
misspecified.

The first argument seems to be weak compared to the second
and third because it is almost impossible to determine
whether or not world economics is in "upside of a long
cycle", and more importantly this argument focuses only on
the data sampling period. The sampling period is certainly
one reason of problems but obviously does not explain all
reasons of problems. Therefore, we should concentrate on
argument 2) and 3). Data problems are constantly pointed out
in all of the research. Disadvantages of the appraisal value
approach, the index approach, and REITs data approach listed
in section 3-3-1 describe the general source of errors.

There are two other important data problems. One is that
most of research is done on portfolios which consists of
either pure financial securities or real estate. This is
mainly because there are few observable data which based on
the analysis of optimal portfolios, including both real
estate and financial securities. The other is that the
returns on real estate are generally measured on an unlevered
basis. Real estate investment usually involves intensive
levered capital, and its equity base return may be
considerably different from unlevered return. Furthermore,

the returns of stocks and corporate bonds generally reflect
levered position of the corporations which issue these
securities.

Lusht offers the following insights:

> The omission of nonvariance pricing factors produces
> a mean-variance dominance of real estate that will be
> reflected in portfolio composition. We do not know
> the relative pricing impact of variance versus
> nonvariance factors, nor do we know how the
> nonvariance factors are associated with variance.
> (1988, 99)

This argument points out both the limitation of current
financial theory application, and the direction of future
research.

Because unsecuritized real estate violates the underlying
assumptions of financial portfolio theory more so than the
financial securities, there is presently no ready-to-use
portfolio theory for commercial real estate portfolio
management. However, based on the preceding review of
portfolio theories, the CAPM and its extended models appear
to be the most applicable to commercial real estate portfolio
management.

Although all assumptions pertaining to financial portfolio
theory are not applicable to real estate, the following

points are critical for the successful application of financial portfolio theory to the real estate market.

1) Indivisibility

Investment in real estate requires large amounts of capital. Therefore, investors who include real estate in their portfolio are virtually "putting all their eggs in one basket." Without some specific method like securitization or limited partnership, real estate investment is an indivisible, "all or nothing" type of investment. This condition tends to eliminate investors who have only small capital and thus efficient market assumption becomes less valid than for financial securities.

2) Long time span

Unlike financial securities which are traded minute by minute, there is usually a big time-lag between the initial real estate investment and a return from the investment. The average time span for the investment, including new construction, is likely to exceed a year. Theoretically, this time span is reflected in the discount cash flow calculation; but fixed discount rate calculation cannot accurately reflect the uncertainty of this time span.

Investment in real estate is also usually irreversible. The money is locked in the project, and it is difficult to change the original plan of the project even after the economic situation has completely changed.

3) <u>Transaction cost</u>

The acquisition and disposition of real estate entail a tedious administrative process which is both time and cost consuming. Holding real estate itself requires considerable maintenance and house keeping. These conditions alone completely violates basic frictionless market assumptions.

3-5 Conclusion

This chapter has briefly reviewed financial portfolio theories focussing on their applications to real estate portfolio management. Capital asset pricing model (CAPM) and arbitrage pricing theory (APT) are two of the main portfolio theories which are frequently tried to apply to real estate portfolio management. Although CAPM and its extended models are the most commonly used models, none of the financial portfolios has thus far proven to be directly applicable to real estate portfolio until now. Arguments about how to measure risk and return of real estate still have to be resolved prior to application of these portfolio theories. Finally the underlying assumptions for these financial portfolio theories are much more fragile for real estate than

for financial securities. Therefore, while diversification

is beneficial for real estate portfolio, research is still

needed to determine which category of diversification is

effective.

4-1 Introduction

This chapter, I focuses on how to evaluate the strategic importance of corporate real estate, a factor which is closely related to how corporate real estate portfolio is constructed and which is usually only recognized when the structure of the corporate real estate portfolio is clarified. Therefore, the understanding of the strategic importance of corporate real estate is not a separate issue from the structuring of the portfolio.

The following discussion of the strategic aspect of RPPM will consider these issues: (1) determination of corporate development stage; (2) determination of strategic value; (3) determination of key values related to strategic value; and (4) systematic option selection for alternative use.

4-2 The stage of corporate development

Before discussing corporate real estate portfolio structure, it is necessary to understand the corporation development stage from the point of view of expanding real estate portfolio. At different points in its development, a corporation will have different uses and requirements for its real estate and different attitudes toward RPPM. In other words, the firm's inclination toward either a financial or

Table 4-1 Levels of corporate development

Development stage	Corporate situation	Real estate requirement	RPPM function
Level I	Invention and initial pilot production/ marketing	Housed in home, garage,or low-rent	Litte or no attention directed
Level II	Preliminary expansion of product/service	Small facility to handle production, distribution, and office function	The minimum space is leased under decision of founder
Level III	Rapid expansion of product/ service requires geographic decentralization	Multiple facilities to handle manufacturing, distribution, and office function spread over are of several states	A corporate owned main office is most likely built at this level. Some lease contracts have already matured. The corporation has accumulated some experience in decision making process of lease renewal or purchase. A real estate professional is usually hired at this stage
Level IV	Expansion into major regional presence	Facilities owned are being expanded while new locations are being leased or constructed throughout entire region	RPPM function is frequently separated from other administrative functions
Level V	Further expansion into national company and start of overseas operations	Facilities owned or leased by a corporation spread out into many regions	Real estate has expanded and diversified in terms of property number, type, size, and location in proportion to the business expansion. Vice-president level directs RPPM division. Some profit-seeking projects are developed by the RPPM division

strategic management emphasis will be affected by its stage
of development. The typical process of a firm's growth from
a corporate real estate point of view can be simplified as
shown Table 4-1, which is based on Silverman 1987, 64-65.

The firm which has recognized the importance of corporate
real estate management has reached at least level IV. At
this stage, corporate real estate has reached a considerable
volume, and its efficient management is important whether or
not it is recognized by the firm. Therefore, when RPPM
starts, the portfolio has reached a considerable size.
Although RPPM serves important functions for corporations in
each stage of development, it is most useful to the
corporation which has reached a relatively matured stage.

It should be borne in mind that the further a corporation
develops, the greater the emphasis will be on the financial
aspects of corporate real estate. Although the strategic
aspect of corporate real estate is an important factor
throughout all stage of development, conflict between the
strategic and financial aspects is likely to surface after
development level III has been reached.

4-2 Strategic issues regarding corporate properties
While the financial value of all properties should be be
objectively determined, the essential value of corporate real
estate is derived from its strategic purpose. Consequently,

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a process should be devised by which the strategic value of a property can be independently and systematically accessed. However, the strategic value of a property is difficult to determine quantitatively; it must therefore be established using a ranking method. From a wider perspective, a property's strategic value can be considered an aspect of its use value. But because of the importance and uniqueness of strategic value, especially for the corporate real estate, a separate evaluation of strategic value is needed to provide a more precise picture of the entire corporate real estate portfolio. The following discussion explains a basic approach to determining the various aspects of the strategic value of corporate real estate.

4-2-1 Quantitative approach

Each corporate property fulfills some specific function within the corporate framework, but the value of this function is not usually determined quantitatively. One possible method of quantitative evaluation of strategic value is to assess the cash flow which is related to each property. The value-add activity which uses a specific property produces profits for the corporation; therefore, the profits which are produced by using the property can be considered as part of the strategic value of the property. Obviously, this profit is not equal to the return of real estate, but it is an objective figure by which to assess the utility of a specific property.

A comprehensive example of this approach is the case of a
processing plant for a manufacturer. At a facility such as
this the value-add activities are clear: the plant converts
raw material into manufactured goods. Figure 4-2 shows the
flow of activities in this facility.
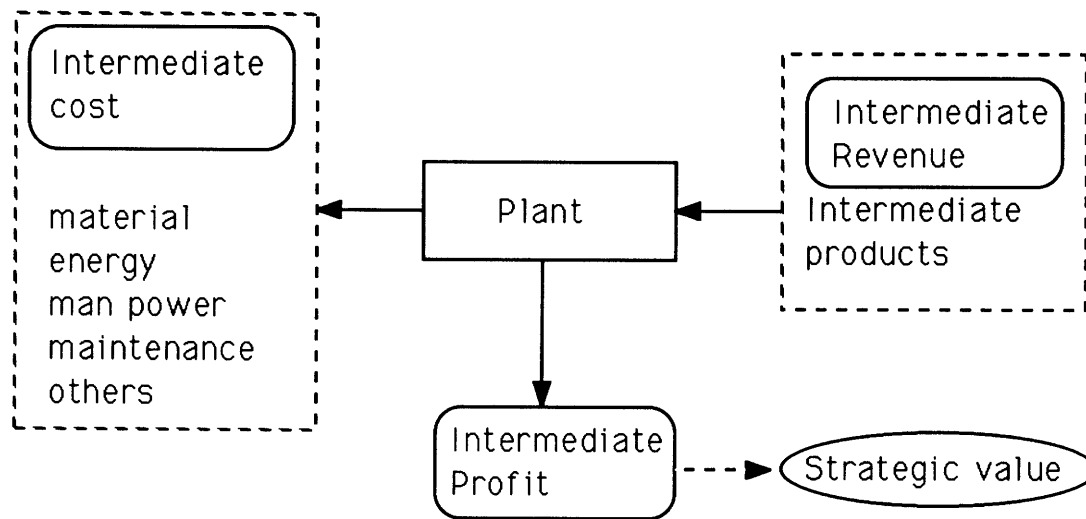
Figure 4-2 Quantitative approach for strategic value

The data needed to determine the strategic value of a
specific property can be found in the corporate accounting
information. If the company is careful about cost-benefit
analysis, and if it tracks the expense and revenue of each
facility, this particular quantitative approach is relatively
easy to apply. For example, a highly divisionalized
corporation will often keep internal accounting information
(including fairly detailed cost-revenue data) on a division
by division basis (i.e., independent accounting among

different divisions). If a division uses the services of another division or if it uses intermediate products which are produced by another division, an independent account system records these transactions as if they were trades between different divisions. Within this system, it is relatively easy to assess strategic value on an on-going basis.

But, as with any method of this kind, this particular quantitative approach has its limitations. For example, if the corporation keeps only consolidated accounting records of the total corporation, it is difficult to break down detailed transactions between different properties. Even in cases in which the corporation applies an independent accounting system, it is difficult to evaluate the strategic value of some properties such as housing for employees and warehouses. Employee housing does not contribute to the profitability of the corporation directly, and there is no value-add activity in this facility; therefore, the quantitative approach can not determine the strategic value of this property. But obviously, its strategic value is not zero. High quality housing attracts new applicants to the corporation and contributes to the motivation of employees and to the development of a better quality of human resource, factors which are beyond the scope of quantitative evaluation. Therefore, if used correctly and within the appropriate parameters, the quantitative analysis of the strategic value

of corporate properties is capable of making a basic
assessment of strategic value.

4-2-2 Portfolio strategic value

The standard corporate real estate portfolio consists of
various kinds of facilities. Considering the differences
between corporate and commercial real estate, it is necessary
to first have an accurate understanding of the structure of
the portfolio. The difficulty of designing and implementing
the corporate real estate portfolio is that it is not a
simple financial portfolio but is part of a complex corporate
strategy, and different parts of it have to be managed
according to different guidelines. For example, some parts
of the portfolio are important to the corporation in terms of
strategic issues, and decisions involving these properties
have to be made on a strictly strategic basis. On the other
hand, other parts of the portfolio may have to be dealt with
by applying the commercial real estate portfolio management
methodology. Accordingly, a primary mission for a corporate
real estate portfolio manager is to maintain an objective
measurement of the corporate real estate portfolio in direct
relation to corporate policy. The first requirement, of
course, is a thorough understanding of the specific nature
and requirements of each part of the portfolio.

