GROWTH, CHANGE, AND LAND USE PATTERNING IN STRIP COMMERCIAL DISTRICTS: A VANCouver CASE STUDY

by

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We accept this thesis as conforming to the required standard

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Abstract

The purpose of this thesis is to gain an improved understanding of the structure, dynamics and planning of land-use in off-center commercial strip districts. In the pursuit of these objectives, this thesis combines a literature review with a case study of commercial land uses on Central Broadway Avenue in Vancouver.

The literature review is divided into two segments. The opening section addresses issues of general land-use, commercial land-use, and then focuses on strip commercial districts in an inner city context. After establishing the structural basis for the thesis, the remaining literature addresses the topics of growth, change and the patterning of land-use. The discussion looks at invasion and succession as well as internal reorganization of land-uses as temporal aspects of land-use. In terms of land-use patterning, issues of accessibility, linkages, and external economies are explored. It is concluded from the literature, that historical processes of growth and change as well as functional associations as defined by linkages and external economies are determinants of land-use patterns within commercial strip districts.

The case study applies some of the principles addressed in the literature. Specifically, three statistical applications, the Markov transition probability matrix, the nearest-neighbour analysis, and the cluster analysis are used to demonstrate the growth, change and spatial proximities/affinities of land-uses. The study area consists of eighteen commercial blocks of Central Broadway Avenue in the inner city of Vancouver. The data base
used in the analysis was comprised of the locations and types of uses for all establishments fronting on Broadway in five-year intervals from 1951 to 1981.

A number of conclusions become evident from the literature review and case study. First, it was observed that planning and in particular, land-use control has played a limited role in commercial land-use districts. It is observed that planners have been hesitant to intervene in what has traditionally been a market aspect of the urban economy. Second, Broadway has evolved from a low-order, convenience-natured commercial strip to a diverse and highly specialized commercial complex of retail, service and office uses. Third, as observed from the Markov matrix, the analysis was able to demonstrate stabilities of locations. During the first decade, 1951-1961, establishments generally remained at one location longer than was the case over the decade 1971-1981. Fourth, various like uses, as defined by the classification scheme, cluster among themselves, while other uses exhibit patterns of regularity and random distribution. Fifth, the relationship between different uses, indicates that certain uses are located in proximity to other uses with more regularity than could be explained by random probability. In the case study, the location of retail and service uses in and around office uses suggests a spin-off effect by office development onto the other two commercial uses. Finally, it is concluded that Central Broadway, within the bounds of the study area is composed of five distinct segments, ranging from a low density, retail section to a multi-storey office node. It is also recognized that the "blanket" land use control in place may
be inappropriate in light of these delineations of the study area.

The implications to planning are addressed from both an academic and a practical standpoint. From an academic viewpoint, commercial land-use should be viewed as an aggregate of structures and activities, continually changing, but still arranged into patterns of land-use. On the practical side, land-use regulations should reflect contemporary trends and patterns of land-use. Planners should recognize the market forces at work in commercial districts and work with these in guiding and controlling commercial land-use and development.
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I would like to acknowledge my gratitude to Drs. P.J. Smith and D.B. Johnson at the University of Alberta for nurturing my interest in urban planning and to Drs. V.S. Pendakur and T. Hutton for guiding me through my years at the School and for providing me an advisory committee for this thesis. I would also like to thank the many people in Vancouver for their valuable contributions to the thesis and especially, Hugh Kellas (GVRD), Claude Pierce (Macaulay, Nicolls, Maitland and Co.), Glen Cooper (Computing Science, UBC), and my many friends and colleagues at U.B.C. And last, but most important, I would like to thank my parents for their encouragement as well as financial support in seeing this thesis to its fruition.
CHAPTER 1
PROBLEM STATEMENT AND BACKGROUND

This thesis addresses one aspect of intra-urban commercial structure, that of land-use patterns within commercial districts. The study examines relevant theories and models of urban land-use, placing emphasis on commercial land-use, and finally focuses on a case study of a strip commercial district.

1.1 Problem Statement

Although a great deal of work has been done on general land-use theory, the study of commercial landUSES within urban environments has failed to produce a thoroughly satisfactory theory or theories of urban land-use structure. Significant works have described commercial land-use, but little success has been met in explaining its structure. Clearly, the factors affecting the structure of commercial land-use are many and highly interrelated. However, existing urban theory and modelling tend to group all retail and office activity into a broad commercial category, ignoring differences in internal structure and dynamics.

In this study, the processes of growth and change of establishments within strip commercial districts are examined and related to spatial proximities and other spatial patterns. The central concern of the research in this thesis is to explore the way in which spatial patterns have evolved and to what extent they are a result of historical processes and functional
associations.

Competition and locational centrality between uses are among the factors which shape various spatial patterns. This patterning of the landscape conveys benefits to like uses and reduces conflicts between incompatible uses. Considerable research has suggested that establishments do locate proximate to other functionally linked establishments (Getis, 1968; Goddard, 1975; Parker, 1962; and R.L. Davies, 1972). (Linkages include the movement of goods and services as well as information flows and flows of clientele between establishments.) Establishments locate to minimize costs of supply and to maximize customer volumes between establishments. These locational motives lead to spatial affinities between establishments which are reflected in land-use patterns. For the purposes of this thesis, proximity implies a functional association between establishments and research into such association is supported through an investigation of business locations in the case study of Central Broadway. Growth and change of land-uses within districts, like this one, constitute important planning considerations, considerations which should precede the discussion of land-use patterning.

Commercial establishments and industry often occupy the most desirable and valuable sites within the city. Commercial and industrial firms benefit by being close to major transportation routes and near to markets, populations, and labor pools. This leads to agglomerations of businesses in the most desirable areas where they form the core of the "Central Business District". However, due to the desirable quality of
this location, competition for space there is intense and land is expensive; only those activities that expect to generate a high revenue can afford to locate there.

As time passes and the urban areas attract greater populations, the patterns of land-use change. Technological advances and social change contribute to this shift. In the Twentieth century improved forms of transportation have allowed the residential population to move further from the core; the urban hinterland has become larger and larger. This residential exodus to the suburbs has been rapidly followed by other urban land-uses: industrial firms, in search of available land at lower costs and proximity to the working population, located in peripheral areas; commercial land-uses followed in order to serve the population.

Commercial expansion from the core occurs in two forms: either through a "leapfrogging" of establishments to peripheral suburban locations, or through a radial extension of commercial establishments along arterial roadways. This latter form of development benefits both the residential population located proximate to the strip, and the transient population commuting to inner city jobs along these routes. In many cases these strips developed as extensions of the core (for example Granville Street). Others evolved from small commercial nodes expanding along arterials which connected the core and suburbs. Central Broadway, the focus of this thesis, is a prime example of this second type of arterial.

These commercial strips evolved to service the needs of both local neighbourhoods and the commuters using the roadway.
The depth of the strip, never more than one block on either side of the arterial, reflects the importance of the early modes of public transport and the later influence of the automobile in the evolution of these districts. Property values decrease exponentially with distance from the artery, with the result that residential uses tend to occupy the sites behind the commercial properties.

Commercial strips derive their character from the varied establishments along their length, which in turn reflect the land-uses surrounding the strip:

The nature of the uses comprising the conformation depends upon the extent to which it is the core or a residential area. The use of the street as a traffic artery attracts retail shops serving the transient - filling stations, accessory shops, auto showrooms, quick lunches, and refreshment stands, food markets, and fruit stands. The proximity to residential districts encourages convenience type outlets - drugstores, grocery stores, laundry and cleaning branches, hardware stores, delis, and pool halls. (Ratcliffe, 1949).

While there may be a wide range of uses, these tend to be grouped spatially:

.... the ribbons are multifunctional in spatial terms in that proportions of the ribbon may have concentrations of such functions as motels while other portions may be concentrated by food stores, drug stores and beauty and barber shops. (Boal and Johnson, 1968:330).

Automobile "rows", furniture districts and more recently office agglomerations have grown on commercial strips. The quotations above illustrate one important fact of commercial districts in general: while they are districts which supply goods and services to the public, they are composed of a variety of structures and activities which are not necessarily randomly distributed. Functional linkages contribute to the fact that
each area possesses spatial affinities which characterize the district. The implications involved in planning these districts with their unique patterns become obvious. Generalized statements in the form of zoning bylaws, regulations, guidelines and/or policies are simply not adequate to ensure attainment of community goals if they ignore these specializations along the commercial strips.

While it is important to understand the functional nature of the strip commercial districts through the type of uses and relationships between uses, it is also necessary to consider historical processes which have shaped the strips to their present form. Due, in part, to a host of factors -- economic, social, historical, and political -- commercial strips have displayed considerable growth and change. Along the more successful strips, absolute growth has accompanied an internal rearrangement of uses. Smaller buildings have given way to larger and higher structures, which house a number of establishments. As the strip increases in density, the types of uses generally shift to those oriented to specialized consumer needs. While still retaining services for the local neighbourhood, the strip now serves a larger trade area. The less successful strips are conspicuous by their decaying and out of date buildings and activities. This general deterioration and obsolescence has become acute in inner city locations. Renewal and redevelopment measures, often capital-intensive and in many cases little more than "cosmetic", have tried to counter this blight. A more efficient and effective measure would be to first understand the structure and dynamics of commercial districts
and then to harness and use market processes of growth and change in planning.

1.2 Relevance
A number of aspects of planning for commercial land-use are evident over and above the necessity for general urban planning:

• Various strip commercial districts close to the core are showing continual signs of growth and prosperity, avoiding common blight and decay endemic to less viable areas: determining why these strips continue to prosper could improve programs aimed at rehabilitating decaying areas.

• While commercial districts occupy a relatively small percentage of the land they provide jobs for a high percentage of the population, as well generate vital tax revenue. As important as they are, little in the way of comprehensive planning has been aimed at ensuring planning goals.

• Market forces shaping commercial districts must be understood and used in conjunction with regulations and policies to achieve community goals in these areas.
• Regional planning goals for attracting commercial growth to peripheral locations may benefit from an understanding of the spatial affinities which exist between establishments.

• The data base collected and the statistical methods explored may find application in future studies in the field of commercial land-use planning.

1.3 Thesis Objectives

The objectives of this thesis are:

[1] To investigate the growth and change of land-uses within commercial strip districts resulting from historical trends and functional linkages.

[2] To determine whether commercial land-use patterns reflect spatial affinities resulting from historical trends and functional linkages.

[3] To statistically analyze a data base pertaining to the above problem statement and research question.

[4] To identify the implications of these internal relationships for the planning of land-use along commercial strips.

1.4 Case Study Area

The research methodology is conducted on the Central Broadway Avenue commercial strip district in Vancouver. A major
east-west arterial, this strip is located south of the downtown peninsula and False Creek. Over the eighteen block length from Ontario Street in the east, to Burrard in the west, the strip bisects the Mount Pleasant, Fairview Slopes, and Granville/Burrard areas of the City.

Residential land-uses are located both north and south of the strip. Residential structures of higher density are being developed in the Fairview Slopes to the north, while a mix of single and multi-family structures are located to the south.

Two important institutional uses distort land-use in this area and make it unusual among commercial strips. City Hall and Vancouver General Hospital are located within three blocks of Broadway. The combined daytime workforce associated with these two uses is immense and has a profound impact on Broadway both in terms of traffic generation and retail potential.