It is also important to determine the value of each property
within the context of its relationship to other facilities

and their respective corporate functions. On this basis,the
corporate real estate portfolio can be organized into several
clusters of facilities groups on the basis of function. At
the cluster level, there are two main issues. First, the
strategic value of each cluster can be evaluated by using a
ranking method which focuses on the utilization of properties
in the corporate main business. Secondly, the strategic
value of each property in the cluster can be evaluated by
determining linkage within the cluster. Each cluster has key
facilities and supporting facilities, and linkage among these
facilities is the key for understanding the strategic
importance of facilities.

The following is a hypothetical example of the clustering
approach to corporate real estate portfolio management based
on a model from the manufacturing industry.

> The list of the total facilities in the portfolio
>   Office No.1-11   Warehouse No.1-6
>   Factory No.1-9   Storage No.1-10
>   Housing No.1-4   Canteen
>   Gymnasium

Clustering based on facilities linkage is as follows:

> Cluster #1 Head office buildings
>   Office No.1   Office No.2
>   Office No.3

> Cluster #2 Main manufacturing facilities
>   Factory No.1   Storage No.1
>   Factory No.2   Storage No.2
>   Factory No.3   Storage No.3
>   Warehouse No.1   Warehouse No.2
>   Office No.4

Cluster #3 Sub-manufacturing facilities
  Factory No.4   Storage No.4
  Factory No.5   Storage No.5
  Factory No.6   Storage No.6
  Warehouse No.3   Warehouse No.4
  Office No.5

Cluster #4 Sub-manufacturing facilities
  Factory No.7   Storage No.7
  Factory No.8   Storage No.8
  Factory No.9   Storage No.9
  Warehouse No.5   Warehouse No.6
  Office No.6

Cluster #5 Laboratories
  Laboratory No.1   Laboratory No.2
  Office No.7

Cluster #6 Supporting offices in main factory areas
  Office No.8   Office No.9

Cluster #7. Other supporting facilities at main factory
    areas
  Canteen   Storage No.10

Cluster #8 Housing
  Housing No.1   Housing No.2

Cluster #9 Housing (other locations)
  Housing No.3   Housing No.4

Cluster #10 (stand-alone facilities)
  Office No.10   Office No.11
  Gymnasium

The linkage of these clusters can be illustrated as Figure 4-3.
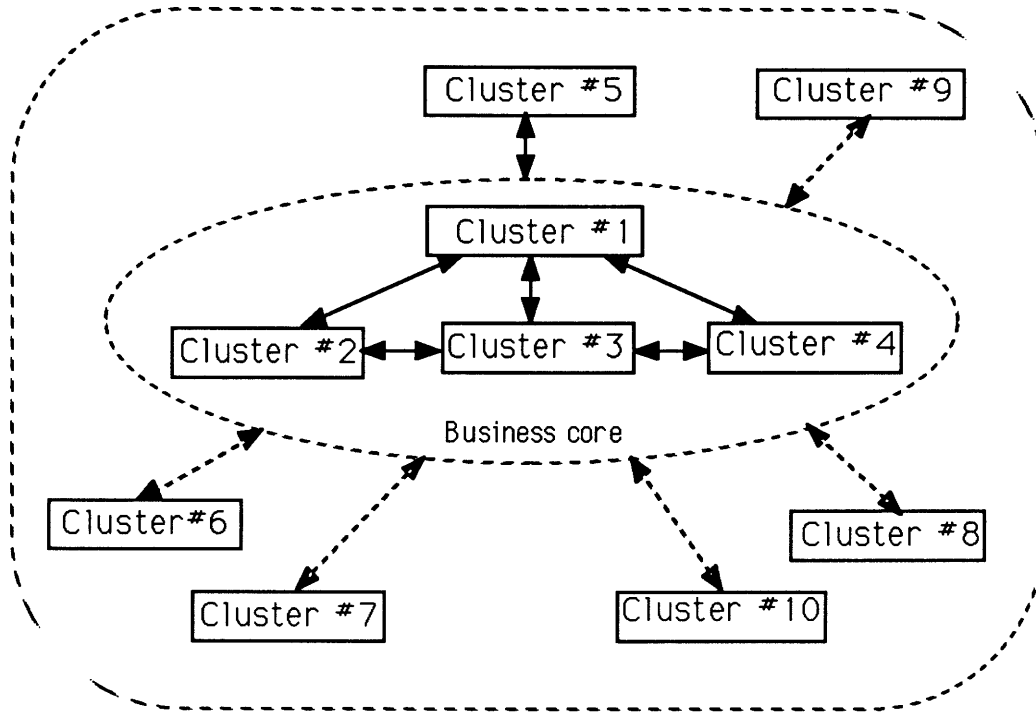
Figure 4-3 Cluster linkage chart

These clusters can be further classified into the following
ranking method which describes the value of each cluster
qualitatively:

Rank I   The business center clusters. This cluster is
           the center of value-add activities and profit-
           making for the corporation. It consists of
           clusters #1 and #2.

Rank II   The main supporting function clusters for Rank
           I clusters. The function of these clusters is
           supportive but directly related to the main
           business. It consists of clusters #3, #4, and
           #5.

Rank III   The secondary supportive function clusters for Rank I or Rank II. This cluster's function is directly related to the main business but it is not unique and therefore it is replaceable. It consists of cluster #6.

Rank IV   The supplemental function for the corporate main business. This cluster's function is not directly related to the corporate main business. It consists of clusters #7, #8, #9,and #10.

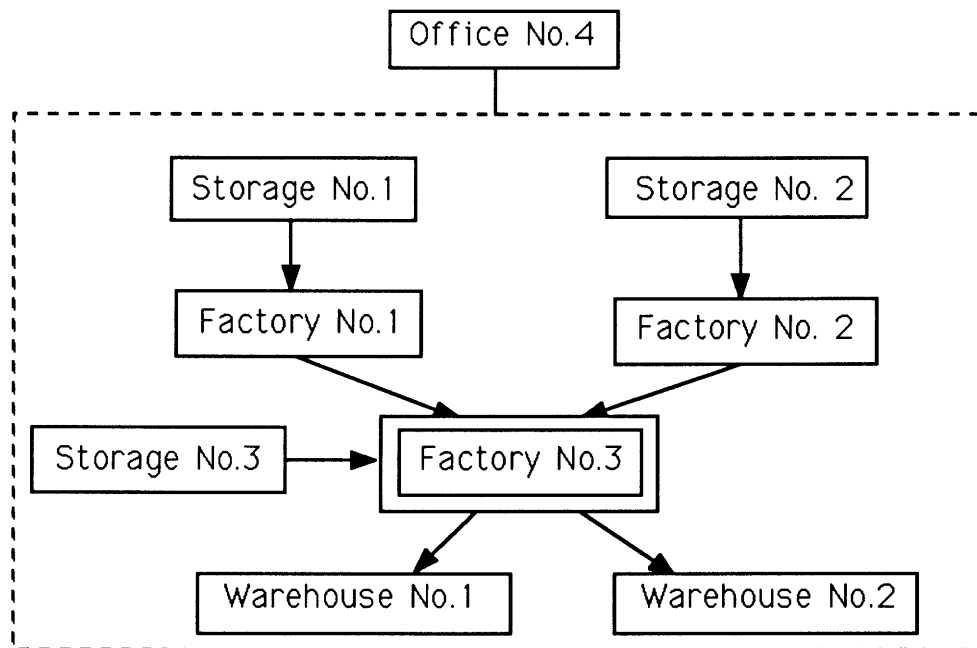Rank V   The reserve properties or allowance for future expansion.

Figure 4-4 Property linkage within the cluster #2

Linkage among facilities in a cluster comprises a sub-structure of the portfolio in which the interrelationships

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among the facilities are clear, thus allowing the strategic value of a specific value to be easily and clearly defined. Consider the example of cluster #2, illustrated in Figure 4-4.

In this cluster, the key facility is factory No.3, and the other facilities can be considered as subordinate facilities. Once linkage between facilities and the strategic importance of each facility is established within this structure, each property can be further categorized on a functional basis as follows:

Rank I   Facilities which are directly used for business and which are unique on the basis of purpose, location and other corporate strategic issues. The costs of relocating these facilities would exceed their market value or severely damage corporate strategy, e.g., headquarter office, key manufacturing plants and attached facilities.

Rank II   Facilities which are directly used for business Relocation costs for these facilities would be under market value and therefore not impractical or detrimental to corporate strategy, e.g., storage, warehouse, some manufacturing plants, some offices.

Rank III   Facilities which are not directly used for

business, e.g., housing, health care

facilities for employees.

Rank IV   Facilities which are not or will not be used

for main business operations, e.g., open land,

obsolete facilities.

Rank V   Facilities which are currently leased to third

parties and which produce income.

Finally, in this example, we obtain an evaluation result as

shown in Figure 4-5. Clearly, properties which are assigned

large number have lower strategic value.

This type of ranking method is the first step in assessing

the strategic property value within the structure of the

corporate real estate portfolio. The facilities in Rank IV

and V can be operated under the same concepts as commercial

real estate. On the other hand, the commercial advantages of

manipulating the facilities in Rank I are minimal, if not

non-existent, and therefore, decision making regarding these

properties should be left in the hands of top management. In

essence, the ranking method described above provides an index

of non-financial issues which actually facilitates

financially-based decision-making on all properties in the

portfolio.

Strategic Value ranking chart				
Cluster Number	Property name	Cluster rank [1]	Property rank [2]	Final rank [1]x[2]
1	Office No.1 Office No.2 Office No.3	1	1 2 2	1 2 2
2	Factory No.1 Factory No.2 Factory No.3 Storage No.1 Storage No.2 Storage No.3 Warehouse No.2 Warehouse No.1 Office No.4	1	2 2 1 2 2 2 2 2 2	2 2 1 2 2 2 2 2 2
3	Factory No.4 Factory No.5 Factory No.6 Storage No.4 Storage No.5 Storage No.6 Warehouse No.3 Warehouse No.4 Office No.5	2	2 2 1 2 2 2 2 2 2	4 4 2 4 4 4 4 4 4
4	Factory No.7 Factory No.8 Factory No.9 Storage No.7 Storage No.8 Storage No.9 Warehouse No.5 Warehouse No.6 Office No.6	2	2 2 1 2 2 2 2 2 2	4 4 2 4 4 4 4 4 4
5	Laboratory No.1 Laboratory No.2 Office No.7	2	1 2 2	2 4 4
6	Office No.8 Office No.9	3	2 2	6 6

7	Canteen Storage No.10	4	3 3	12 12
8	Housing No.1 Housing No.2	4	3 4	12 16
9	Housing No.3 Housing No.4	4	2 5	8 20
10	Office No.10 Office No.11 Gymnasium	4	5 4 3	20 16 12

Figure 4-5 Property ranking chart

4-3   Determination of value of properties

Book value, replacement value and market value, are all
fundamental information for both commercial and corporate
real estate management. However, the determination of use
value is especially important for corporate real estate
because it is a dominant factor in corporate decision-making.
This section discusses several types of property value and
the application of the option pricing model as a method of
determining use value and other financial indicators which
describe property performance.

4-3-1 Book value

For accounting purposes, book value is usually kept on a
corporate balance sheet. In many cases, the corporation
records two separate book values of properties. Accelerated
depreciation based book value is adopted for tax report
purposes, and linear depreciation base book value is reported
for share holders in order to both reduce corporate tax and

maximize profits on the balance sheet. These book values are needed for the calculation of corporate tax and capital gain tax as well for the official property values which the corporation is required to report to the public. For corporate real estate management purposes, book value is easy to locate in the corporation's accounting book and is required for determining the difference between the accounting value and the market value of the properties.

4-3-2 Replacement value

Replacement value is the cost of rebuilding properties at a given point in time. This value can be quantitatively determined by using reasonably precise square foot cost data published by several authoritative sources, such as Means. Replacement value is cost-side information and can be collected during the appraisal process.

4-3-3 Market value

Market value is price-side information. It is considerably higher than book value and is therefore important information for the corporation to maintain. For instance, when a corporation liquidates its properties, the market value is always the main focus of corporate decision-making. It is important to note that even though the market value is of critical importance to the corporation, few corporations keep track of market value on and on-going basis.

However, precise market value can be determined only at the time of property liquidation. Prior to this time, estimates of market value have to be made usually by means of appraisal value. In most cases, appraisal value is calculated by observing three different aspects of the property. First, an appraiser scrutinizes the real market value of similar type of properties. The real market value is based on considerations of regional characteristics, micro and macroeconomical conditions, and other conditions unique to the properties in question. If adequate data exist, the appraiser can statistically observe market trends focussing on the behavior of the market value of specific type of properties. Secondly, replacement value is calculated. As mentioned earlier, replacement value is cost-side property information. It consists of objective data such as the physical value of the properties. Third, expected cash flow produced by the property is estimated and present value of cash flow is calculated. These cash flow figures amount to the income value of the property, a highly significant factor for the entire portfolio but especially for commercial property. The final, and most subjective part of the appraisal, entails the appraiser's consideration of the property's age, unique specification, likely rate of appreciation, and other factors which might affect its market value all of which result in an adjustment of appraisal value.

None of the three processes just described is easy and
straightforward. There is a considerable margin for error
and the final determination of value is under the influence
of an individual appraiser's speculation of the market. For
these reasons the use of appraisal value is often criticized.
Nonetheless, appraisal value is the most widely used value
for actual real estate transactions; even if it is affected
by the appraiser's subjectivity, the appraisal value is still
determined by a professional using all the data at his
disposal. So, while appraisal value is not exactly the market
value, it is the most reliable estimated value attainable.
Furthermore, this process of determining value by means of
informed, professional speculation, is similar to the process
used by financial managers in the security market.

4-3-4 Use value

The most important value for corporate real estate is use
value--the total benefits of using a specific property. Use
value might also be the most difficult value to define
because the total utility of a property is determined not
only by its financial performance, but also by its non-
quantitative performance. This non-quantitative performance
includes a property's contribution to worker productivity,
user satisfaction, and other "psychological" conditions. If
we look at these categories closely, it becomes clear that
numerous factors affect final use value. For example,
ceiling height, performance of HVAC system, finish material,

interior design and other physical factors all have some affect on the use value of properties.

Because the influence of the above factors on use value is difficult to quantify, it is necessary (and reasonably safe) to assume that the market value of equivalent property lease cost has already been taken into account. Therefore, if the market is fairly competitive and both lessees and lessors hold the same information, the lease cost under consideration will probably reflect the physical performance of the property. For example, in the commercial real estate market, if a property has the function of a data management system which all tenants share (such as optic fiber data line connected to center processing unit), the lease price will most likely be higher than a standard equipped property. This assumption is based on the customary estimate of market efficiency in standard real estate transactions in which an appraiser will estimate cash flow generated by the property. In the case of corporate real estate, this process amounts to an estimation of the equivalent lease cost of the property, data which a corporation uses to determine the opportunity cost of occupying a give space.

For corporate real estate, both the direct and indirect contributions of properties to the corporate business are another major factor in determining use value. This factor is unique for each property and for each corporation and will

be defined here as the strategic value of the property in contradistinction to use value, per se. A more detailed discussion of strategic value can be found in next section 4-4.

In summation, use value can be defined as the sum of two components. The first component is the equivalent lease cost of the space. This figure can be estimated as part of the process of appraisal and reflects all physical specifications of a property. The second component is the flexibility of operation of the property for the corporation. When the corporation owns the property, it can change how it makes use of it. This flexibility is one of the important incentives for a corporation to own its own properties. Some lease contracts allow minor changes of properties to the lessee, but these allowances are usually limited and require a long time to be authorized. The value of this kind of flexibility is similar to that of financial option characteristics and can be converted into quantitative value by using the option pricing model.

4-3-5 Option pricing model

First, before discussing the use of the option pricing model to determine use value, I will briefly review the option pricing model in the financial market.

In the security market (especially in future trading), option is one of the most important tools for both financial securities and commodities futures trading markets. There are many types of option-like trades, but in terms of the option holder's right, there are two major types of option as described below.

Call option : A call option gives its owner the right to buy stock at a specified exercise or striking price on or before a specified exercise date.

Put option : A put option gives its owner the right to sell stock at a specified exercise or striking price on or before a specified exercise date.

The value of options is difficult to determine. Moreover, the methodology of forecasting cash flow and discounting the opportunity cost is not helpful for calculating option price options, because the risk of an option changes whenever the stock price moves or whenever stock price takes "a random walk" through the option's lifetime.

The first effective option pricing formula was introduced by Black and Scholes (1973) and was based on a perfect market efficiency and a no-arbitrage profits opportunity assumption. Black-Scholes formula is,

Present value of call option (C) = $SN(x) - Kr^{-t}N(x - v\sqrt{t})$

where $x = \log(s/Kr^{-t})/v\sqrt{t} + v\sqrt{t}/2$ (log is natural log)

S = current price of stock

K = exercise price of option

t = time to exercise date

r = risk-free rate of interest

v = variance of expected rate of return of stock

N(x) = Cumulative normal probability density function

The Black-Scholes formula looks complicated, but, surprisingly, it uses only five variables and the the only variable which has to be estimated is variance of expected rate of return of stock. All other four variables are observable. Cumulative normal distribution function N(x) can be calculated by using a polynomial approximation, which is for (x) greater than zero,

$$N(x) = 1 - (1/\sqrt{2\pi})e^{-x2/2}(b_1k + b_2k^2 + b_3K^3 + b_4k^4 + b_5k^5)$$

where $k = 1/(1 + ax)$

$a = 0.2316419$

$$b_1 = 0.319381530$$

$$b_2 = -0.356563782$$

$$b_3 = 1.781477937$$

$$b_4 = 1.821255978$$

$$b_5 = 1.330274429$$

For (x) less than zero, a correct result can be calculated by subtracting the above calculation for positive (x) from one. If (x) is equal to zero, N(x) is equal to 0.5.

Therefore, the value of an option described by the Black-Scholes formula is easily calculated by micro-computer. The value of put option is calculated by using the call-put parity formula:

$$\text{Present value of put option (P)} = C - S + Kr^{-t}$$

The Black-Scholes formula is valid for European option (option exercise is limited only on the specified date) and for no-dividend stock. The Black-Scholes formula is based on the following assumptions:

1) Returns of stock are log-normally distributed.
2) Returns during separate time periods are not correlated.
3) Returns have the same mean and standard deviation over any two time periods of equal length.

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4) Traders are able to continually adjust their
portfolio without transaction cost and tax. Borrowing
and lending are allowed for all investors (i.e.,
frictionless market assumption).

5) Perfect efficient market assumption is held

6). Risk-free rate is constant during the holding time.

Strictly speaking, none of these assumptions is correct in
actual practice. But empirically, this Black-Scholes model
gives satisfactory results, specially when K and S are close
numbers, and time to reach maturity (t) is approximately a
few months for securities options. As in the case of the
CAPM, there are several extended models of option pricing.
Merton (1973) relaxed the no dividend assumption and proposed
the option pricing model for American call option. Fisher
(1978) studied the option pricing model when the exercise
price is variable. Stulz (1982) values an option price of
two mutually exclusive, risky assets.

Several studies have investigated the applications of option
pricing to real assets. Myers and Majd (1983) used Merton's
extended model and evaluated the abandonment value of the
projects. Paddock, Siegel, and Smith (1983) used the option
pricing model to evaluate oil well development. Majd and
Pindyck (1987) compared the option pricing approach with a
simple NPV rule and determined the effects of time to build,
opportunity cost and uncertainty on investment decision. The

results of each of these studies indicated that lease values obtained using the option pricing model were greater than those obtained with traditional methods, and, furthermore, they were also closer to the observed winning bids.

Extended option pricing models sometime require extensive use of a computer. For example, Merton's model needs a finite elements technique in order to approximate the option value. Therefore, they still seem to be primarily for academic use.

The contingent claim aspect of real estate development is highly conducive to the option pricing approach. In the case of corporate real estate, the corporation's right to modify the original property use is essentially an 'option' process in which the the option value is the use value of the property along with equivalent lease costs. The major difference between financial option and physical asset option is that in the case of real asset options, the owner has a range of options. Discussed below are several examples of the determination of use value using a simple call and put option pricing model.

Example 1: Liquidation option

If a corporation decides to sell a property at the some point in the physical life of property, it has a simple put option for liquidation. The comparison of variables between stock option and liquidation option is as follows:

	Stock option	Liquidation option
S :	Current stock price	Net present value of equivalent lease cost and costs of operation
K :	Exercise price	Market value of the property
v :	variance of rate of return of S	Variance of rate of return of S
t :	time to reach maturity	Physical life of property
r :	risk-free interest rate	Risk-free interest rate

Example 2: Renovation option

In cases where the corporation converts property to other uses, it also has a simple put option with which to implement the conversion. The analogy of variables between stock option and conversion or renovation option is as follows.

	Stock option	Liquidation option
S :	Current stock price	Net present value of equivalent lease cost and costs of operation
K :	Exercise price	Net present value of equivalent lease cost and operation costs of the alternative use of the property
v :	variance of rate of return of S	Variance of rate of return of S
t :	time to reach maturity	Physical life of property
r :	risk-free interest rate	Risk-free interest rate

A numerical calculation example is shown in Appendix 3

The implementation of either of these two options is very likely to take place during the property's life. And besides these two examples, there are other situations in which the corporation changes original property use and in which each option value can be calculated based on the analogy of stock option. The results of the calculations give each option value as if it is the only option for the corporation. Unfortunately, we cannot simply combine these results to arrive at the total option value for the corporation because, in most cases, these options are mutually exclusive. That is, if the corporation exercises one option, it cannot exercise other options at the same time; but the corporation might be able to exercise another option at a later time.

The nature of the real asset option is highly complicated, and in fact, it usually becomes a compound option (i.e., the exercise of one option produces another option). Compound option analysis requires a more detailed real asset option structure and numerical approximation of option pricing. This type of development is clearly the future direction of research in this area.

The Black-Scholes formula gives us a simple quantitative index by which to choose options and calculate each option value on a comparative basis. By sacrificing simplicity, the

Black-Scholes extended model has a slight advantage over the original when it comes to precision in calculating option values. For example, Stulz model can calculate the value of two mutually exclusive options. It can calculate the value of owner position which has two alternative future directions. In this type of situation, the Stulz model allows somewhat more realistic modeling. But in the case of real asset options having multiple option choices, the Stulz model has little advantage over the Black-Scholes model.

The main problem of applying option pricing formulas to real asset options is not only the violation of underlying assumptions of option pricing, but also the long time span required for option maturity. In the case of physical properties, physical life is sometimes several decades. As the option maturity time increases, its value gets close to current underlying asset price, and constant risk-free rates and variance of return assumptions become more uncertain. It is obvious that calculated option values may not be error-free; they are also not absolute values. Therefore, this process has to be used judiciously on the basis of a clear understanding of underlying assumptions and with a watchful eye on potential changes in conditions.