In the past, Broadway was typical of commercial strips, housing a variety of uses and displaying nodes of special function uses. While it is considered an inner city commercial strip, Central Broadway does not fit the stereotype of a decaying arterial commercial strip. Due to its proximity to the hospital, this area has a predominance of thriving medical and health service facilities. In addition, Broadway's "auto row", although declining, still occupies major tracts of frontage along Central Broadway. More recently, large office establishments have located on the strip. Rents are generally lower than downtown while access to the Central Business District (CBD) is still good. The growing concentration of business-oriented uses has provided additional incentives to
these large office developments.

1.5 Research Methods

A documentary analysis is carried out on commercial land-use theory and its origins in general land-use theory with a particular focus on strip commercial districts. This analysis identifies and explores some of the internal dynamics of commercial land-use districts, namely the growth, change, and patterning of land-uses. Having established a theoretical framework based upon the research question, the thesis then turns to an empirical study of a strip commercial district within the inner city of Vancouver.

Using data gathered from City Directories, the Greater Vancouver Regional District (GVRD) data files, and the City of Vancouver's Planning Department data bases, a statistical analysis is undertaken. Three statistical tests are applied to the data. These three, the Markov transition probability test, the nearest-neighbour analysis, and the cluster analysis were all chosen because it was felt that they satisfied two criteria: general applicability to planning; ease of use and more importantly the ease with which the results can be understood; in addition the computer software was available. To demonstrate the evolution of the various land-use categories through time, a Markov transition probability matrix indicates which uses succeed others (see Appendix A). The frequency tables indicate the number of changes as well as the relative percentage of change in land-uses. The supporting Markov analysis illustrates functional ties between uses by indicating the probability use
"A" will succeed use "B" at a particular location. The Matrix is constructed for five year intervals over thirty years and is limited to ground oriented establishments. The Matrix has common applications where it is useful to show the dynamics of land-use change (Sim, 1982; Bourne, 1971; 1976).

The second statistical application is a "nearest-neighbour" analysis (Clark and Evans, 1954; Pinder and Witherick, 1973). This test determines the amount of clustering that a group of data displays. Modified to handle linear case study areas, this analysis is used on ground oriented commercial establishments along Central Broadway for the year 1981 (Pinder and Witherick, 1972). This test compares the observed distance between nearest neighbours as they actually occur with the expected or random distribution of "n" number of establishments over the length of the study area. A value of clustering is calculated for each land-use category and the values are compared. If clustering of certain activities occurs in certain areas, the existence of functional linkages underlying these spatial affinities may be inferred (Goddard, 1973; Alexander, 1972).

The third method, used to illustrate spatial affinities between different types of land-use, is the cluster analysis option of the BMDP (1981) statistical software package. This option groups similar variables (elements) in a hierarchical manner such that the lowest level of clustering includes two elements and the highest cluster includes all elements. The basis of measurements for similarity is the distance between each shop and its closest neighbour (see Appendix A). The "quantum leap" from raw data to the input format necessary for
the BMDP run was handled by Glen Cooper (UBC Computing Center), who created a program capable of measuring distances between shops and compiling these distances into the input matrix. Within the method, those shops which have arrays of similar distance are also closely associated geographically with each other, in other words, they display spatial affinities.

The statistical tests are not aimed at definitive causal relationships; rather they are used to illustrate land-use patterns, from which inferences about functional associations may be drawn. Although a multitude of other variables may influence land-use patterns they are not considered here as time and resources have precluded a more detailed study. Limitations pertaining to data sources also constrain the depth of analysis. In spite of these shortcomings, this thesis provides a fairly comprehensive investigation of strip commercial land-use patterns and the trends and relationships which have created them.

1.6 Thesis Organization

This thesis presents theories of land use as they have developed over the past half century, followed by an empirical study which is the focus of this work. Chapter One sets out the problem statement and research question; a brief discussion of the concepts presented in the thesis is also included here. Research methods and case study area are outlined, with a more detailed discussion left to later chapters. The "relevance" section of Chapter One suggests some of the issues which are
important to the study, issues which should help the reader appreciate the direction from which the thesis was written.

Chapter Two is a compilation of the literature which forms the theoretical and contextual basis for the thesis. The flow is essentially from the general to the specific: from land use theory to that of commercial strip districts within the inner city. Chapter Three addresses the topics of growth, change, and land-use patterning within commercial districts and, in particular, within commercial strip districts. This section is followed by a short investigation of land-use regulations in general and then as they pertain to zoning. A short summary of Chapters Two and Three concludes this chapter.

Chapter Four applies the theoretical base established in the earlier chapters to an existing commercial strip in the inner city of Vancouver. The opening segments of the chapter briefly discuss the strip, how it has been administered from the point of view of planning, and how the market has responded in the area. The bulk of the chapter presents and analyzes the results of the actual study. Chapter Five draws the thesis together presenting the conclusions, limitations, implications for planning, and finally suggests avenues for further research. Appendices A and B describe the data collection and analysis, and the methods used. Appendix C contains the relevant sections of the City of Vancouver zoning by-laws.
2.1 Introduction

Commercial strip location theory is a small sub-section of general land-use theory and more particularly of commercial land-use theory. The generalized theory provides the necessary context for commercial strip literature. The following chapter begins by discussing literature pertaining to the theory of general land-use, continues with that dealing with commercial land-use and finally centers on commercial strip districts as the focus of the thesis.

2.2 Land Use Theory

Development of urban land-use theory and modelling is a relatively recent occurrence. Cities have existed for over ten thousand years and over the centuries researchers have studied urban structures and processes.

Early models of urban structure stress the core as the dominant commercial component of the city. The three theories of urban form which have emerged have generally been held as the foundation of city form. Building upon the work of Hurd (1903), Burgess and the "Ecological" school in Chicago proposed a model of city form which is described as the "Concentric Zone Theory" (Burgess, 1925). According to the theory, various land-uses occupied homogeneous rings about the city centre. Burgess suggested a competitive environment in which sectors of the
population allocated themselves to these various rings: inner city residential zones were occupied by working classes while more peripheral zones housed the wealthier, and more mobile populations. Hoyt's "Sector Theory", also of this period, recognized the influence of transportation modes on city structure (Hoyt, 1939). Concentric rings, adopted from the earlier Burgess model, were given direction by transportation routes radiating out of the centre of the city. Emphasis was placed on the residential sector with little mention of commercial land-use outside of the core commercial area. The third of these early models, the Harris and Ullman model, showed significant strides towards a more realistic representation of the city (Harris and Ullman, 1945). Their "Multiple-Nuclei" model recognized the grouping of various activities about the urban landscape. While maintaining the importance of the core, the model acknowledged the existence of other nodal points or agglomerations of similar land-uses. Harris and Ullman recognized the special locational needs of certain activities and the benefits that accrue to establishments in such agglomeration.

Building upon these works, several models have been proposed emphasizing various facets of urban agglomerations. Transportation theories and access theories, proposed by Wingo (1961) and Guttenberg (1960) respectively, have brought forth contemporary location factors and patterns. Wingo (1960) developed an equilibrium theory of residential development in which transportation costs substitute for space costs. He suggested that the distribution of households results from the
interplay of rent paying abilities of the households and the particular site-rents as a function of transportation costs and distance between work and home. His theory placed emphasis on the location of households in relation to land value and accessibility, and the effect these two have on locational decisions. Guttenberg (1960), also on this theme, indicated that the community desire is to overcome distance and viewed internal interaction as the basic determinant of urban spatial structure. Guttenberg characterized the urban environment as a complex of transportation systems and facilities. Where the transportation system is poor, facilities will be relatively evenly distributed throughout the urban landscape; however, an efficient transportation system allows concentration of facilities into specific areas in the city.

Labelled as the "Classical Theory of Land Use", Alonso's work concentrated on the use of land and the value of that land. In considering residential land-use patterns with respect to employment, Alonso (1964) considered such factors as supply of land, price of land and household budgeting constraints. His theory consisted of three parts (Chapin, 1976):

(a) individual equilibrium is reached by selecting that combination of quantity of land, distance from the city centre, and quality of the composite good that as a combination will maximize its satisfaction, but stay within its constraints" (p.39);

(b) bid rent curves are calculated, reflecting patterns of preference as to location of households; and

(c) equilibrium is established over the aggregate market, where households with steep bid rent curves will occupy central locations.

Alonso introduced the notion of competition for land as it related to individual household characteristics. Commercial
land-use patterns can also be explained through this logic of competitive bidding.

2.3 Commercial Land Use

Theoretical work relating to commercial land-use has paralleled the more generalized land-use theory and modelling, both gaining from the general concepts and at the same time providing an area for micro-analysis of these. In many cases analogues are adopted from the more general to the more specific. As R.L. Davies (1972:69) stated: "Since all general land-use models embrace commercial activity as an integral part, there are clearly strong links to be found between overall patterns of land-use in the city and the particular pattern of shopping centers. These links become more evident when it is realized that common but varying levels of accessibility are operating on the urban market as a whole and on the commercial market as part of this."

The study of commercial land-use gained some prominence with Proudfoot's study of several American cities (1937). The key to this study was the delineation of the urban commercial structure:

1. Central Business District (CBD) - retail heart of the city and location of the widest range and most specialized shops;
2. Outlying Business Centers - smaller replicas of the CBD located at intersections of major transportation routes;
3. Principal Business Thoroughfares - a mix of local residential and traffic oriented demand stores;
4. Neighbourhood Business Streets - a network of convenience stores, located throughout the city;
(5) Isolated Store Clusters - convenience stores of a complementary nature (drug stores, grocery stores, meat markets, etc.).

An earlier study of Baltimore (Rolph, 1929), and subsequent studies of Detroit (Ratcliffe, 1949), and Chicago (Garrison et al, 1959) reinforced this framework.

A second concentration in the research of urban commercial land-use centered on the hierarchical differentiation of commercial districts (Berry, 1959). The emphasis here was placed on the classification of commercial districts into levels according to market areas and threshold sales. While lower-order establishments of a convenience nature generally rely on the immediate neighbourhood for both of these requirements, higher-order or more regionally-oriented establishments require a somewhat larger market area to realize threshold potentials. The studies drew analogies from Central Place Theory (CPT) (Christaller, 1933) by direct comparison: an isolated store cluster was equated with the designation hamlet in CPT at the lowest level of the hierarchy; neighbourhood shopping was matched to the village level; community shopping centers to towns; regional shopping centers to cities; and finally, at the upper-most end of the scale, the CBD to the metropolitan region (Berry, Garrison, et al, 1959). Reflecting the regional CPT, lower-order commercial locations at the intraurban scale were most widespread; higher-order centers housed a greater and wider range of stores, produced greater sales volumes, a larger trade area, and employed greater numbers within the population (Yeates and Garner, 1976). Higher order centers in addition to their designated higher-order functions, also performed all the
functions of subsequent lower-order centers (see Figure 2.1).

Garner's model of commercial land-use introduced the variable of land value as a factor affecting the hierarchical arrangement of land-uses within commercial nucleations. According to this model, businesses sought levels on the hierarchy by threshold size, where a high threshold size indicated a high level on the commercial hierarchy. High threshold levels also related directly to the rent paying ability of the establishment. Those establishments of large threshold sizes were generally able to pay high rents for locations (Garner, 1966; Yeates and Garner, 1976). As expected following this argument, high rent paying establishments locate on the highest value sites, such as those sites closest to peak street intersections (see Figure 2.2). Although this model generates a realistic, albeit simplified, pattern for lower-level nucleations, it probably does not hold in highly complex nucleations such as the CBD (Yeates and Garner, 1976).

Expanding the work of Garner and bringing together the three generalized theories (Concentric, Sector, and Multiple-Nuclei), R.L. Davies (1975) proposed a composite view of urban commercial structure. His model allocated commercial typologies into physical locations. The nested hierarchical nature of this model followed Garner's notion of threshold sizes of shops and concentric pattern of land-use. Major axial routes bisected this regular pattern and gave rise to various districts as well as to commercial ribbon development proximate to the axials. Specialty areas or nuclei developed on the urban landscape in response to a variety of site and accessibility advantages (see Figure 2.3).
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<th>Community Shopping Goods</th>
<th>MAJOR REGIONAL</th>
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<td>Gift and Novelty</td>
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<td>Camera stores</td>
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</table>

Adapted from: Yeates & Garner, 1976.
Model of Shopping Center Characteristics

Adapted from: B. J. Garner, 1966.
Structural typologies and hierarchical delineations are drawn together into an effective form by B.J. Berry (1963) (see Figure 2.4). Although the model is an effective tool for delineation and classification it does have several shortcomings. The representation of the nucleated centers draw foundation from Central Place Theory of inter-urban geographical theory, ribbon and specialized area configurations have not been shown to correspond to their respective settlement patterns. For this and other reasons, ribbon and specialized area configurations have been dealt with to a lesser degree in urban studies.

2.4 Strip Commercial Configurations

The bulk of the commercial activity outside the CBD occurs along major arterial thoroughfares. By its very nature, the commercial strip encompasses a combination of uses along a principal access route, deriving its character from both the nature of the establishments and its role as a transportation route. In terms of land-uses, commercial districts are usually highly multifunctional. The multiplicity of uses evolved principally in response to an increase in specialization and transportation factors. Commercial strips have generally met with disfavor among city administrative staffs, "development... was of a laissez-faire, or unplanned nature and factors such as an effective retailing mix and locations of business anchors were not taken into account" (Silberberg et al., 1976). Despite this attitude, a variety of commercial strips have evolved over the past thirty years and today are considered
NUCLEATED
1. Central Area
   A. Apparel Shops
2. Regional
   B. Variety Shops
3. Community
   C. Gift Shops
4. Neighbourhood
   D. Food Shops

RIBBON
1. Traditional Street
   E. Banking
2. Arterial
   F. Cafes
3. Suburban
   G. Garages

SPECIAL AREA
1. High Quality
   H. Entertainment
2. Medium Quality
   J. Market
3. Low Quality
   K. Appliances
   L. Furniture

THE COMPLEX MODEL

Adapted from: R.L. Davies, 1972.
Adapted from: Berry, 1963.

CLASSIFICATION OF URBAN BUSINESS CONFIGURATIONS

M.A. THESIS UBC
BLAKE B. HUDEMA
FIG 2.4
some of the most prominent commercial areas in the city, outside of the core.

Commercial strip districts grew first in response to improvements to public transport within the cities and later to the widespread use of the automobile. Increased mobility allowed the spread of populations and commercial structures further from the core. Arterial strips grew out of the core as logical extensions of the commercial land-uses. Greater specialization and differentiation in peripheral residential districts gave rise to more isolated, less continuous strip districts.

Commercial strip studies have generally dealt with the classification of business types into standard configurations. Berry, in his work on Spokane, hypothesized that business types "fell into orderly hierarchical patterns of shopping center and business districts" and "that these patterns were a product of the areal grouping and dispersion characteristics of individual stores and business types" (Berry, 1963). Examining ribbon developments, he recognized four configurations of business types as the distance from the core increased. First were the inner city strips which catered to convenience goods and services at the lowest level, typically including grocery stores, drug stores, laundries, beauty and barber shops. Yeates and Garner (1976:282) stated that: "although their businesses share common locations with those of other ribbons, they differ in that they cater to home based trips, which may be of a multipurpose nature. Hence there are more linkages between business types in these kinds of ribbon developments than in any of the others." The second type of ribbon, the urban arterial
strip, categorized the bulk of commercial ribbons: automobile repair shops, furniture stores, appliance dealers, office equipment sales outlets, funeral parlors, lumber yards and fuel dealers were identified as common uses. These uses are generally space-intensive and as such they attract customers on special-purpose trips. Linkages between the establishments were weak, and existed only by virtue of location along the same strip. Land values and hence, site rents, were lower than retail nucleations; thus, establishments like the ones listed, which needed good access and lower rents, were attracted to these strips (Berry, 1963). New suburban ribbons formed the third (and most recent) configuration of commercial ribbons. Set in the newest residential areas of the city, these, like the traditional shopping streets, serve a local population with lower order goods and services (Yeates and Garner, 1976). Chain stores and modern drive-through stores are often found along these strips. The fourth type of strip described by Berry (1963) and furthest from the core, is the highway oriented ribbon. This "natural" form of strip evolves strictly in response to the demands of highway motorists. Highway developments are generally uncontrolled as they often lie just outside the administrative boundaries of the city. Scattered establishments occupy tracts of land which are large by urban standards. Highway-oriented establishments are patronized primarily by transient motorists on "one stop" shopping trips. Most of the enterprises along these strips supply automobile service, food, and/or lodging (Garrison et al, 1957).

Such classification of ribbon commercial districts is
highly generalized. Most commercial districts within the city are hybrids of these and other configurations. The location of the ribbons may vary: traditional shopping streets may be situated in peripheral locations while highway oriented strips may approach inner city locations. Nevertheless, many studies concentrating on commercial strips have used this classification scheme.

Merry (1957) in his study of a commercial ribbon in Denver looked at location habits of businesses along a highway. His variables included traffic volumes, directions of traffic flow, and the extent of the residential neighbourhood around the strip. He found that the density of establishments decreased with distance from the CBD (with minor peaks at major intersections), and that the in-bound highway lanes which carried greater volumes of traffic, were lined with gas stations and auto dealers. Merry identified patterns of clustering and dispersion. Stores agglomerating into high density clusters included beauty and barber shops, grocery stores, clothing outlets, hardware and dry goods shops, and drinking establishments. Automobile dealers, auto repair shops, chain grocery stores, and ice cream parlors occupied a wider more dispersed area. Restaurants, cleaners, laundromats and furniture stores showed little affinity to high or low density clusters (Berry, 1963; Garrison, 1959).

In a study of business ribbons in Cape Town, D.H. Davies (1960) reaffirms the need for further research as a necessary step in long-term urban planning. Davies suggests that uses along Voortrekker Road in Cape Town fall into three groups:
"ribbon uses proper", "nucleations or bead uses" and "indifferent uses". The first group includes service stations, fuel sellers, building material supply centers, and various household service and repair shops. The shops in this grouping rely upon the flow of traffic, availability of large sites, and lower site values as necessary adjuncts to the conductance of business. His second group, is sustained through the patronage of the neighbouring residential districts. This grouping of retail and service establishments complement the ribbon use group and "depend upon linkages much as do similar establishments in the central business districts" (D. H. Davies, 1960:46). Restaurants, bars, hardware and appliance stores which form the third group showed little tendency towards nucleations or dispersion, instead located throughout the strip. Davies concluded that strip commercial districts contain nucleations of uses and that analysis of these uses "can assist in route [transportation] planning both contributing to an understanding of the functioning of the local area and by aiding in the delineation of its various components thereby pointing to suitable sites. The kind of method adopted here carried through more fully, should be able to contribute to the solving of a number of local planning problems, not merely those related to roads and traffic" (D. H. Davies, 1960:48).

Criticism of early commercial ribbon studies has been levelled by Boal and Johnson (1965). The authors noted a lack of consensus among urban researchers as to what functionally constitutes commercial ribbons. In their review of six studies (including the three cited above), Boal and Johnson point out a
certain ambiguity as to the type of uses found on ribbons, listing thirty-one types ranging from service stations to boutiques. They go on further to indicate that this ambiguity is increased "by the existence of a variety of definitions used to delineate such streets" (Boal and Johnson, 1965:155). On the more positive side, Boal and Johnson identify characteristics associated with the overlap of locational and functional attributes: "it is possible to view the Trail, on one hand, as a series of locations with varying attributes suitable for a wide range of establishments and on the other hand, as a series of establishments characterized by a variety of functional mixes" (Boal and Johnson, 1965:159) (see Figure 2.5). The authors suggested that establishments along strips are the result of both transitory customers and those of a local residential nature. They recommend limiting the length of strips in general and the number of establishments along these strips in particular. Their views generally counter the "popular disfavor" commercial ribbons have received from planners and civic administrators (Boal and Johnson, 1965).

In their second article, Boal and Johnson (1968) explain some of the functional characteristics of establishments on commercial ribbons in Calgary. Using Berry's establishment classification scheme and their own "trip" classification, they interpreted the results from a series of personal interviews. Eight establishments on each of the three strips of varying location used in the study were chosen as interview sites; here, shoppers were questioned on their trip route, on the establishments visited and on their mode of travel. The results
Locational & Functional "Screening" of Firms on Commercial Ribbons.

(Boal & Johnson, 1968)
were subjected to principal component analysis yielding five groups of similar establishments. The grouping analysis indicated that both the actual type of establishment and the particular ribbon influence the functions of establishments on the ribbon (Boal and Johnson, 1968).

The second half of the article demonstrated the linkages between establishments as defined by customer trip behaviour. The "inner tangential" ribbon, identified as having a high degree of shopping and service clustering, was supported by high volumes of shoppers. The analysis of the "radial" strip, on the other hand, illustrated that establishments here were less likely to cluster and, therefore, showed little sign of agglomerative linkages. Boal and Johnson (1968) summed up their article with a planning strategy for the location of establishments on the strip to positions on or proximate to the strip, depending upon the reliance of these establishments on passing traffic and/or the local neighbourhood. The article is one of very few to mention land-use analysis as a tool to achieve "a layout closer to some specified optimum". (Boal and Johnson, 1968).

Although they began as logical extensions of the CBD and the "natural" highway strips, commercial ribbons now are evident in all parts of the contemporary city. In this thesis, the emphasis is on those commercial strips in the inner city. The following section briefly addresses this category of the commercial strip.
2.5 Inner City

As a consequence of their location within the inner city, commercial strips have undergone both dramatic declines and growth. The inner city was traditionally the hub of commercial, industrial and cultural activity for urban agglomerations. Significant changes in social, economic, and technological aspects of society over the past half century have manifested themselves in an upheaval of the "traditional" city. Residential land-uses abandoned the inner city for more desirable locations in the suburbs; commercial uses seeking proximity to customers and industrial uses in search of available and affordable sites were quick to follow. This decentralization has left a void in the inner city, many buildings are vacant, decaying, or blighted. The desirability of the inner area of some cities has declined to a point where only the lowest socio-economic classes occupy this area. Where prosperous industrial firms once flourished, light manufacturing and warehousing now constitute the bulk of non-residential activity. The core of the city, however, has largely escaped this decay. Due to high value/desirability, it has attracted major development, primarily in the form of financial and informational services (Naisbett, 1984).