In summary, the definitions of property values which have been discussed in this section are as follows:

Book value	: accounting book value, both linear and accelerated depreciation book value
Replacement value	: costs of reproduction of a property using square foot cost data
Market value	: appraisal value
Use value	: equivalent space lease cost plus option value of future change of property use

4-4. Systematic selection of future property options

Over a given time frame, the financial value and strategic importance of a corporate property will change because of changes in business and economic conditions. When this occurs, the properties will be or should be used for another purpose. In order to take timely action, it is important to maintain lists of possible conversion options for each property. These options will vary from property to property and will be different for each corporation. However, basic option selection can be generalized for screening before actual choices have to be made. This section proposes general selecting methods for future options.

A corporation's consideration of options for property use changes is usually triggered by a set of conditions (Moreover, these conditions often develop at the time when

the corporation has started to undertake effective property management). The following is a survey of conditions which usually prompt consideration of alternative property uses.

1) Emergency cash requirement : In this case, the corporation has already decided to liquidate some properties which can quickly generate a substantial amount of cash with minimum damage to the corporate operation.

2) Cyclical business environment change : This occurs when the original business purpose of a property becomes obsolete before the physical life of the property has expired.

3) Lease term expiration : When a property lease expires, the corporation has to review the property performance both in terms of financial and strategic perspective.

The above conditions amount to passive motivations and tend to be necessity-driven rather than strategy-driven; therefore, the actions are likely to be "spur-of-the-moment." To avoid this, option possibilities and the data required for their selection should be systematically maintained on an on-going basis.

Although the process of choosing an alternative use option is specific for each property, there are several general areas

of consideration which apply to all cases. They are: 1) hold
versus release; and 2) lease versus ownership.

4-4-1 Hold   versus release

The most basic issue is whether the corporation holds the
property or releases it. The form of holding includes both
lease and ownership; release results in ether liquidation of
the property or termination of the lease contract. The
decision should be based on both financial calculation and
strategic consideration, with more emphasis on the latter.
Related information is listed below.

Financial data

Costs	Benefits
maintenance cost	market value
repair cost	use value (cash flow from
energy cost	property operation)
lease cost	tax shield (depreciation,
tax	expense,debt)
relocation or
move out cost

Strategic considerations
real estate market environment
strategic value
expected future property need

Decisions regarding holding and releasing property should be
made on the basis of a clear understanding of the total value

and contribution of the property to the corporate business
and always with consideration of other possibilities.   It is
therefore essential to also consider strategic value in
making the final decision and to maintain a constant data
collection effort to ensure the selection of the right
options.   Any of the following three conditions is a strong
indication that a property should be considered for
alternative use.

1) Low strategic value and use value : As noted above, the
   original purpose of the property sometimes becomes obsolete
   before the physical life of the property has expired. For
   example, in the industries in which business cycle is
   extremely important, (such as integrated-circuit (IC) chip
   makers), the project life of the property tends to be very
   short. In the transition period of micro-memories
   development, the memory chip manufacturing plants were
   required to change their specifications such as height of
   ceiling and inside air quality after less than a year
   cycle. In a case such as this,when the strategic and use
   value become low, the corporation should review the
   performance of the property and the possibilities of
   alternative use.

2) High market value : National or local changes in economic
   conditions can sometimes cause a property's market value to
   increase drastically. An office building in a booming

downtown area, a warehouse in a waterfront district targeted by developers, or a factory located in rapidly developing suburb could all experience major market value increases. These external condition changes happen regardless of the strategic importance of the property to the corporation. The point is that extremely high market value of the property can often compensate for all other factors making changes of the original property use feasible.

3) High cost of maintaining property : The optimal time for replacement of a property is often reached when the total cost of holding the property increases excessively and the property tax becomes a burden for the corporation. This usually occurs near the end of the physical life of the property when maintenance and repair cost become very expensive. If these costs becomes exorbitant compared with the strategic and use value of the property, the advantages of retaining the property should be carefully reviewed.

One good tool for assessing both the cost of operation and efficiency of management is the microeconomics transfer pricing model. According to Veale (1985, 41-42), approximately two-thirds of all corporations charge some form of internal rent within the corporation. And, 40% of them charge for cost recovery. This internal rental price fairly reflects the efficiency of real estate management; therefore;

it is a good device for the review the cost side information of property. If real estate management takes a clear profit-centered approach and seeks its own profits within the constraints of the maximization of corporate business profits, the RPPM manager has to closely supervise the internal real estate rental situation. The following guidelines should be adhered to in applying this model:

1) The RPPM division charges a constant fee (P) for the space rented to the other division.

2) The RPPM division can estimate the reasonable cost function of the maintenance and control of the space, which is based on the cost function of the main business. Both cost functions can be described by using rented space as a variable.

The optimal internal rental price can be calculated by the following process.

First, profits (π) of each division and total corporate profits have to be calculated. The price which maximize the total profits of the corporation is the optimal price.

The RPPM division's profits (π_r) can be calculated as follows:

$$\pi_r = P \times A - C_r(A)$$

where

$$P = \text{rental price (\$/sf)};$$

A = rented space (sf); and

$C_r(A)$ = cost function of the RPPM division

depending on A.

The main business profits (π_m) can be calculated as follows:

$$\pi_m = NR(A) - P \times A$$

where

$$NR(A) = R(A) - C_m(A)$$

R(A) = revenue of the main business division depending on A

$C_m(A)$ = Cost function of the main business division depending on A

The total profits (π_t) can be calculated as follows:

$$\pi_t = \pi_r + \pi_m = NR(A) - C_r(A)$$

If there is no outside market, maximization of the profits of both divisions and total profits appear under the following conditions.

$$\partial \pi_r / \partial A = P - \partial C_r(A) / \partial A = 0$$

$$P = \partial C_r(A) / \partial A = MC_r$$

where

$$\partial C_r(A) / \partial A = MC_r \text{ (Marginal cost of the RPPM division)}$$

$$\partial \pi_m / \partial A = \partial NR(A) / \partial A - P = 0$$

$$P = \partial NR(A) / \partial A = NMR$$

where

$$\partial NR(A)/\partial(A) = NMR \text{ (Net marginal revenue of the main}$$

business division)

Rental price (P) can therefore calculated as follows:

$$P = MC_r = NMR$$

A graphic representation of this application of the transfer pricing model is shown the next page.

This equilibrium point (P*, A*) shown above gives the corporation maximized profits in terms of space and internal rental cost of space. In practice, it is appropriate to assume that there is a perfect outside market which offers equivalent space at the market price (P_m).
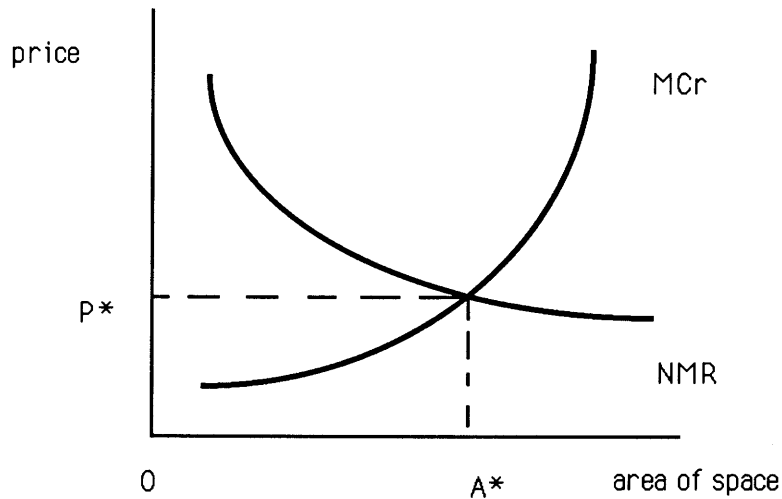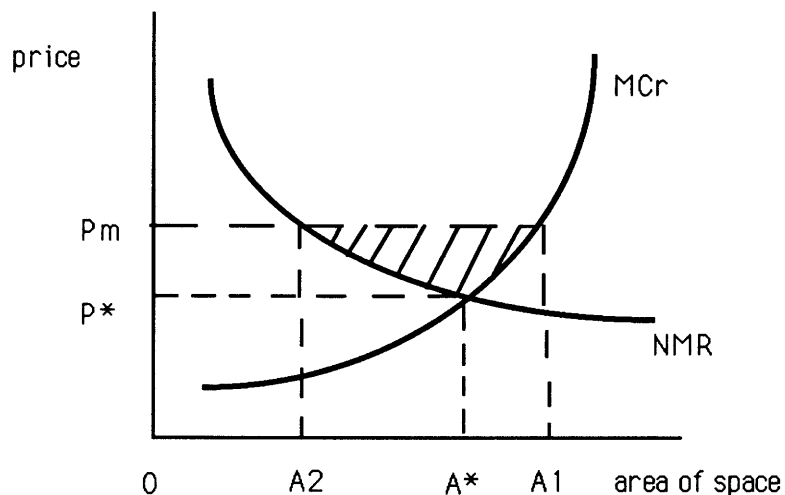

Figure 4-6 Transfer pricing (no outside market)

Figure 4-7 Transfer pricing Pm > P*

In this situation, there are three possible scenarios for the corporation. First, if the market price (Pm) and equilibrium price (P*) are equal, the situation is exactly the same as the result obtained on the basis of there being no outside market. Secondly, if the market price (Pm) is higher than the equilibrium price (P*), the RPPM division offers (A₁) and the main business division rents (A₂) as shown in Figure 4-7. The difference between (A₁) and (A₂) is rented to the outside market. In this case, the corporation can earn economic profits (shown as shaded area) reducing main business space and increasing rental for the third parties. (See Figure 4-7).

The third condition is the reverse of the previous condition. If the market price (Pm) is lower than equilibrium price (P*), the RPPM division offers (A₁) to the main business division and the main business business division rents (A₂)

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shown as Figure 4-8. The main business division rents the space difference of (A₁) and (A₂) from outside markets. This is also produces economic profits for the corporation, shown as the shaded area in Figure 4-8.
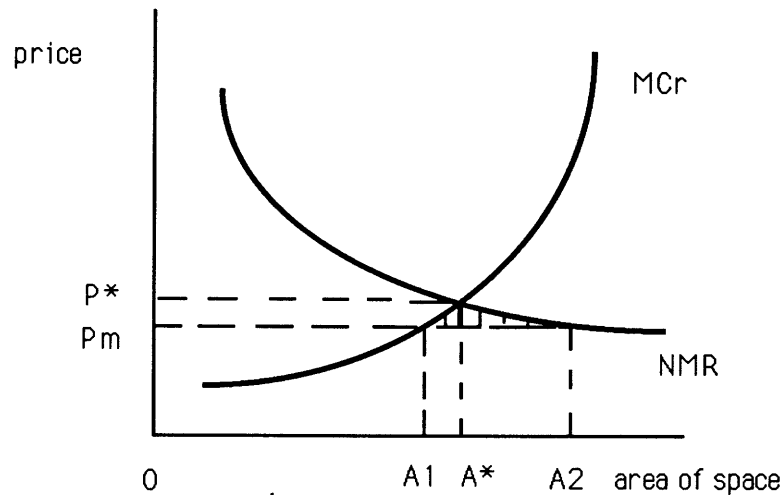

Figure 4-8 Transfer pricing Pm < P*

This transfer pricing model is a useful control on the internal rental price and gives the corporation the supporting data needed to determine whether lease or ownership is better from economic point of view. If the internal equilibrium rental price is higher than the outside market, there will be operational loss for the corporation. The cost for managing the space should be reviewed and trimmed in order to eliminate loss. If the cost is excessively high, the financial calculation indicates that the property should be abandoned by the RPPM division. In extreme cases, perhaps even the division itself should be closed down. Although the final decision has to take into

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account the property's total strategic importance, this check
will function as an effective indication of the effectiveness
level of RPPM. (A numerical illustration is provided in
Appendix 4).

4-4-2 Lease versus ownership

The decision as to whether a property should be leased or
owned is also based on both financial calculation and
strategic considerations. At this level, financial
calculation is sometimes used as the primary basis for the
decision. The basic financial categories and symbols used
are the following:

Present value	Ownership	Lease
Initial investment	-IN	0
Lease payment	0	-LP
Salvage value of property	+SV	0
Maintenance cost	-MC1	-MC2
Use value		
(Cash flow from property operation)	+UV	+UV
Tenant area finish cost	-TC1	-TC2
Investment tax credit	+ITC	0
Capital gain tax	-CT	0
Property tax	-PT	0
Tax on cash flow from property operation	-OT	-OT
Depreciation tax	+DS	0

shield		
Lease payment tax shield	0	+LS
Tax shield of maintenance expense	+MS1	+MS2
Tax shield on debt interest	+IS1	+IS2
Net present value	NPV1	NPV2

A simple financial calculation demonstrates that if NPV1 is greater than NPV2, the corporation should invest in the property and hold it as its own. If NPV2 is greater than NPV1, the property should be leased. As shown in the list above, the issues related to tax and tax shield are major factors affecting the decision.

Lease confers some general benefits on the lessees as listed below.

- Flexibility of short-term lease: Short-term lease is sometimes convenient for the corporation if it needs general space, such as, office space, and a short project life is expected. In a case like this, leasing gives the corporation the flexibility to relocate the space and the opportunity to rid itself of the initial investment, heavy fixed cost, and debt service. Furthermore, if the contract of the lease allows the corporation to terminate the lease in the middle of the contract term, then the corporation has

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a valuable option for coping with unforeseen difficulties at a later date.

- Reduction of fixed cost: Depending on the terms of the contract, a lessor is usually responsible for major maintenance and repair costs. Therefore, the lessee can often eliminate tedious and expensive housekeeping tasks and use the space without excessive administrative overhead costs.

- Extra tax shelter : As shown on the list above, several items are related to tax shield. The lease contract sometimes allows a lessee to share the tax shield with a lessor possibly in the form of low lease payment.

Although financial information is important for the selection of lease or ownership, the final decision should be made considering the problems of financial calculation and other non-financial issues as well. Some of the potential problems stemming from a reliance on financial calculation are listed below.

- Determination of discount rate : Net present value calculation is the selection of discount rate. Especially, in the case of a long-term lease, a fixed discount rate is hypothetical and can cause errors in calculation. In practice, WACC (weighted average cost of capital) is used to calculate the discount rate for

cash flow generated from property operation and initial investment. This means that the corporation requires the same level of return from the investment in the property. There is room for the corporation to reconsider the discount rate for the investment in the property. If the corporation automatically applies the same discount rate to the property investment without recognition of the meaning of the discount rate, the resulting calculation may be misleading.

• Salvage value: For a lessor or for the owner, the salvage value of the property is an important factor which affects the final result of the NPV calculation. In the most simple cases, a discounted future land price is used for the salvage value of the property, and the value of the facility on the land is ignored. In practice, the property price is highly unpredictable although it is generally on the appreciating trend. In the financial calculation, the salvage value appears only on the end term of the project, and it is considerably affected by the assumption of the rate of the appreciation and discount rate.

Some of the important non-financial issues which should be taken into account when deciding between lease and ownership are described below.

- Specialization of the property: If the property serves
  a highly specialized function within the corporate
  structure, the corporation is required to exert extra
  effort to arrange an appropriate lease contract. As a
  result, the lease price may not be necessarily
  competitive, and administrative duties concerning the
  property may increase.

- Long-term flexibility: If the corporation leases the
  property and has to change its specifications
  frequently, the corporation will have to absorb the
  time and costs involved because the usual lease
  contract limits the right of the lessee to change the
  finish of the property. In fact, it is almost
  impossible for the lessee to change the original use
  of the property completely.

  If the corporation has a fairly clear idea when the
  property will be no longer be needed, the short-term
  lease offers the advantage of flexibility in terms of
  property disposition and change of location. On the
  other hand, timing of future change of the use is
  unpredictable, and furthermore, it is likely to happen
  frequently. But having the privilege to convert the
  property according to corporate requirements gives
  ownership the advantage of long-term flexibility.
  Therefore, the option value of the right of conversion

should be determined at the initial decision making process.

- Market trend speculation: When the corporation selects a form of ownership, it changes short-term assets (cash) into long-term assets (property). If the corporation considers ownership of the property purely as an investment, speculation on the future value of the property necessarily becomes a major concern. This situation requires the corporation to analyze the macro and micro-economical issues and carefully review the regional and national real estate market trends.

4-5 Conclusions

This chapter has discussed several concepts which can be used for understanding corporate real estate portfolio structure with specific emphasis on strategic issues. Although intermediate profits generated from each property can be used to quantitatively determine strategic value, this methodology is not applicable to properties which do not directly generate cash flow from operational use. A qualitative ranking method is more widely applicable for both the property level and cluster level in the portfolio, and, moreover, it is helpful to evaluate portfolio structure by defining linkage between properties and clusters.

In addition, several important quantitative value of
corporate real estate has been defined in this chapter.
Among them, use value is especially important for corporate
real estate as a means of evaluating benefits from ownership
of property. The option pricing model was proposed for the
quantitative determination of use value.

In order to take timely action in managing corporate real
estate, it is beneficial to maintain scenarios of potential
alternative property use. General screening methods for
choosing between both hold and release, and between ownership
and lease has been discussed along with several key
indicators for decision making.

Chapter 5 Conclusion

As indicated in the introduction, in this thesis, I focus on
two issues: (1) the application of financial portfolio theory
to RPPM; and, (2) the development of a systematic process for
maintaining a clear picture of the corporate real estate
portfolio structure. In this final chapter, the RPPM concept
and the specific methods of implementation proposed in the
proceeding chapters are reviewed.

5-1 Financial aspects: Applications of financial portfolio theories to RPPM

Current research on the application of financial portfolio
theory to real estate portfolio management demonstrates that
no one portfolio theory can be easily applied directly to
real estate portfolio management. The concept which has the
greatest potential for success in RPPM is the capital asset
pricing model (CAPM). Even though research on CAPM
applications to real estate is still on the academic level,
and even though some basic CAPM assumptions are likely to be
violated when applied to real estate, a great deal of
research concentrates on the application of CAPM because it
is a well-established, proven concept in the financial
security management. With some revisions, CAPM can be
adapted to RPPM making it possible to conveniently manage all
assets and securities under one unified theory.

In the attempt to find an effective way to avoid violations of basic CAPM assumptions and also to simplify real estate return analysis, several studies focus on securitized real estate, such as REIT (Real Estate Investment Trust). Securitized real estate is in fact a financial security, and, therefore, the CAPM (and other concept of financial portfolio theories as well) are logical choices for evaluating its performance. However, this approach introduces another significant research issue: the relationship between the performance of securitized and unsecuritized real estate. For example, research on securitized real estate assumes that its performance is an exact reflection of the performance of real estate which is owned by the institution issuing the securities. In brief, there are still many unsolved, controversial issues underlying securitized versus unsecuritized real estate, and research in this area is still in the exploratory stage.

The fundamental problem is how to assess the risk factor in real estate. Almost all financial portfolio theories are based on the assumption of investors' mean-variance utility function; therefore, risk is measured as the fluctuation of return from real estate operation. One general finding of the research concerning the application of financial portfolio theory is the low risk of real estate return. Risk-adjusted return in real estate is considerably higher than in other financial securities implying that real estate

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investment is safer than financial securities such as stocks and bonds. However, common sense and a little experience in real estate investment lead to the opposite conclusion: real estate investment _is_ risky business. But research on the subject of non-variance risk in real estate has been sparse. This is cause for some concern because the success of future research on the application of portfolio theory to real estate depends to a great extent on the development of a systematic method of determining the non-variance risk component of real estate.

The need to diversify real estate portfolios is one valuable lesson learned from portfolio theory. It would seem that diversification might be an effective way to control and reduce the large unsystematic risk factor in real estate return; however, the unsystematic risk factor is so large that it is difficult to devise a method of diversification which can adequately deal with the subtle differences between properties. Diversification categories will, of necessity, be generalized causing specific differences to be overlooked or misinterpreted, resulting in widely different risk-return profiles within the same portfolio. Furthermore, not only does the heterogeneity factor make it difficult to develop adequate general diversification categories, but the broadness of the different categories themselves--property type, size, region, and so forth--could make determination of specific risk factors difficult.

Clearly then, diversification categories should be developed

based on considerations of the cost and benefit trade offs

involved in diversification. Furthermore, certain restraints

need to be applied to diversification in all cases, but

especially in the area of corporate real estate. For

example, certain diversification categories, such as property

type and region, are inappropriate because the acquisition

purpose for corporate real estate simply denies flexibility

of choice in these categories.

From this point of view, the most applicable diversification

category for corporate real estate is the form of ownership.

The selection of ownership or lease and the selection of

lease structure allow the corporation to achieve some

diversification benefits without the extra cost of

diversification and without detriment to the strategic

necessity of corporate real estate. (The general

consideration of selection of ownership is discussed in

section 4-4) It should be emphasized also that the

quantitative analysis of diversification through selection of

form of ownership is an area of much needed research.

5-2 Strategic aspects: Process for maintaining a clear picture of the corporate portfolio structure

The first step in understanding strategic value of corporate

real estate is to assess the corporation's level of

development. There is a general rule that the more a corporation develops, the more the financial aspects of corporate real estate will be emphasized. Therefore, in order to determine the general management attitude toward corporate real estate, it is important to assess corporate development. For this purpose, a general assessment table is provided in section 4-2.

The next step is to determine the specific strategic value of the corporate properties. First, intermediate profits generated through the use of a specific property are posited as a quantitative measurement of the property's strategic value. This definition is applicable especially for properties which are at the center of value-add activities. The distinction between this concept of strategic value and the cash flow generated by property operation should be duly noted. This quantitative approach measures the contribution of a specific property to corporate operations as the strategic value of the property; therefore, if the generated cash flow of the business using the specific property decreases, the strategic value of the specific property also decreases. In effect, the property's monetary contribution to the corporate business is the most direct measurement of strategic value.

A more widely applicable method is the qualitative ranking method. This process is directly related to understanding

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how the corporate real estate portfolio is constructed because in this process the strategic importance of a property is viewed in connection with other corporate properties. The corporate properties are first divided into several clusters on the basis of business purpose. Linkages between the clusters are analyzed in order to determine the main structure of the corporate real estate portfolio. Based on the linkage patterns, each cluster is ranked within five developmental levels arranged in the order of their strategic importance for the main business of the corporation. Next, linkage of properties within each cluster is determined, and the strategic importance of each property is ranked in five categories. Finally, cluster number, cluster rank, and property rank are assigned to each property in order to describe its strategic importance, thus enabling the generation of both cluster level and property level. This method is widely applicable regardless of portfolio size and complexity.

Another important value for the corporate properties is use value. In this thesis, use value is defined quantitatively as the sum of the equivalent lease cost and the future option value of the properties, and the option pricing model is applied to evaluation of the future option value. The option pricing model is also effective in determining the quantitative evaluation of an owner's right of future change of original use. The Black-Scholes option pricing model is

used for this purpose and provides reasonable results for financial securities when (1) the term of maturity is short (less than a few months) and (2) the difference between the current price of underlying assets and the execution price is not substantial, based on empirical tests in the financial securities market.

However, the application of the financial option pricing model to the evaluation of property use value tends to violate the above two conditions. Therefore, determination of the effectiveness of the option pricing model application should be considered only on the basis sufficient data. Applications of option pricing model to determine use value is still in the introductory level, and thus, the empirical testing of its application to use value assessment needs to be researched in more detail.