Rehabilitation and revitalization programs of the 1960's and the 1970's were aimed at arresting this trend of decay within the inner cities which was widespread in the United States. In Canada, our cities fared better; decay and abandonment within inner areas has been minimal in comparison, largely due to continual redevelopment of inner city locations.
Ley, 1981). Ley goes on to point out that not only have Canadian cities avoided decay, they have actually increased the intensity of inner city land-uses.

The modern city, whether American or Canadian, is typified by a zone of office/retail activity surrounded by a zone of mixed commercial, industrial, and residential land-uses (Preston and Griffin, 1966; Horwood and Boyce, 1959). While the core has generally been spared the inner city blight and obsolescence, the area surrounding it has been less fortunate. Only now are vacant industrial sites undergoing redevelopment to residential and cultural uses. A move to repopulate the inner city with residential uses has bolstered the revitalization of the inner city with varying degrees of success. Middle and upper socio-economic groups are being attracted back to the inner city, close to the office complexes which employ many of them. Higher income residents with smaller families have pushed densities and land values upward (Alexander, 1971). Investment in these areas has now become desirable and inner city residential areas are flourishing in some cases.

Among all this change, various uses have persisted. Typically, hospitals located in inner city locations have had to remain, due in part to massive capital investments in land and infrastructure. City halls, sports facilities, and cultural sites have also maintained inner city locations.

During the last decade or so, major hotels, office buildings, and commercial complexes have moved back into the inner city. Spillover of development from the core has pushed land values up and has generally encouraged investor confidence.
in the inner city locations.

2.6 Summary

This chapter has looked first at generalized land-use theories, and then at those relating to commercial land-use and the strip commercial district within their inner city context. Much of the commercial land-use growth within the city has been hapazard, a result of fragmented growth rather than of concerned planning. Internal dynamics of commercial land-uses are important planning considerations and are explored in more detail in the following chapter.
3.1 Introduction

The generalized land-use models examined in Chapter Two develop an appreciation for the city and its various districts, but do very little in the way of illustrating or explaining some of the dynamic processes actually taking place. A micro-analysis of the land-use structures and activities is necessary. Clearly, effective planning relies on an understanding of the processes of land-use change.

Commercial districts are typified by a vast range of buildings occupied by an even greater variety of activities. Patterns of activity dictate the shapes and sizes of buildings, although, at the same time these activities are constrained by the range of existing physical structures. Land use structure results from the combination of these two elements. Spatial form arises out of the interaction between activity and structure. In this study, one activity in a particular location is considered as the establishment, while the relationships between two or more establishments define linkages. The combination of establishment and linkage gives rise to commercial land-use pattern. Looking at the historical processes of growth and change of land-uses, this chapter examines the effect of these processes on patterns of use. Issues of accessibility, linkages and external economies, and spatial proximity will be
3.2 Land Use Growth

Commercial land-use structure as it stands today is a "legacy from the past and a product of the present" (Preston and Griffin, 1966). In constant change, any area represents only a transitory stage in its development; equilibrium is never reached (Allpass, 1968). Supply and demand shift the balance so that current land-use structure is perennially out of date. Growth towards the equi-optimum involves two factors: an increase in size, and an internal structural change to building stock and use. Growth involves the alteration of land-use, land values, and the intensity of use in various land-use configurations.

Urban growth results in the main, from the processes of concentration and deconcentration. Although opposite in force, these two yield net growth differently over space: concentration brings about an increased demand for existing land and buildings; deconcentration tends to relieve this competitive pressure for location. Commercial districts have experienced various fates through the effects of these processes. In the post-war years, deconcentration accompanied by suburbanization has had a dramatic effect upon inner city commercial districts. Core areas have lost retail and cultural functions to the suburbs, while some commercial strip streets have become subject to decay and blight. Inner city strips have suffered in a variety of ways. Blight and decay have rendered some strips undesirable, while others, having weathered contemporary trends
in commercial development, have flourished. Promotion of inner city housing and other redevelopment efforts have rejuvenated many of these areas -- fresh uses are occupying existing structures and, where profitable, new structures are being built.

The most visible growth of these districts occurs when one land-use is "invaded" and gives way to a more competitive one. Districts of low intensity uses such as residential and light industrial are often subject to the expansion of commercial land-uses. Expansion occurs along peripheral locations where the land values are low, where there are available sites for development, and where there is reduced resistance to development. Attempts by urban researchers to explain the invasion and succession processes have generally relied on the methods of the physical sciences, often with dubious consequences.

Originally developed by plant and animal ecologists to describe the evolution of plant and animal communities, invasion and succession processes have found some applicability in urban research. In the urban setting, invasion and succession offer one explanation of land-use structure. Bourne (1971:2) identified the mechanism driving the process, "in theory each area witnesses a selective adaptation of those functions for which it is best suited, particularly those which are capable of outbidding others in the competition for location". Work by Griffin and Preston (1968) on the inner city have shown the validity of these processes. Outward expansion is not, however, a smooth process. Development usually occurs on a site-by-site
basis, resulting in succession being a very sporadic process (Sim, 1982). As Bourne (1971) states, "succession tends to be complex, discontinuous in both space and time, slow in pace and to contain a strong probabilistic basis." Invasion and succession, while strengthening the more competitive uses, have the effect of breaking traditional population and land-use patterns. Peripheral growth is a more dramatic process, though much slower than the conversion of uses within existing structures.

3.3 Land Use Change

The change of use within commercial districts is one of the most common forms of urban change. This evolution of uses in existing structures is often overlooked, because of the lack of immediate disruption that these changes impose on the surrounding environment. Where the economy is healthy, these changes are relatively quick. Rates of change can be phenomenal. Cowan (1967) shows that fifty-four percent of the establishments within Fitzroy Square in London had occupied their premises for less than the two years prior to his study. Changes occur as uses become less suited to locations and other, more suitable uses, displace them. Changes, however, are not always abrupt. For a number of reasons, uses operate under conditions which are not to their best advantage: shop owners may maintain a location in hopes of a more prosperous future or they may be waiting to occupy a new site. Land-use changes, on the whole, result from market forces and public policy effects:
(a) functional obsolescence - where an optimum fit between building or site and establishment diverges so much so as to cause a move on the part of the establishment (Sim, 1982);

(b) community obsolescence - where the business volume drops in response to a community wide alteration of its trade balance, pedestrian or traffic flows (Sim, 1982);

(c) expansion of the CBD - where invasion and succession are operative processes (Sim, 1982);

(d) rezoning - where upzoning and downzoning have a significant effect upon the direction of growth and change in land-uses; and

(e) comprehensive redevelopment - where zoning issues may set precedents and result in land-use changes in surrounding areas.

Bourne (1971) and Sim (1982) have shown that land-uses are relatively stable in traditional commercial districts where existing retailing establishments have retained locations. The invasion of office development into these traditional retailing districts is one of the major issues of contemporary commercial land-use planning. Change here is sporadic and discontinuous in both time and space. Areas of lower accessibility, and, therefore, of greater uncertainty as to profitability, tend to undergo a greater degree of change (Sim, 1982).

3.3.1 Redevelopment

The most dramatic form of internal reorganization is the replacement of existing structures. Construction of new buildings follow closely the trends in local and national economic cycles, occurring towards latter stages of upswings when the money supply is plentiful. Once feasible, construction generally proceeds under a profit motive by the owner. Replacement structures, which are usually larger and of greater
intensity of use than the ones they have supplanted, facilitate a greater range of commercial functions.

Structures and activities are seldom considered in theories of urban land-use, even though they have significant effects upon the activities and rates of growth and change within the urban environment. Once buildings are constructed, they are continually modified in response to concerns of general maintenance and changing use. Where buildings cannot be altered within set performance parameters to accommodate the needs of the establishment, a use change is imminent. Taken to the extreme, demolition and replacement will become viable options. Lean and Goodall (1968) summarize the life of a building:

The economic life of something as durable as a building varies widely in practice and ends not because the structure is physically worn out but because of change in demand, reflecting alterations in accessibility in environmental merits, in economic, social, and technological standards, and in materials used and services expected in modern buildings. Since change is continually taking place, any building can only be in line with current standards during the earliest years of its economic life and will become less well adapted to the highest performance of its functions as time passes. All buildings therefore, become progressively obsolete, although the physical condition of the building itself and its basic equipment is seldom a primary criterion of obsolescence. The physical and economic life span of buildings are not the same, for the economic life of buildings is determined primarily by the earning power of that building rather than by its structural durability. The physical and economic lives of buildings would only be identical in such cases as sound buildings are completely destroyed by fire, etc. Sooner or later the decision has to be taken to end the use of the building and redevelop in the most profitable way.

Redevelopment through replacement depends upon a number of factors, including the age or obsolescence of the structure, ownership patterns, potential for future gain and the overall
growth in various sectors of the economy (Bourne, 1971). Age and obsolescence, though important factors, do not necessarily dictate replacement. Older buildings continue to be used while newer buildings may be replaced (Cowan, 1967). Where properties are owned by a number of interests, replacement becomes difficult. Potential for future gain from the structure, where replacement relies on an increase in business demand, is indicative of, or projected from, general economic trends. Delays in replacement may occur where intervening uses occupy the building beyond its expected economic life.

3.4 Land Use Patterning

The net effect of past and present redevelopment and land-use change has been the evolution of highly structured land-use districts. At a macro level, commercial districts are discernable from industrial, which are in turn discernable from residential areas. Patterns of land use are also evident at intra-district levels. Thus, within commercial, industrial and residential areas, patterns of various activities and structures are identifiable. Up to the present time, theoretical work on these patterns is scant, and, where available, show little consensus.

A number of factors cause the clustering of land-uses within commercial districts. Primary among these is the fact that establishments when looking for a site are motivated by profit. They seek a location which will enhance revenues, one accessible to customers and to supplies, in order to minimize costs. Because small specialized establishments are affected by
a network of linkages with customers, suppliers, and competitors, proximate locations become necessary. Clustering results from this desire by firms, linked by the movement of people, goods, services, and information, to locate in proximity. Clearly accessibility and linkages, in conjunction with the external economies, are major determinants of commercial land-use patterning.

3.4.1 Accessibility

Accessibility affects the cost of moving people, goods, and information between locations. The time necessary for travel between establishments and the cost of that time clearly outweigh the notion that the inconvenience of distance is the only accessibility variable. Accessibility confers benefits upon both customers and establishments, and in addition, highly accessible sites can serve the greatest number of customers. Serviced by efficient transportation systems, accessible sites are generally close to high volume routes and key intersections. Lean and Goodall (1968) suggest that the accessibility of the city core is the key factor in determining urban land-use pattern. The greater the need for movement of goods and services between establishments, the greater the role accessibility plays in the urban pattern. Increased accessibility also allows greater specialization because a larger trade area is available.
3.4.2 Linkages and External Economies

Two further concepts, linkages and agglomeration economies, combine with accessibility to give a comprehensive view of location decisions as they relate to land-use. Linkages refer to the corridors of movement of goods and services between establishments, while agglomeration economies refer to the cost reductions which are a direct result of location. According to Townroe (1970:18), "The concepts of 'linkage' and 'external economies' have been used to stress both the importance of size and the patterns of relationships within urban areas...." While Townroe is speaking in reference to industrial land-uses, it is generally held that linkages and agglomeration economies are important to commercial land-uses (A.J. Scott, 1983, 1982; Fernie, 1977; and Goddard, 1973). Alexander (1974:15) supports this view, making references to commercial land-uses in the CBD of Perth, Australia. "[The] significance of linkages (or in non-jargon terms, connections) between activities for purposes of their operation has already been pointed to a general location factor which draws activities to the city center. But linkages may also be important on a more detailed level as they appear to affect certain activities within the central area."