Finding as effective method for selecting select alternative use of properties is another strategic consideration. In general, the best alternative use of properties differs from property to property. However, there are following two general considerations for every property: (1) hold versus release, and (2) ownership versus lease. Transfer pricing model is introduced as a decision-making tool for both these considerations. This model is effective in evaluating internal rental price and is a good indicator of the efficiency of real estate management.

5-3 RPPM process: Total perspective

Finally, the entire RPPM process will now be reviewed in order to clarify the relationship between its financial and strategic aspects. As illustrated in Figure 5-1, the RPPM process has three major stages: the formation stage, the assessment stage, and the action recommendation stage. The formation stage is the preparation for initiating RPPM. Because RPPM objectives are set at this stage, it has considerable impact on the execution and outcome of RPPM. There are three main concerns in this stage. The first is the setting of RPPM objectives. Each corporation has specific needs which RPPM must fulfill. One corporation may emphasize financial and profit-making aspects of corporate real estate, while another may emphasize strategic use. Secondly, the task setting of RPPM is also accomplished at this stage. While RPPM tasks are generally the same in all corporations, important fine-tuning of specific task designations among related management areas is necessary for each corporation. It is also important at this level to estimate RPPM's entire scope of activities and the total perspective of RPPM in terms of budget and human resource allocation in order to provide an outline of RPPM activities for top level management.

Finally, the formation process has to include the formation of the organization of the RPPM division. Because the

success of RPPM depends largely on a well-established information exchange between the RPPM division and top management level, the organizational formation must be executed so as to secure the status of the RPPM division within the corporation and to ensure a favorable management attitude toward RPPM.

In the assessment stage, the objectives of daily RPPM operation and data accumulation are clearly defined. The specific focus here is on the recognition of the current status of corporate real estate. This is a fundamental aspect of RPPM, and consists of two main issues: assessment of corporate development status and assessment of portfolio structure.

As discussed earlier, RPPM needs to be formalized after a corporation has reached a mature level of development. Accordingly, if the corporation has accumulated extensive real estate holdings, but has not yet established the RPPM division, its corporate real estate will most likely be undermanaged. (A general assessment process for the corporate development stage in terms of corporate real estate management is provided in section 4-2).
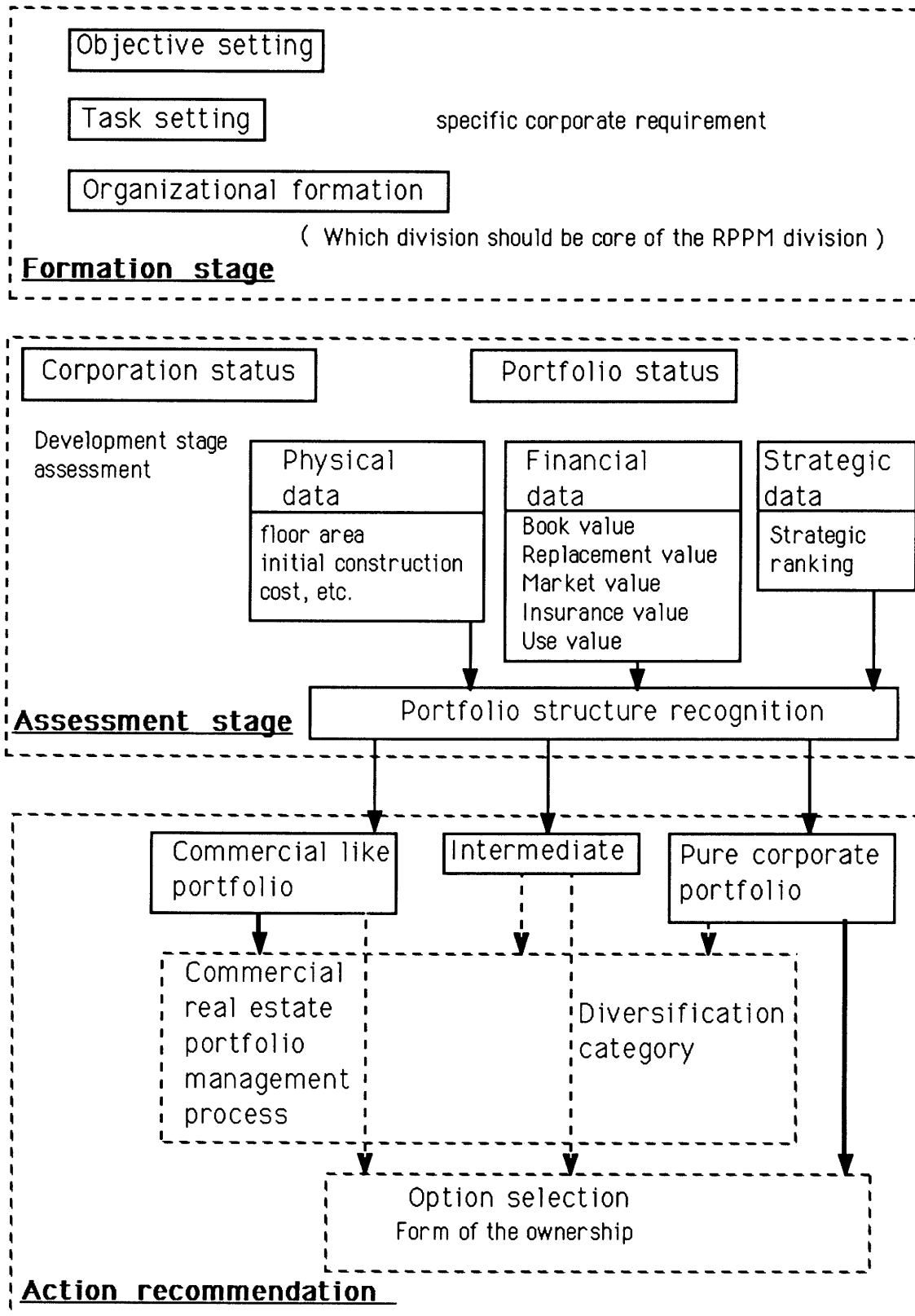
Figure 5-1 The real property portfolio management process

Formation stage

Objective setting

Task setting   specific corporate requirement

Organizational formation

(Which division should be core of the RPPM division)

Assessment stage

Corporation status   Portfolio status

Development stage
assessment

Physical data
floor area
initial construction
cost, etc.

Financial data
Book value
Replacement value
Market value
Insurance value
Use value

Strategic data
Strategic ranking

Portfolio structure recognition

Action recommendation

Commercial like portfolio   Intermediate   Pure corporate portfolio

Commercial real estate portfolio management process

Diversification category

Option selection
Form of the ownership

The understanding of corporate real estate structure is a key factor in the development of effective RPPM. The corporate real estate portfolio will include various types of properties each with different importance in

the corporation. In order to make the structure of the portfolio clear, the RPPM division should collect basic data on each property. If a corporation pays no attention to its real estate before the RPPM division is established, it will have to begin by collecting physical property data such as floor area, date of completion, and cost of initial construction. Following this, the financial and strategic value of properties should be determined and monitored. Property value is described mainly by book value, replacement value, insurance value, market value, and use value of properties. The use value is most important for corporate real estate management and also most difficult to determine. While strategic value is another important corporate real estate value, the strategic importance of properties is determined by a qualitative ranking method. This process is helpful in clarifying how current corporate real estate portfolios are structured.

The corporate real estate portfolio is likely to be categorized as follows: pure corporate real estate, intermediate real estate with both corporate and commercial real estate characteristics, and a corporation's commercial

holdings. High ranked clusters or properties are generally categorized into pure corporate real estate while those of low ranked are likely a commercial holdings. This categorization is necessary to resolve conflicts between the financial performance of corporate real estate and its strategic needs.

The third stage of RPPM is action recommendation. For the management of corporate "commercial" properties, the commercial real estate portfolio management process is helpful. Unfortunately, as mentioned earlier, there is no portfolio theory which is practically applicable for real estate portfolio management. But risk-return analysis is fundamental for investment evaluation even though modern portfolio theory lacks a method of evaluating the non-variance risk of real estate. The basic process of risk-return analysis should be understood in order to develop a profit-centered management approach to corporate real estate. For the totality of corporate real estate, especially for pure corporate real estate, options for future alternative use should be considered systematically, on the basis of the key issue of selection of form of ownership.

These three main stages of RPPM are not independent but rather interact to continue the effective exchange of information with upper management. Because of continual changes in the main business of corporation, the corporate

real estate structure is always changing and continuous
effort for updating the information of corporate real estate
is essential.

The area of study RPPM is still at the starting point. Many
related areas should be investigated before the final result
is reached. I hope that this thesis will encourage many
readers who are interested in this field to go through
further research.

Appendix 1   Capital asset pricing model

The following is a brief explanation of the development of the capital asset pricing model.

Based on Markowitz's assumptions, If an investor constructs a portfolio with a mixture of all assets in the market, the relationship between expected return and variance of return of the portfolio must appear in the shaded area which is shown in Figure A1-1.
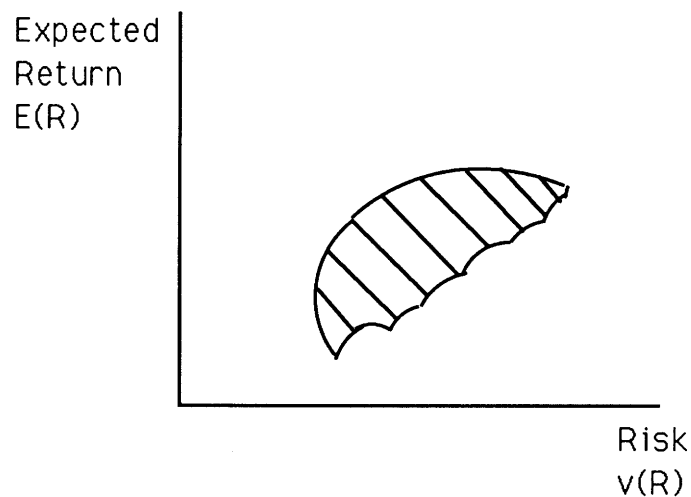
Figure A1-1 Portfolio selection

Because investors seeks maximum profits with minimum risk (variance), they prefer portfolios along the heavy line in Figure A1-2. (If a portfolio is not on the heavy line, there is always another portfolio which provides higher return with the same risk). A portfolio on the heavy line is called an efficient portfolio, and the heavy line is called an efficient frontier. The Markowitz model tells us that the

portfolio which is at the point where the efficient frontier
and each investor's utility function converge is the best
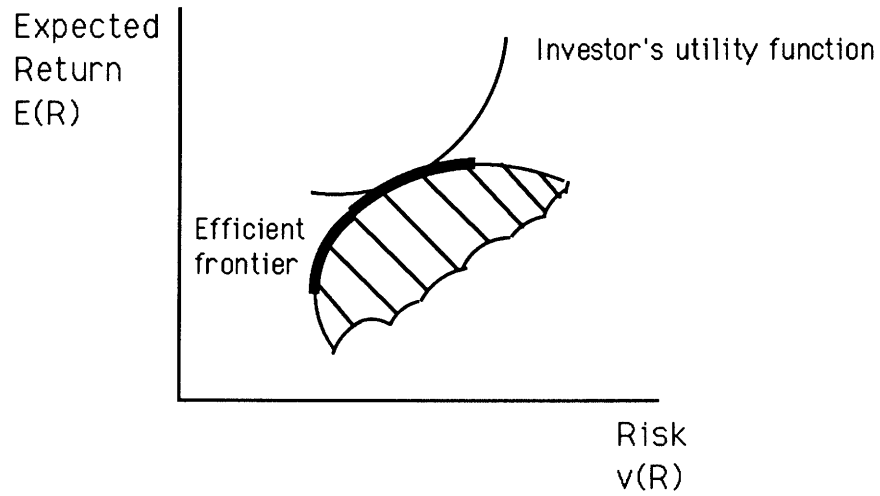portfolio for the investor (see Figure A1-2).
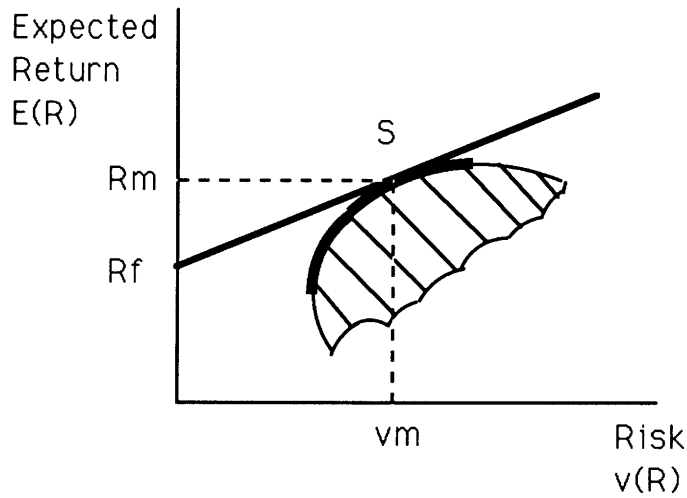

Figure A1-2 Efficient frontier and utility function

Figure A1-3 Capital market line

The crux of CAPM is that it introduces risk-free lending and
borrowing. If there is risk-free rate (R_f) which is equal
for both lending and borrowing, an investor can obtain any

combination of expected return and risk along the straight line joining (R_f) and point (S) in Figure A1-3 through a combination of lending and borrowing (R_f) and (S). Although This line can be drawn with (R_f) and any portfolio in the shaded area, again in order to maximize expected return with minimum risk, this line should be a tangent of efficient frontier. The portfolio at the point (S) is called <u>market portfolio</u> and the tangent line is called <u>capital market line</u>(CML). Thanks to the CML, we do not have to worry about an investor's utility function in order to find the most efficient portfolio because every investor has to maintain this portfolio regardless of his utility function, and, furthermore, the investor's utility function has to contact the CML. For the preparation for the next step, bear in mind that the slop of the CML is equal to ($E(R_m) - R_f)/v_m$.

Consider the slope of the CML from a different point of view. If a portfolio consists of a% invested in risky asset (I) and (1 - a)% in the market portfolio, expected return ($E(R_p)$) and risk ($v(R_p)$) of this portfolio is described as follows:

$E(R_p) = aE(R_i) + (1 - a)E(R_m)$

$v(R_p) = [a^2v_i^2 + (1 - a)^2v_m^2 + 2a(1 - a)v_{im}]^{1/2}$

Therefore,

$\partial E(R_p)/\partial a = E(R_i) - E(R_m)$

$\partial v(R_p)/\partial a = 0.5[a^2v_i^2 + (1 - a)^2v_m^2 + 2a(1 - a)v_{im}]^{-1/2}$

$$x \ [2av_i{}^2 - 2v_m{}^2 + 2av_m{}^2 + 2v_{im} - 4av_{im}]$$

In the case of the market portfolio, (a) should be equal to zero because a market portfolio is already in equilibrium. Therefore, substitute (a) = 0 for the second equation:

$$\partial E(R_p)/\partial a = E(R_i) - E(R_m)$$
$$\partial v(R_p)/\partial a = (v_{im} - v_m{}^2)/v_m$$

From these equations, the slope of the CML can be defined as follows:

$$(\partial E(R_p)/\partial a)/(\partial v(R_p)/\partial a) = (\partial E(R_p)/\partial v(R_p))$$
$$= (E(R_i) - E(R_m))/((v_{im} - v_m{}^2)/v_m)$$

This should be equal to $(E(R_m) - R_f)/v_m$

Therefore;

$$(E(R_m) - R_f)/v_m = (E(R_i) - E(R_m))/((v_{im} - v_m{}^2)/v_m)$$

This relationship can be arranged to solve $E(R_i)$ as follows:

$$E(R_i) = R_f - \text{ß}(E(R_m) - R_f)(v_{im}/v_m{}^2)$$

where

$$\text{ß} = (v_{im}/v_m{}^2)$$

This is the final formula of the CAPM. This equation describes the relationship between return and risk in a simple linear fashion.

Appendix 2   Arbitrage pricing theory

The arbitrage pricing model (APT) is based on a general factor model which can be written as follows:

$$R_i = a_i + b_iF_1 + b_{i2}F_2 + \cdots\cdots + b_{im}F_m + e_i$$

where;

a_i = non-factor-related return

b_i = sensitivity of factor (i)

F_i = the value of factor (i)

m = the number of factors based on the assumptions that the expected value of each security-specific return is zero;

security-specific returns are uncorrelated with factors; and

security-specific returns are uncorrelated with each other.

If we assume that there are many securities and that sensitivities to the factors differ substantially among securities, it should be possible to construct a portfolio which satisfies the following conditions:

1) Sensitive to factor 1.

2) Unaffected by every other factor.

3) So highly diversified that security-specific returns can be eliminated.

The expected return from a pure factor portfolio will depend on the expected value of the relevant factor. Therefore, the expected return on a pure factor (i) portfolio ($E(R_i)$) is:

$E(R_i) = R_f + r_i$

where;

R_f = the riskless rate of interest rate

r_i = the difference between the expected return and the riskless rate (i.e., the expected return premium per unit of sensitivity to the factor)

If ($R_f + r_i$) is different between two different factors, an investor can earn arbitrage profits to use in lending and borrowing (i.e., purchasing the securities in the higher-expected-return portfolio and selling those in the lower-expected return portfolio). Therefore, all factor (i) portfolios will have the same expected return ($R_f + r_i$) and arbitrage would insure that the expected return on security k would be

$$E_k = R_f + b_{k1}r_i + b_{k2}r_2 + \cdots\cdots + b_{km}r_m$$

This equation is the general form of the APT.

Appendix 3   Use value evaluation by option pricing model

In applying the option pricing model to use value determination, the following conditions are necessary:

1) The corporation does not intend to renovate the property, and only considers possibility of liquidation of the property; therefore, use value can be defined as the sum of equivalent rental cost and liquidation option value.

2) These conditions are given:

   Remaining physical life of property = 10 years

   Net present value of equivalent lease cost = $450/sf

   Net present value of operational costs = $150/sf

   Net present value of market value of the property = $1,000/sf

   risk-free interest rate = 5%

Under these conditions liquidation option value is calculated as Figure A4.

If expected future variance of market value is 0.2, liquidation option value is $157.7. Therefore, the total use value is $607.7 (equivalent lease cost, $450, plus liquidation option value, $157.7).

Stock price($)=	600	(Net present value of equivalent lease cost & operational cost)					
Exercise price($)	1000	(Market value of the property)					
time to reach							
matuirity (year)	10						
riskless							
interest rate =	1.05						
variance	x	x-vt	k1	k2	N(x)	N(x-vt)	Put
1	1.574	-1.588	0.7328	0.731	0.9422	0.0561	544.82
0.8	1.256	-1.274	0.7746	0.7721	0.8954	0.1013	488.95
0.6	0.937	-0.961	0.8217	0.818	0.8255	0.1683	405.88
0.4	0.614	-0.651	0.8754	0.869	0.7305	0.2577	294.03
0.2	0.28	-0.352	0.9391	0.9245	0.6103	0.3622	157.68

Figure A4 Option value calculation

As Figure A4 shows, this calculation is sensitive to expected variance, especially if time to reach maturity is long (in this case (t) = 10 years). Although the result is also sensitive to risk-free interest rate, it is relatively stable compared with variance of market value. Market value of the property is the only value which should be estimated for this calculation; therefore, accuracy of this estimation is crucial in determining the result.

Appendix 4   Numerical example of transfer pricing theory

For the numerical calculation of a transfer price, suppose that the following conditions are provided.

The RPPM division's cost function $C_r(A)$;

$$C_r(A) = A^2 - 199,800A + 25 + F(x)$$

The main business division's cost function $C_m(A)$;

$$C_m(A) = -0.5A^2 + 100,000A + 30 + G(y)$$

The main business division's revenue function $R(A)$;

$$R(A) = 200A + H(z)$$

where

$F(x)$, $G(y)$, $H(z)$: other variables related to each cost function and revenue function

A = rented space (A)

Under these given conditions the optimal transfer price is arrived at:

By calculating the RPPM division's profit (π_r) and the main business division's profit (π_m) follows:

$$\pi_r = P \times A - C_r(A)$$

$$= P \times A - A^2 + 199,800A - 25 - F(x)$$

$$\pi_m = R(A) - C_m(A) - P \times A$$

$$= 200A + H(z) - 0.5A^2 + 100,000A - 30 - G(y) - P \times$$
$$A$$

The first derivative of (π_r) and (π_m) should be zero at the optimal operation level; therefore;

$$0 = \partial\pi_r/\partial A$$
$$= P - 2A + 199,800$$

$$0 = \partial\pi_m/\partial A$$
$$= 100,200 - A - P$$

From these two equations, we can determine both (P) and (A):

$$P = 200 \ (\$)$$
$$A = 100,000 \ (sf)$$

The above result is the optimal internal rental price and operation space.

Bibliography

[Articles]

Antia, M., S.Kapplin, and R. Meyer [1983] "A certainty-Equivalent Approach to thew Valuation of Risk Real Estate Investments" Real Estate Issues: 15-20, Fall/winter

Black, F., and M. Scholes [1973] "The Pricing of Options and Corporate Liabilities" Journal of Political Economy, vol 81, 631-654, May-June

Black, F. [1972] "Capital Market Equilibrium with Restricted Borrowing" Journal of Business, 444-455 July

Black, F., M. C. Jensen, and M. Scholes, "The capital Asset Pricing Model: Some Empirical Tests" Studies in the Theory of Capital Market. Praeger, New York, 1972, 79-124

Bogue, M. C. and R. R. Roll [1974] "Capital Budgeting of Risky Projects with 'Imperfect' Markets for Physical Capital", Journal of Finance: 601-613, May

Bon, R. [1988] "Replacement simulation model: a framework for building portfolio decisions" Construction Management and Economics, 149-159 vol 6

Bon, R. [1990] "Real Property Portfolio Management (RPPM): A Case in Decision-Support System Development" unpublished research paper

Blume, M.,and I. Friend, "A New Look at the Capital Asset Pricing Model" Journal of Finance, March 1973, 19-34

Brennan, M. J. [1970] "Taxes, market Valuation and Corporation Financial Policy" National Tax Journal, December, 417-427

Breeden, D. T. [1979] "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunity" Journal of Financial Economics, vol 7, 265-269, September

Brueggeman, W., A. Chen, and T. Thibodeau [1984] "Performance and Portfolio Considerations" AREUEA(American Real Estate and Urban Economics Association) Journal: 333-354, Fall

Burns, W. L. and D. R. Epley [1982] "The Performance of Portfolios of REITS and Stocks" Journal of Portfolio Management, Spring

Conroy, B., M. Miles, and C. Wurtzbech [1986] "A Practical View of Real Estate and Modern Portfolio Theory" Industrial Development: 11-20, May/June

Conroy, B., M. Miles, and C. Wurtzbech [1986] "Institutional Real Estate Investment" Industrial Development: 5-10, July/August

Cullen, T. F. and B. Blake [1980] "How Does Real Estate as an Investment Compare with Stocks and Bonds" Trusts and Estates, July