Linkages involve the transfer of people, goods, services, and information between establishments. Linkages in manufacturing or industry must facilitate the handling of tangible goods (i.e. raw materials and finished products). Office linkages differ; offices deal in intangibles and services and depend on communication linkages for the transfer of information (i.e. telephones, teleprinters, and other
telecommunication systems). Service and retail establishments require a variety of both tangible (product-oriented) and intangible (information) goods and services. Much of the study of these links between establishments has been based on industrial establishments. A significant body of literature reviewed in A.J. Scott (1983, 1982) indicates that linkages tend to affect establishment location decisions in industrial and office establishments. There is a general consensus that these links are also found in the retail and service components of commercial land use (Alexander, 1974; Rannells, 1956). Rannells has provided one of the better taxonomies of linkages within the urban context:

(i) Competitive linkages - each establishment strives to hold or increase its own share of the market, for goods as well as services, dealing either with a generalized public, with groups of establishments, or with a single establishment. Competition is so all-pervasive that examples are legion, from newstands to publishers, from peddlars to department stores.

(ii) Complementary linkages - both establishments supply the same market or a single customer - establishment with goods or services which are interrelated. The products of both establishments may be mutually interdependent; or the product of one establishment may supplement the product of the other. Examples of both kinds abound among establishments supplying the "bits and pieces" and subassemblies of manufactured goods of all sorts to the prime manufacturing establishments, from mens clothing to motor cars.

(iii) Commensal linkages - both establishments use the same facilities or depend upon the same supplier or the same market. There may be no direct business relationship between establishments commensally linked.

(iv) Ancillary linkages - services are especially common in major business centres where cafeterias, cigar stores, and various "consumer service" establishments serve the working population (p. 29).
Linkages within various sectors of the economy are not uniform; rather they depend upon production and marketing practices, the inventory of other land-uses within the area and the juxtaposition of these linked uses with the establishment. According to Townroe (1970:19), "linkages within various sectors of the economy tend to be found more strongly in processes that are fairly specialized by the skill rather than the capital machinery involved, and which produce non-uniform and custom built goods. The process has to be speedily adaptable and sensitive to technological change. The strongly linked firm tends to be small in size, to be housed in a single plant, and to have an owner-manager, with a high level of direct management involvement in production [marketing]."

The concentration of urban land-uses and the flow of linkages implies the existence of external economies of scale (See Figure 3.1). These economies accrue to establishments either as a lowering of production or marketing costs or as an increase in revenue of output, caused by internal or external forces within the economy. Agglomeration economies are one type of external economy which try to explain locational decisions of individual establishments (Weber, 1909). Agglomeration economies are of four types (Townroe, 1970):

(a) **Internal Scales of Economy** - a reduction in costs per unit as a result of an increase in size of production inputs or plan of an economic activity.

(b) **Economies of Localization** - aggregation of complementary or related range of industries benefit due to: (i) a pooling of specialized labor; (ii) availability of specialized services; and (iii) a concentration of buyers.

(c) **Economies of Urbanization** - external economies where unlike plants congregate, using common facilities of commerce and banking, technical services, education, subcontracting, and wide range of adaptable skills.
EXTERNAL ECONOMIES
MAJOR FUNCTIONAL LINKAGES OF ESTABLISHMENTS

SERVICE PROVIDER

SUPPLIER

ORIGINATOR OF SUBCONTRACT WORK

ESTABLISHMENT

CUSTOMERS

FIRMS SUBCONTRACTING FOR EST

FROM: LLOYD AND DICKEN, 1972:131

External Economies
(Lloyd & Dickens, 1972)
"These latter types of economies are sometimes called economies of spatial juxtaposition".

(d) Transfer Economies - the savings in transport costs to each firm as a result of locating adjacent to one another (p.18).

Smaller firms, as identified above, operating in an unstable or unpredictable market consider external economies an important locational criteria (Yavitz and Stanback, 1973). These firms must maintain close ties (distance) with markets, customers, suppliers, and competing establishments.

The relationship of linkage and agglomeration economies has direct implications for the spatial arrangement of land-uses within urban areas (A. J. Scott, 1983; Fernie, 1977; and Townroe, 1970). As Scott suggests,

Even though considerable caution is in order in any attempt to argue directly from economic structure to spatial structure [ie. Linkages to location], these latter findings all suggest that some kinds of enterprise, at certain levels of the technical division of labor [specialization], seem to be highly interdependent in both functional and geographical terms (p.15).

Costs of establishment and relocation can be excessive in relation to output. Establishments generally seeking to reduce the costs of distance through spatial clustering (A.J. Scott, 1983). Suppliers will want to locate close to demand establishments, while demand establishments will want to locate close to suppliers to ensure supply. Scott (1983:20) summarizes these relationships of economies and location as follows, "industry and offices that are small in scale, unstandardized, labor intensive, and functionally interrelated find themselves under heavy pressure to locate close to one another in geographical space." Three important factors contribute to these
relationships and patterns (Scott, 1983):
(a) Transportation and communication benefits of clustering represent an extraordinarily important agglomeration economy for establishments.
(b) Specialized agglomeration effects are, among others, (i) small unstandardized firms facing constantly changing sets of input and output relationships; and (ii) clustering allows a more efficient dissemination of market information.
(c) Specialized role of subcontracting occurs in two forms: (i) complementary, where work is subcontracted because it cannot be done in-house; and (ii) current, where overflow work must be subcontracted.

The implications of linkages thus become important and clearly establish the relationship between functional association and spatial affinities. The remainder of the chapter will review some of the relevant literature on this subject.

3.4.3 Spatial Proximity

Clustering of complementary establishments is a common feature of commercial markets throughout the world. P. Scott (1970) cites examples from Africa and Southern Asia which illustrate spatial proximities of retail establishments. The specific example of a shopping street in Padra, India illustrates the significance of strong proximal locations. Of three hundred shops along this section of the street, forty-seven were clothing, thirty-six were goldsmiths, thirty-five were grain dealers and twenty-five were tailors, and "no less
than eighty-five establishments have a shop of the same type next door" (p.27).

The bulk of commercial land-use study, and more specifically that of spatial linkages, was pioneered by Haig during the Twenties. In his study on Manhattan office land-uses, Haig (1923) pointed out that clusters of offices emerged as a direct result of the need for personal exchange through face-to-face contact. Over two decades later, Ratcliffe (1949) examined retail clusters in twenty-four American cities. Tabulating the proportion of block fronts of a particular use, he went on to present the agglomerative tendencies he found. Shoe shops, furniture stores and variety good stores tended to cluster among themselves, while jewellery stores showed only moderate tendencies towards agglomeration.

One of the most comprehensive studies of commercial land-uses was undertaken by Rannells in Philadelphia in the mid Fifties. Rannells, in his book The Core of the City (1956), looked at the concentration of establishments, their centers of gravity and dispersion, and finally the linkages between various land-uses. Departing from popular descriptive studies of this era, Rannells explored the underlying process of changing land-use patterns. "Rannels was responsible for presenting the CBD [Central Business District] in a new light, not as an area to be defined but as a product of a complex which determined locational decisions, a complex which has to be unravelled before anything useful could be said about the area" (Carter, 1980:231). Using very broad classifications of land-use, Rannells successfully describes linkages between land-uses. His
primary conclusions which are presented in Figure 3.2 take the form of a three-way screening process relating the two variables of accessibility and linkages with a third, availability. Accessibility and availability are "reciprocal and dynamic, that is -- as accessible space is used, more intensively, less of it is available and its cost rises." (Rannells, 1956:150). Linkages provide the contacts between accessible and available locations.

Compatibility between establishments is a prerequisite for clustering: uses must benefit from proximity while minimizing competition. Nelson (1958) delineates his "rule of retail compatibility" from eight principles of retail location:

(a) Adequacy of present trading area potential.
(b) Accessibility of site to trading area.
(c) Growth potential.
(d) Business interception.
(e) Cumulative attraction.
(f) Compatibility.
(g) Minimizing competitive hazard.
(h) Site economics - size, shape, topography, etc.

Nelson is more concerned with individual firms and their physical needs than with the relationship between firms; but, because locational decisions are made by individual firms, his eight principles are relevant to this study.

Looking at the interaction between establishments in terms of communication, Weber (1964) suggested that the core of the city offers the accessibility which encourages clustering of establishments. Clustering increases contact and simultaneously reduces costs of distance and time and allows the exploitation of external economies (Sim, 1982). Dunning also has suggested that, in order to minimize costs of interaction, establishments would agglomerate. He listed four advantages of clustering (Sim,
Three Way Screening.
(Rannells, 1957)
the need for rapid transmission of information,
(ii) the need for personal contact to promote mutual trust,
(iii) a savings in time for managers and directors connected
with multiple establishments.
(iv) ease of personal contact between junior members
of firms, aiding mutual understanding.

Spatial affinity of commercial establishments is the
central theme of a study by Getis and Getis (1966). They argue
that spatial affinities can be considered as a factor
influencing location in cases where establishments are grouped
or clustered. Using heterogeneous and homogeneous data sets,
Getis and Getis applied a test of significant association,
comparing expected (random) and observed results (Getis, 1967).
They concluded that, while retail store affinities exist, the
number and magnitude are small. R.L. Davies (1972), in a study
of the retail patterns in Coventry, also demonstrated
statistical significance for spatial affinities among shops:

Except for the categories of food shops and specialist
shops, all other categories of retailing facilities are more
commonly related with their own functional kind than would be
expected under random conditions .... This means there is a
spatial affinity in terms of attraction between them, clothing
stores locate near other clothing stores, leisure services
locate near other leisure services, etc. This suggests that in
turn further evidence for specialized clusterings throughout the
central area and through the overall retail distribution may
appear mixed, there is considerable order in linkages underlying
such diversity (p. 21).

Using historical data, Varley (1968) identified clusters
and related these to recorded clusterings of similar
establishments. In this way, he was able to trace emerging
spatial linkages. Varley's study of Manchester illustrated the
close ties of traditional uses, such as stockbrockers to their
"anchors" -- in this case, the stock exchange. More contemporary
uses such as travel agents seemed to be more dispersed and lacked a centre of gravity or "anchor". Grouping and index dispersion techniques were followed by a combination analysis of land-use data. Blocks were ranked and grouped according to the percentage of various land-uses. The results yielded a map of dominant land-use districts, including what was termed, "strong retail agglomerations" and the "traditional office area".

The agglomerations of office establishments in large cities have been the subject of a number of empirical studies. Offices as a class are unique: their product is primarily information and, therefore, difficulties arise with measurement of output. Offices generally locate in upper floor space as opposed to retail reliance on ground floor locations. Goddard has conducted some of the most intensive studies of office linkages and location. In his London studies, Goddard demonstrates the functional linkages between them (Goddard, 1973). Face-to-face contact was considered the important interactive mode, with over a third of all business journeys made on foot and lasting less than ten minutes. Proximity of other functionally linked establishments is suggested as a factor in office location decisions. As Goddard concludes, "the analysis has revealed that the center of the large metropolitan city consists of a series of over-lapping spatial sub-systems that can be defined in terms of both movements and location patterns. Underpinning this interdependence between movement and spatial structure is a complex network of functional connections between area business activities."
3.5 Land Use Regulation: Zoning

So far in this study, the issues of land-use growth, change and patterning have been discussed essentially from a market perspective. Competition, complementarity, accessibility, and proximity between uses have been recognized as significant influences on urban land-use structure. However, a second major group of influences acting on land-uses warrants consideration: the public regulations imposed by local administrative agencies. Chapin (1979:49) argues in the context of urban land-use planning:

A normative theory of land-use would provide the basis on which a locality could establish what its pattern of land-use ought to be. In this perspective, urban spatial structure is a conjunctive outcome of the functioning of the market and political processes, the one providing the means by which individuals, firm, and institutions pursue their self interest, and the other, the means by which government articulates and pursues the common interest.

Zoning has permeated nearly every sector of most cities over its relatively short seventy year history. Extending beyond the obvious physical relationships inherent in cities, it has had significant effects upon housing and employment opportunities, as well as on the local tax base (Listoken, 1974). City planning as we know it today relies heavily on zoning. The following section briefly outlines the historical underpinnings of zoning, its evolution over seventy years, its rationale as a device of land-use regulation and finally contemporary forms of zoning.

Land-use regulations in general have been in place only a short time by city standards. Emerging in the early part of the century as a logical extension of public nuisance laws, zoning
had its foundations in the case of Village of Euclid v. Ambler Realty Co. (Babcock, 1966). In the case, the court rejected the proposed development of an apartment building in an established residential neighbourhood by the Realty Co. The rejection indicated the court's feeling that the development was misplaced, and, like a nuisance: "may be merely a right thing in the wrong place, like a pig in the parlor instead of the barnyard" (Babcock, 1966:4). Zoning emerged from the desire to prevent change within existing neighbourhoods (in this case, higher density housing). It grew also in response to the relatively small-scale ownership and development of land, which led to both a variety of uses and the need for some uniformity. In this period of early city development, land ownership and development was generally on a lot-by-lot scale: "... regulation of relationships among land uses required regulation of relationships among land users as well" (Listokin, 1974:24). In terms of the conflict between uniform districts and variety of use, zoning was thought to be a compromise and one which would distribute uniform districts throughout the city. As Listokin indicates, however, "the price of this uniformity was a significant over-simplification of the complex potential relationships among building and activities within small areas." Such over-simplification has clearly become an acute problem today and the complex internal structures and activities of land-use zones are often neglected under general or vague zoning designations, as has happened, for example, in the areas of Granville Mall and Gastown in Vancouver.

The persuasiveness of the legal professions to enact such a
new and bold regulation had definite ramifications for the character of zoning. In its early form, the scope of zoning extended only within the territorial bounds of the local government. Its parochial nature stemmed from the legitimacy the local government derived through charters and enabling legislation conferred by higher forms of government. Early zoning regulations were further characterized as being "self-executing, non-compensative, and negative" (Listokin, 1974:23). In other words, zoning districts were created in advance and expected to be self-regulating thereafter; no compensation would be made to owners for losses created by these regulations. The negativeness of the early regulations stemmed from the device which prohibited uses and controlled development standards. Finally, early zoning regulations, which permitted a wide range of activity in many areas of the city, were typified by their general lack of definitive control. The subsequent "overzoning" of vast areas of the city reflected the limited role of planning and the desire not to depress property values (Listokin, 1974).

The evolution of zoning has seen significant change. A general swing has been felt in a positive direction as more contemporary devices emphasize permitted uses as opposed to prohibited ones. The processes of regulation have also become more sophisticated, creativing districts reflecting a wider range of development characteristics (landscaping, screening provisions, appearance of buildings, economic compatibility of uses permitted, etc.). Performance standards now dictate zonal use and development. In contrast, cumulative zoning, an early device through which each successively lower use allowed all
uses and standards of higher uses (single family dwelling zones occupied the apex of such schemes), ensured no intrusion of other land-uses. The refinement of districting has imposed increased restrictions on land-use and development, attributed by Listokin (1974) to the greater public acceptance of land-use regulations.

As these changes indicate, zoning and land-use planning, operate within the physical, social and economic sectors of the city for the good of the public interest. The public interest is best illustrated by the following classification from Chapin (1979):

(a) Health and Safety - injurious and harmful conditions within the city must be minimized. Issues related to noise, pollution, protection, privacy, and availability of light and air become important.

(b) Convenience - the relationship of time/distance bring up issues of the circulation systems, arrangement of land-uses and the functional relationships between land-uses.

(c) Efficiency and Energy Conservation - from the perspective of land-use, efficiency related to least cost alternatives of land-use. Energy conservation has responded to concerns over the scarcity of resources.
(d) Environmental Quality - the trend of the Seventies has raised concerns of environmental degradation (primarily the loss of agricultural land to urban uses and the pollution of air and water) and the effects on human health.

(e) Social Equity and Social Choice - equal access to and a free choice of the opportunities offered to life in the city.

(f) Amenity - the opportunity to live, work, and play in a pleasant environment. The issues here range from tangibles to perceptual attributes of urban design.

While these groups offer a simplified version of public interest, significant overlap occurs when specific issues are addressed in any group. Conflicts may also arise in the above interpretation, for example, when efficiency increases to the point where convenience is sacrificed.

The emphasis on environmental and amenity issues have contributed to the transformation of traditional zoning devices. Significant shifts in administrative process have yielded to what Listokin (1978) calls the "wait and see" approaches to land-use regulations. Building on early approaches of variances and conditional land-uses, where lots within zones could be granted special uses (outside the literal uses specified), increasingly imaginative and complex devices have typified modern zoning. These more contemporary devices emerged in an attempt to offset metropolitan expansion and the evolution of a variety of development techniques.

Contemporary land-use regulations are of three types: low
density zoning, conditional zoning, and the "planned unit development" or "PUD". Low density zoning involves designating underdeveloped tracts to very low densities. Subsequent development proposals for higher densities (rezonings) are subjected to review in accordance with local plans and policies. The device allows for an incremental growth in times of uncertainty and market fluctuations. Conditional zoning is similar to low density zoning, but provides the flexibility of demanding specific development standards as a condition of approval. A recent trend has been towards the provision of public amenities through a "bonus system". Developers are allowed greater heights and/or density in return for the incorporation of public amenities into the development. Potential problems could arise with abuses of this discretionary device. In addition, it is only viable in periods and places of relatively high development pressure. The final device considered in this section is the PUD; redevelopment occurring at this scale is referred to as special district zoning. This device allows for a variety of uses and standards on site which are not possible with traditional zoning. Comprehensive development plans allow greater densities while encouraging innovative design (site and building) and increased open green space. These devices have found widespread use in North America, notably in New York with its special districting for theatres, and in Vancouver with the development of the British Columbia Place lands.

Regulation has shown a gradual growth over the last seventy years, but still retains much of its traditional character.
Innovative devices are attempted in only the larger cities, while smaller cities cling to conventional forms of zoning as an approach to development control. Nevertheless, it becomes clear, through the investigation of market dynamics and land-use regulations, that current zoning methods are not adequate in the maintenance and growth of the commercial land-uses in the city. Contemporary zoning regulations should reflect an appreciation for land-use structure and dynamics within commercial districts.

3.6 Summary

Land use theory has been approached from number of different disciplines, so that today we have no definitive theory of urban land-use. The literature is, therefore, difficult to synthesize. Concentrating on a few directions in land-use theory, the last two chapters have looked at commercial land-uses from both a market perspective and a public regulation point of view. The focus of this thesis is on the commercial strip districts within the inner city as one type of commercial configuration. This district, present in most cities, has always been subject to a great amount of change, either growing and prospering or declining in cycles. Emphasis has been placed in those districts which have shown the more prosperous evolution from "typical" commercial strips to specialized strips characterized by office and service commercial land-uses.

Within this thesis, the investigation is directed to the internal structure and dynamics of the commercial districts, with specific reference to strips where possible. The work concentrates on the spatial locations of commercial
establishments and relates these to historical processes and functional associations between establishments. Growth and change as historical processes include the expansion of districts into neighbouring ones, changing the character of these and the internal organization of land-uses within existing districts. This latter type of change is examined in the case study. Functional associations implied by the spatial patterning, specifically proximity, encompass a number of aspects of which accessibility, linkages and external economies are discussed in detail. These processes, which operate in the urban environment, are thought to arise from and give rise to spatial proximities. The literature, reviewed above, does lend support to this premise.
CHAPTER 4
CASE STUDY

4.1 Introduction

The theoretical basis of this study has been discussed in the previous two chapters. Research has shown that historical trends and functional associations may lead to spatial proximities between commercial establishments. In this chapter, a physical description of the Broadway strip is followed by a brief history of the land-use regulations and the market forces affecting the study area. The bulk of the chapter is a presentation and analysis of the results of the statistical tests applied to the data. (A discussion of the data and methods used can be found in Chapter One and in the Appendices).

4.2 The Case Study Area

Broadway Avenue is one of the major east-west transportation routes spanning Vancouver and Burnaby. Connected at its eastern end with the Lougheed Highway, Broadway provides good access to the highways and suburbs to the east; its Vancouver segment begins at Boundary Road. Although East Broadway is predominantly fronted by warehouses to the south, it is residential along the rest of the route to Main Street. Two activity nodes have formed along this stretch of Broadway, the Vancouver Community College and the intersection of Broadway and Commercial Drive. From Main Street west to Alma Road, approximately forty blocks, Broadway is primarily a commercial
street, with two main concentrations of activity: one located in what is referred to as West Broadway, (from Arbutus Street to Alma Street) and the second, the Central Broadway commercial strip between Main and Burrard Streets. This latter section is the focus of the study. The boundaries of this area are set at Ontario Street in the east (division of east and west street addresses in Vancouver) and Burrard in the west, creating an eighteen block area with street addresses ranging from 0001 West Broadway to 1795 West Broadway. The Central Broadway strip has shown substantial redevelopment activity over the past two decades and provides a wealth of activity to study. Adding to the area's potential is the proximity of City Hall and the province's largest hospital, Vancouver General. Both of these land-uses generate large volumes of daytime customers for the Central Broadway commercial complex. While this study focuses only on those establishments which front on Broadway and extend a maximum of a block on either side of the artery, the effects of these two large land-uses are taken into account.

The areas surrounding Central Broadway are predominantly residential, although with significant industrial enclaves, especially north of Broadway. Mount Pleasant, to the east and south of the strip and which is mainly single-family oriented, has not experienced the high density redevelopment as of residential areas in the inner city to the west. South of Broadway and west of Cambie, to the limit of the study area, single-family land-uses give way to multi-family apartments. North of the strip in the east, a predominance of industrial and warehousing has prevented any significant residential
development. The only residential area north of Broadway is Fairview Slopes, between Willow and Hemlock, extending north to False Creek. Areas west of Hemlock and north of the strip are also light industrial and warehousing districts.