Curcio, R. J., J. P. Gaines, and J. R. Webb. [1981] "Alternatives for Assessing Risk in Real Estate Investments" Real Estate Issues: 25-32, Fall/Winter

Del Casino, J. J. [1985] "on Assembling Real Estate Portfolios" Real Estate Issues: 47-49, Fall/Winter

Draper, D. W. and M. C. Findlay [1982] "Capital Asset Pricing and Real Estate Valuation" AREUEA Journal: 152-183, Summer

Fama, E. F. [1970] "Multiperiod Consumption-Investment Decisions" American Economic Review, LX(March), 163-74

Fama, E. F. [1977] "Risk-Adjusted Discount Rates and Capital Budgeting Under Uncertainty" Journal of Financial Economics: 3-24, August

Fama, E. F. and J. MacBeth, [1973] "Risk, Return and Equilibrium: Empirical Test" Journal of Political Economy, May/June, 607-636

Fama, E. F. and G. Schwert [1977] "Asset Returns and Inflation" Journal of Financial Economics, November

Farragher E.J. [1984] "Corporate Real Estate Asset Decision-Making" The Real Estate Appraiser and Analyst: 13-17, Fall

Findlay, M. C., C. W. Hamilton, S. D. Messner, and J.S. Yormark [1979] "Optimal Real Estate Portfolios" AREUEA Journal: 298-317, Fall

Findlay, M. C., R. McBride, J. Yormark, and S. Messner, [1981] "Mean-Variance Analysis for Indivisible Assets" Omega 9:1 77-88, February

Fischer, S. [1978] "Call Option Pricing when the Exercise Price is Uncertain, and the Valuation of Index Bonds" Journal of Finance, vol 33, No.1 March

Fogler, H. R. [1983] "A Mean-Variance Analysis of Real Estate" Journal of Portfolio Management, Winter

Friedman, H. [1971] "Real Estate Investment and Portfolio Theory" Journal of Financial and Quantitative Analysis: 861-874, March

Hartzell, D. J. Hekman, and M. Miles [1986] "Diversification Categories In Investment Real Estate" AREUEA Journal: 230-254, Summer

Higgins, R. C., and H. R. Cunningham, [1970] "Computerized Calculations - Rates of Return and Risks in Commercial Properties" The Appraisal Journal : 37-49, January

Hoag, L. [1979] "A Real Estate Return Index: Measurement of Risk and Return", Proceedings of the Seminar on the Analysis of Security Prices, University of Chicago : 223-259, May

Hoag, J. [1980] "Towards Indices of Real Estate Value and Return" Journal of Finance: 569-580, May

Ibbotson, R. G., J. J. Diermeir, and L. B. Siegel [1984] "The Demand for Capital Market Returns: A new Equilibrium Theory" Financial Analysis Journal: 22-33, January/February

Ibbotson, R. G. and C. L. Fall [1979] "The United States Market Wealth Portfolio" Journal of Portfolio Management: 82-92, Fall

Ibbotson, R. G. and L. B. Siegel [1983] "The World Market Wealth Portfolio" Journal of Portfolio Management: 5-17, Winter

Ibbotson, R. G. [1984] "Real Estate Returns" A Comparison With Other Investments AREUEA Journal: 219-242, Fall

Ibbotson, R. G., J. J. Diermeier, L. B. Siegel [1984] "The Demand for Capital Market Returns: A New Equilibrium Theory" Financial Analysts Journal, January-February

Kain, J. and J. Quigley, [1970] "Measurement the Value of Housing Quality" Journal of the American Statistical Association 65:330 : 532-548, June

Lintner, J. [1965] "The Valuation of Risk Assets and The Selection of Risky Investments in Stock Portfolios and Capital Budgets" Review of Economics and Statistics: 13-37, February

Lusht, K. [1988] "The Real Estate Pricing Puzzle", AREUEA Journal 16(2) :95- 104, Summer

Maduara, J. [1983] "How to Construct Real Estate Portfolios" Real Estate Issues: 13-14, Fall/Winner

Majd, S., and R. S. Pindyck [1987] "Time to Build, Option Value and Investment Decision", Journal of Financial Economics, vol 18, 7-27

Markowitz, H. M. [1952] "Portfolio Selection" Journal of Finance 8: 77-91, March

Mayers, D. [1972] "Non-Marketable Assets and the Capital Market Equilibrium under uncertainty" Studies in th Theory of Capital Markets, Praeger, New York, 223-248

Melnikoff, M [1984]"A Note on the Dawn of Property Investment by American Pension Funds" AREUEA Journal: 401-407, Fall

Merton, R. C. [1970] "A Dynamic General Equilibrium Model of the Asset Market and Its Application to the Pricing of the Capital Structure of the Firm" Working Paper No. 497-70, Sloan School of Management, M.I.T. October

Merton, R. C. [1973] "The Theory of Rational Option Pricing" Bell Journal of Economics and Management Science, vol 4, 173-174

Miles, M. and T. McCue [1982] "Historic Returns and Institutional Real Estate Portfolios" AREUEA Journal: 184-199, Summer

Miles, M. and T. McCue [1984] "Commercial Real Estate Returns" AREUEA Journal: 355-377, Fall

Miller, M. and M. Scholes, "Rates of Return in Relation to Risk: A Re-examination of Some Recent Findings" Studies in the Theory of Capital Markets, Praeger, New York, 1972, 223-248

Myers, S. C., and S. Majd [1983] "Calculating Abandonment Value using Option Pricing Theory" M.I.T. Working Paper, No. 1462-83, August

Paddock, J. L., D. R. Siegel, and J. L. Smith [1983] "Option Valuation on Claims or Physical Assets: the Case of Offshore Petroleum Leases", M.I.T. Energy Laboratory Working Paper, No. MIT-EL 83-005WP, February

Pellatt, P. [1972] "Risk and Return: Instability of Earnings as a Measure of Risk", Land Economics: 229-261, May

Pyhrr, S. A. [1973] "A Computer Simulation Model to Measure Risk in Real Estate Investment" The Real Estate Appraiser: 13-31, May-June

Roll, R. [1977] "A Critique of the Asset Pricing Theory's Tests; Part I: On past and Potential Testability of the Theory" Journal of Financial Economics 4: 129-176, March

Ross, S. [1976] "The Arbitrage Theory of Capital Asset Pricing" Journal of Economics Theory: 341-360, December

Roulac, S. E. [1976] "Can Real Estate Returns Outperform Common Stocks?" Journal of Portfolio Management: 26-43, Winter

Roulac, S. E. and D. A. King, Jr. [1977] "Institutional Strategies for Real Estate Investment" The Journal of Portfolio Management: 58-65, Summer

Roulac, S. E. [1977] "Real Estate Investment Analysis and Valuation: Economic Analysis, Disclosure, and Risk" Real Estate Issue: 8-25, Winter

Roulac, S. E. [1981] "How to Structure Real Estate Investment Management" Journal of Portfolio Management: Fall

Roulac, S. E. and R. C. Cirese [1986] "A Risk Analysis Matrix to Improve Investment Decision" Real Estate Review: 36-40, Fall/Winter

Sharp, W. [1964] "Capital Asset Prices: A theory of Market Equilibrium Under Conditions of Risk" Journal of Finance: 425-442, September

Scmalensee, R. [1981] "Risk and Return on Long-Lived Tangible Assets", Journal of Financial Economics 9: 185-205

Smith, K. V. and D. Shulman [1976] "The Performance of Equity Real Estate Investment Trusts", Financial Analysts Journal: 61-66 September-October

Stulz, R. [1982] "Options on the Minimum or the Maximum of two Risky Assets", Journal of Financial Economics, vol 10

Titman, S. and A. Warga [1986] "Risk and the Performance of Real Estate Investment Trusts: A Multiple Index Approach" AREUEA Journal: 414-431, Fall

Ross, S. [1976] "The Arbitrage Theory of Capital Asset Pricing" Journal Of Economic Theory, 341-360, December

Webb, J. R. [1984] "Real Estate Investment Acquisition Rules for life Insurance Companies and Pension Funds: A Survey" AREUEA Journal: 495-520, Winter

Webb, J. R. and J. H. Rubens [1986] "Portfolio Considerations in the Valuation of Real Estate" AREUEA Journal: 465-495, Fall

Webb, J. R. and J. H. Rubens [1987] "How Much in Real Estate? A Surprising Answer", Journal of Portfolio Management 13(3): 414-431, Fall

Webb, J. R. and C. F. Sirmans [1980] "Yields and Risk Measures for Real Estate, 1966-1977" Journal of Portfolio Management: 14-19, Fall

Wheaton, W. [1987] "The Cyclical Behavior of the National Office Market", AREUEA Journal, 15(4): 281-299, Winter

Wofford, L. E. and R. K. Preddy [1978] "Real Estate Investment Perception: A Multidimensional Analysis" AREUEA Journal: 22-36, Fall

Wofford, L. E. and E. Moses, [1978] "Relationship Between Capital Markets and Real Estate Investment Yields: The Theory and Application", Real Estate Appraiser and Analyst 44:6: 51-61, November-December

Zeckhauser, S., and R. Silverman [1981], Corporate Real Estate Asset Management in the United States, Report prepared by Harvard Real Estate, Inc., Cambridge Massachusetts

Zeckhauser, S., and R. Silverman [1983], "Rediscover Your Company's Real Estate", Harvard Business Review, January-February, pp 111-117

Zerbst, R. H. and B. R. Cambon [1984] "Real Estate: Historical Returns and Risks" Journal of Portfolio Management, Spring

[Reference books & reports]

Avis, M., V. Gibson, J. Watts [1989] Managing Operational Property Assets, Department of Land Management & Development University of Reading

Bon, R., [1989] Building as an Economic Process: An Introduction to Building Economics, Englewood Cliffs, New Jersey:Prentice-Hall

Bon, R., M. Joroff, P. Veale [1987] Real Property Portfolio Management, Discussion paper and symposium summary, The Laboratory of Architecture and Planning M.I.T.

Brealey, R., and S. Myers [1988] Principles of Corporate Finance, Third Edition, New York: McGraw-Hill

Copeland, T. E. and J. F. Weston [1979] Financial Theory and Corporate Policy, Addison-Wesley Publishing Company

Cox, J. C., Mark Rubinstein [1985] Options Markets, Englewood Cliffs, New Jersey:Prentice-Hall

137

Jaffe, A. and C. F. Sirmans [1982] Real Estate Investment Decision Making, Englewood Cliffs, New Jersey:Prentice-Hall

Jensen, M. C. [1972] Studies in the Theory of Capital Markets, Praeger Publishers

Sharp, W [1985] Investment: Third Edition, Prentice-Hall

Lachmann, L. M. [1978] Capital and Its Structure, Sheed Adrews & McMeel

Pindyck, R. S., D. L. Rubinfeld [1989] Microeconomics, New York, Macmillan Publishing Company

Pyhrr, S. A. and J. R. Cooper [1982] Real Estate Investment: Strategy, Analysis, Decision : Warren, Gorham and Lamont

Silverman, R. A. [1987] Corporate Real Estate Handbook, McGraw-Hill

Veale, P. R. [1989] Managing Corporate Real Estate Assets: A survey of U.S. Real Estate Executives The Laboratory of Architecture and Planning M.I.T.

[Thesis]

Bar-Or, E [1984] "Application of the Option Valuation Model to Construction Projects" M.I.T. Master thesis

Geltner, D. M. [1989] "Risk and Returns in Commercial Real Estate: An Exploration of Some Fundamental Relationships" M.I.T. Doctor thesis

Veale, P. R. [1988] "Corporate Real Estate Asset Management in the United States" M.I.T. Master thesis

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