Broadway Avenue carries large volumes of traffic, in the order of 1800 cars per hour during peak hours and an average of 1200 cars per hour over a twenty-four hour period on its four lanes. The flow is steady but becomes congested at rush hours, particularly near major intersections of dissecting routes. The bulk of the traffic in the area stays on the major north/south routes to and from the downtown peninsula. Burrard, Granville, Oak, Cambie and Main carry the majority of the traffic from the south.

Prior to the introduction of public transit and the widespread use of the automobile as a primary means of transport, Central Broadway was predominantly a mix of residential and low-order commercial goods and service land- uses. Commuter traffic along the east/west strip was low, reinforcing the local nature of retail establishments. The dominance of the CBD over the City, as the commercial, industrial, and cultural hub subdued the profile of Central Broadway as a commercial node. However, with the advent of public transit along Broadway and the growing use of private automobiles, Central Broadway's retail prominence expanded. Accessibility and eligibility of locations along Broadway promoted the area as a viable, growing commercial strip. Building heights rarely rose above one or two storeys until the early 70's, with the only multi-storey office/retail complex
being the Fairmont Medical Building. Built primarily as a medical complex, the building is strategically located within two blocks of the hospital. The fourteen floors of offices related to health services led to this section of the Strip being designated as a "medical node".

During the 1970's, building activity catapulted Central Broadway into the second largest office concentration in the region, next to the CBD. Office space in 1971 totalled approximately 1.0 million square feet; ten years later well over 2.0 million square feet existed. Over that decade, redevelopment projects ranged from two storeys and 20,000 square feet to eighteen storeys and 200,000 square feet (See Figure 4.1). By 1981, the Strip had ten buildings over five storeys. The majority of the large scale projects included substantial increases to the retail floor space at ground-oriented locations. An influx of chain stores replaced local firms. In terms of office space, the shift was away from medical offices towards business and business-service establishments. In the heart of the medical district between Cambie and Oak, office towers at 601 and 999 West Broadway, and one proposed for the 500 block, house a number of non-medical office functions. General and professional businesses, including accountants, lawyers, management and financial consulting services, are locating here. Some professional offices are also locating further to the west along the Burrard/Arbutus segment of Broadway. For example, some insurance offices have established head or regional offices there.

Broadway contains approximately 15 percent of the City's
### COMMERCIAL REDEVELOPMENT ALONG CENTRAL BROADWAY

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<tr>
<th>YEAR</th>
<th>ADDRESS</th>
<th>DESCRIPTION</th>
<th>OFFICE SQ. FT.</th>
<th>RETAIL SQ. FT.</th>
<th>PARKING/RES. UNITS</th>
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<td>171,500</td>
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</table>

* Proposed, approved or under-construction as of Dec. 1981.

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Commercial Redevelopment on Broadway.

(Macaulay, Nicol, Maitland and Co. Ltd.)

FIG. 4.1
office space representing 11 percent of the Metropolitan region's commercial office inventory. Growth within the Broadway area has surpassed all estimates of the GVRD under their "Liveable Region" program. As a commercial district Broadway offers business a location which is close to downtown, with good access and a high profile. Investor confidence has been high in the area, and construction continues.

4.3 Planning Along Central Broadway

Zoning has played a significant role in the development of Central Broadway as a commercial node. Land use regulations along the strip prior to 1975 were predominantly traditional. Building activity in the decade preceding 1975, together with a reassessment of community goals, prompted the city administration to implement a zoning change along Broadway. The major developments mentioned above transformed Broadway into a major office district at a time when the city administration was evaluating non-residential land-uses outside the CBD. In a desire to downzone the CBD, various alternatives for non-CBD growth were explored. Broadway, at that time, demonstrated many of the symptoms of downtown growth and densification and for this, and other reasons, regulations there were revamped to reduce the height and floor space ratios of the buildings. Discretionary uses and conditions were built into the new zoning device such that buildings could not now "automatically" rise above the two storey limit. Discretionary zoning also allowed the city administration to extract social and other concessions of amenity from the developers. The treatment of this area under
the new zoning was unique to Broadway. Other commercial districts have been dealt with in other ways reflecting local goals.

Many of the buildings along Broadway are of post-1965 stock, indicating the lack of building activity before the early 1970's. From 1956 through to the mid 70's, Central Broadway was covered under a C-2 and C-3 zoning designation (See Map 4.3). Land uses were generally commercial and residential with a variety of light industrial, cultural, recreational and public uses but almost any use was tolerated under section 2(34) of By-law #3575, 1956 (see Appendix C):

Any other building or use which is not specifically listed in any schedule or this By-law and which is similar to the foregoing buildings or uses, [may be permitted].

Under the C-2 designation, building heights were restricted to three storeys and floor space ratios to three. C-3 designations allowed greater development potential by permitting up to eight storeys and floor space ratios of five. Heights and floor space ratios above these were allowable through the discretion of the Technical Planning Board.

The loose restrictions placed on the area encouraged the construction of several large complexes of office and retail uses; the early 1970's saw the construction of at least half a dozen major office/retail complexes. Broadway's share of the City's office space increased from 2.5 percent in 1967 to 12.8 percent in 1974. The building activity and the resulting concerns of neighbouring residents, complicated by the potential for major transportation problems along Broadway, prompted the Planning Department to re-evaluate the zoning regulations for
the Central Broadway strip. Concerns were also expressed that controls on downtown space might cause some development to spill over onto Broadway. Some positive features of growth, such as increased pedestrian flows and the characterization of Broadway as a strip with interesting, well-designed and properly-spaced structures, were also cited (Vancouver Planning Department, 1975). However, concerns over traffic overruled these less tangible positive aspects. At this time, the Greater Vancouver Regional District which had just developed its "Liveable Region" concepts and plans, felt that continued growth along Central Broadway could jeopardize the goals of regional planning aimed at decentralization.

By 1976, a new zoning district had been created for the development on Broadway. The new C-3A designation, covering Broadway from Prince Albert Street in the east to Vine Street in the west, included the majority of uses from the C-2 and C-3 sections of the pre-1975 zoning By-law. One major change to the new zone saw building heights reduced from three and eight storeys to a maximum of two. Floor space ratios were also limited to a maximum of one. In further sections of this new By-law, large scale development is permitted at the discretion of the Development Permit Board. As part of its duty in reviewing permit applications, the DPB: "shall also have due regard to:

(a) the provisions of the By-law, the amount of open space, views, plazas, pedestrian needs and interests, the height and bulk of buildings, and its relation to the site and surrounding streets and buildings, the effect of traffic, the provision of off-street parking and loading, its overall design, preservation of the character and general amenity desired for the Broadway and South Granville areas. (Vancouver By-Law #3575)
The new zoning designation clearly reflects the growing importance of urban design issues in City planning practices. Now that the new By-law has been set, it would appear that redevelopments will have to proceed through the Development Permit Board. Multi-storey structures will still be allowed but under greater control and scrutiny by the Planning Department than before.

4.4 Market Review

The commercial structure and land-use patterns along Central Broadway are a direct result of decisions of private investors made under a number of locational, spatial and financial constraints as well as those imposed by public agencies such as the City's Planning Department. That investor confidence has been high in this area is demonstrated by the building activity over the past two decades.

In general, Central Broadway experienced only minor development through the 1950's and 1960's; the medical building at 750 W. Broadway can be considered the only major redevelopment during that period. Towards the late Sixties and into the Seventies, redevelopment flourished. Car dealerships became major horizontal, space-extensive uses along the strip, while office towers added a vertical, space-intensive dimension. Recent office development is overshadowing the horizontal uses to such an extent that replacement by the "efficient" multi-storey buildings seems inevitable. Using these locations for space-extensive uses such as automobile dealerships is no longer economically sound, and a trend is beginning whereby these uses
are locating to Kingsway, Marine Drive, and suburban locations. The vacated locations provide prime sites of assembled land for more intensive redevelopment. The movement towards health and medical service uses has recently been augmented by the influx of business oriented offices. This latter trend may well determine the character of Central Broadway for some time.

At present, major office complexes are clustered between Cambie and Oak Streets and in the area west of Granville. Over the next decade, proposals, approved plans and buildings already under construction, will occupy the low-density sites currently between high-density buildings. The results, if present trends of ground-floor retail space continue, will be a continuous strip of commercial/retail shops at ground level, as the office towers typically dedicate their ground floors to retail uses.

The retail component of commercial land-use along West Broadway occurs in older buildings or ground floor locations of new office buildings. Redevelopment of retail low-rise buildings has been limited to renovations and retrofits. Major redevelopment of sites with old low-rise buildings with new, low-rise buildings would probably be uneconomical in view of the present potential to use the property for more profitable uses. Retail uses along the strip have traditionally relied on pedestrian and auto traffic for customers, but with the redevelopment of sites into major office complexes, large office populations provide the necessary clientele. Retail outlets may now only have to rely on a relatively small number of buildings to stay in business.

Growth along Central Broadway has been positive,
development has, however, occurred in a sporadic and dispersed manner over the last decade and a half. With the addition of about ten percent per annum of office space during this period, the strip is the fastest growing district in the Region (MaCaulay, Nicolls, Maitland and Co. Ltd, 1983). As of 1981, Central Broadway's over 3 million square feet of office floor space give it a 15 percent share of the Vancouver office space and an 11 percent share across the Metropolitan Region. Construction and absorption rates have kept pace with one another over the last fifteen years. Land values and rental rates both peaked in 1981, set at fifty dollars per developable square foot and sixteen dollars per square foot per annum gross, respectively. Land values in Central Broadway have lagged behind those of downtown by a factor of about 0.65, while rental rates have diverged from an on par value in the early Seventies to a 25 percent point spread in 1981. Rental rates for top downtown space was about twenty-seven dollars per square foot per annum gross in 1981. Vacancy rates on Central Broadway have fluctuated from a high of 8.0 percent in 1977 to a low of 1 or 2 percent in 1980-81. The slowing of construction during the early Eighties has helped to keep these figures at a low level.

A number of locational advantages inherent in the Central Broadway strip make it attractive to redevelopment. In addition to the large assembled sites, good accessibility and proximity to downtown, Central Broadway is gaining a reputation as a district of prestigious offices. (Pierce, 1984, personal communication). The strip, particularly on the north side, offers views of False Creek and B.C. Place, the downtown
peninsula and the mountains beyond. Broadway also offers parking advantages: major structures on Broadway have on-site parking at a rate of one stall per 500 square feet of floor space, in contrast to downtown structures which are restricted to one stall per 1000 square feet. Considering these factors and the new construction expected over the next few years, Central Broadway should increase its share of office uses within the Region.

4.5 Analysis of Results

4.5.1 Introduction

The following analysis of results is broken into a number of segments. The first section addresses the concepts of growth and change for retail, service, and office sub-categories of commercial land-use (See Figure 4.2), logical groups in light of the classification system used in the thesis. A synthesis of growth and change follows. The remainder of the chapter presents the results of the clustering analysis, using the same sub-categories as before. A synthesis of the concepts of growth, change, and land-use patterning concludes the work.

4.5.2 Growth and Change

The retail sector of Central Broadway has grown and shifted from a predominantly low order goods function to one of a highly diverse and specialized nature in relation to other non-CBD uses. In response to the absolute growth of commercial land-uses along the strip and the increased relative importance of this
<table>
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<td>Cleaners</td>
<td>Shipping companies</td>
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<td>Tailor</td>
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<td>Dental mechanics</td>
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<td>Hire service</td>
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</table>

*See Appendix A

Land Use Classification.

(Alexander, 1973)
area to the City, retail land-uses reflect the evolving nature of the strip (see Figure 4.3).

The 1951 land-use data indicates that retail establishments accounted for about 15 percent of the shops along the study area. The fifty-six shops catered to the convenience or day-to-day needs of the surrounding residential areas and to the residential community then living on the strip in single and multi-family structures interspersed among the commercial land-uses. The majority of retail shops were ones with small frontage and extending the depth of the block. Major uses included food stores, drug stores, appliance or hardware shops and shops dealing in industrial equipment.

Over thirty years the shift in retail establishments has been dramatic. Highly specialized retail stores, able to pay higher rents, and reliant upon the locational attributes of Central Broadway have replaced the convenience, low-order goods stores. The most obvious shifts have been the emergence of "automobile row", the building of a highly organized medical support retail presence, and the most recent influx of business related retail establishments.

Soon after 1951 major auto dealers moved onto the strip and opened large, space-extensive establishments specializing in new car sales. Entire blocks were taken up by a half dozen dealers. Accompanying this influx were a number of smaller used car dealers. These establishments located in proximity to major new car dealers for comparison shopping (competition) and other functional linkages. The combination of these two types of retail auto uses has characterized Central Broadway as a typical
LAND USE BREAKDOWN ON BROADWAY

M.A. THESIS - U.B.C.

BLAKE B. HUDEMA

FIG 4.3
"automobile row" strip.

Parallel to this growth of the auto oriented retail sector has been the emergence of increased numbers of medical support retail establishments. Pharmacists and opticians found it advantageous to locate near the growing medical complex. Today, the medical retail shops and the medical service uses have evolved into a highly competitive network. The recent emergence of discount optical shops has fueled the already competitive climate of these uses on the strip.

Despite these shifts and trends, the current move on the strip is towards office related establishments. Office supply shops, with emphasis on computer and electronic business equipment, are growing as major uses along the commercial strip. Although these uses are largely linked to business sales, a large number are beginning to cater to personal business machines and computers.

Specialized retail shops are common along Central Broadway. Camera, audio/visual, and high-fashion clothing shops account for a significant portion of the retail uses. Music shops and furniture shops close to Granville really do not reflect the patterns of the strip, instead they appear to be a spill-over from the highly specialized commercial district along Granville.

While the service establishments (personal and business) have remained an important part of the functional character of the strip, they too have changed considerably. The absolute number of service establishments has grown by approximately 250 percent, while sizes of shops have shown little increase. The nature of these establishments has shifted over the last thirty
years from personal services to more business oriented ones.

Service establishments in 1951, like the retail outlets, were oriented to residents surrounding the strip and to those passing in automobiles along the strip. Cleaners, tailors, shoemakers and repair shops were predominant uses. Auto-related service establishments included the garages, tire shops and industrial/machine shops.

The increase in service establishments apparently, has been in response to the increases in both the surrounding residential populations and the growth in day-time office workers on the strip. Restaurants have increased in numbers from 15 in 1951 to over 60 in 1981. They range from convenience sandwich shops and delis to first class establishments. Hair salons for both men and women have paralleled this growth in service establishments. Ladies' salons outnumber men's shops four to one. Real estate and travel shops have found this strip attractive; both have shown marked increases in numbers over the three decades.

Health and medical service establishments have grown in numbers along Central Broadway. Opticians and dental mechanics occupy a number of locations, probably in order to benefit from the existing medical offices on the strip.

Office service establishments related to business rather than to people have increased ten fold over the last thirty years. Employment agencies, computer accounting and a variety of other business services have emerged as peripherals to the offices on the strip.

By far, the greatest growth along Central Broadway has been the office sector. In 1951, fewer than seventy office
establishments located here, compared to over 450 in 1981. By this date the office establishments accounted for over 50 percent of the total establishments along Broadway. Aggregate office categories increased approximately six fold over the thirty years.

General office uses (see Appendices for a detailed list), have become the second largest group of office uses on the strip. The rich diversity of offices indicates the wealth of resources and services available. The increase in insurance offices, as well as the increase in travel agents and real estate agents is probably due more to societal factors, not addressed in this paper, than to considerations of location. One interesting point is the preponderance of large insurance firms on the strip: several firms have located regional and head offices here (this trend will be discussed further in the section on land-use patterning).

Lawyers and accountants have been slow to move onto the strip. This may be attributable to the strong ties each group has to respective communities on the downtown peninsula. The increased perception of the strip as an eligible and prestigious area may lead to an influx of legal and accounting firms. Some professionals, notably architects and engineers, have moved their offices to the strip in the last decade.

Business advisory groups specializing in management and financial consulting have created the most recent trend in office establishments; these establishments are locating to the business sector of the strip, where they are reinforced by business services already located there.
The dominant use on the strip is the health care services. Medical doctors, dentists and other health professionals on Broadway have increased over six hundred percent over the last three decades -- medical doctors outnumber the others by two to one. Medical practices have been, and continue to be, relatively small; dental practices on the other hand show much more grouping into co-operative office space. Through this informal "clinic" system, efficient use can be made of receptionists, hygenists and dental equipment. Moreover, a range of specialists can operate out of a single office. Medical doctors are much less likely to occupy shared premises and the majority of doctors who practice on the strip do so in separate offices.

As has been demonstrated, the increase in retail, service, and office establishments has been substantial. The shift away from convenience and low order goods and services to specialized establishments over the last thirty years has been observed. Trends along Central Broadway reflect the much larger trends inherent in the maturing of a major metropolis. During the Sixties, Central Broadway, as part of the inner city, attracted major auto uses who wanted to centralize in highly accessible locations. Next came a complex network of medical services. This highly interrelated group of uses has grown, and Central Broadway has been labelled as the city's "medical node". The most recent growth and change of land-uses has been toward business office, service and retail establishments. These uses are growing in prominence as new structures are built to accomodate them.
4.5.3 Markov Analysis of Location Specific Change

The Markov analysis provides some valuable insights into the trends of land-use change on a site specific basis. The analysis compares the land-uses of one site over two time periods, in this case five years apart. The aggregate matrices (see Figures 4.4 - 4.9) show the percentage probability that a use will be the same or will change to another use over the time period. Due, in part to the complexity of dealing with upper floor data and the scarcity of this data, the analysis has been restricted to ground level establishments.

Changes to the retail structure of the study area over the last thirty years indicate a decreasing stability for retail establishments. Land uses in the early years of the study were much more likely to stay at their location for longer periods of time than similar land-uses would today. Over the time period 1951 to 1961, retail uses at specific sites generally remained constant. Over the decade, food store locations were still food stores at the end of the decade; the retail uses did not change. This pattern of stability is supported for all sub-categories of retail uses by the information gathered for this thesis. Over the subsequent two decades, 1961 to 1981, the stability of land-uses at specific locations diminished. The stability percentages still hovered around fifty, but noticeable shifts were evident as retail establishments gave way to service shops. Retail-household and retail-miscellaneous locations were replaced by a variety of establishments: primarily service and to a lesser extent office-based. This replacement by service uses might be explained by the fact that it is easier to retrofit an existing

|----------------------------------------|

|  | Residential | Retail Food | Retail Clothing | Retail Misc | Retail Office | Retail Auto | Service Restaurant | Service Hair | Service Personal | Service Persbus | Service Business | Service Bank | Service Contract | Service Auto | Service Repair | Office - General | Office Prof | Office Medical | Office Govt | Office BusAdv | Wholesales | Manufacture | Public | Parking | Culture/Rec | Underconstr | Vacant Bldg | Vacant Land |
|----------------------------------------|
| Residential                           | 64          | 3           | 41           | 4           | 1           | 1           | 4               | 9           | 9               | 7            | 5           | 5           | 7            | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           | 8           |
building for service-related uses than for office establishments.

In contrast to the relative stability of the retail segments, the service segment of commercial land-use displays a range of stability. The greatest stability of use is maintained by restaurants. Restaurants rely on an established location as a foundation for business. The low percentage of change reflects the specialized infrastructure necessary to carry out business. Another plausible explanation of this low rate of change might be that restaurant establishments replace one another, which is quite a common occurrence. Due to the limited scope of the thesis, this was not examined. Generally, restaurant locations change only as a result of redevelopment. Banks demonstrate a similar stability (values of < 85 percent), due also in part to special infrastructure such as vaults and interior design. Bank customers desire and expect stable locations for their convenience. Hairdressing salons are slightly less stable (values of between 70 and 85 percent) in terms of length of stay, but appear to need the integration into the local business community that comes with time. The remaining service locations, personal, personal-business, and repair, show a flexibility of location. For a variety of reasons, including ease of adaptation of the interior space, these uses have shown the greatest amount of instability or change (probability values of less than 50 percent). In other words, the probability of any business lasting five to ten years at a single location is low. Whereas most of these small service uses change sites without apparent pattern, auto service establishments are interesting in that
they are most often replaced by auto retail. This appears consistent with the fact that both rely on similar linkages within the commercial community.

The change of establishments at office locations appear consistent with the stability of the office community. General business offices have remained general business offices over the last thirty years. A small number of businesses moving out of office locations were replaced by a variety of retail and service land-uses. However, as only ground level establishments were considered, it is not difficult to assume that changes of office establishments to retail and service shops are possible. Medical office locations have remained medical offices over the last three decades. The few medical offices which have changed appear to have been replaced by other office uses. Again, the nature of a medical practice relies on stability of location and integration into the community; therefore, little movement should be expected. In some locations, doctors have occupied the same offices through several time periods of the study. The analysis of governmental and business advisory offices proved difficult due to the small number of establishments in these categories. General stability is probable, in keeping with the trend suggested by other office replacement uses.

The Markov analysis has been successful in demonstrating how the Central Broadway commercial strip has changed on a location by location basis. The following section will incorporate this analysis into a discussion of how these individual changes have led to the land-use patterns evident in 1981.
4.5.4 Land Use Patterning

The preceding section has provided some valuable insights into the growth and change of land-uses along Broadway over the last thirty years. The result of these continual adjustment processes has been the formation of land-use patterns. The patterns of commercial land-use are considered from two directions: initially the analysis looks at how individual land-use types cluster among themselves; then, the analysis adopts a more comprehensive approach and focuses on the reasons for which certain land-uses have located in relation to other uses.

Land uses along Broadway have clearly evolved into a variety of identifiable patterns, ranging from clustering to dispersion. Along the strip, clustering or spatial proximities are evident between different land-use types. This interrelationship of uses provides evidence of some of the fundamental location criteria employed by establishments (see Chapter 2). At the macro level, establishments locate in response to a need for land, building, access and equitable financial arrangements. While these factors over-ride most location decisions, it is contended that, implicitly or explicitly, establishments locate with a rational consideration of their orientation with other uses in the area. Therefore, given a choice between the two locations both which meet minimum internal and external attributes, an establishment will choose that location which offers beneficial external economies of location. As outlined earlier, these include proximal location to competition, suppliers and the public, with linkages of a competitive, complementary, commensal and ancillary nature (see
Chapter 3). This next section investigates the physical patterns of land-use. As demonstrated in the literature, evidence suggests that proximal locations imply functional association. The following analysis illustrates the land-use patterns along Central Broadway.

Growth along Broadway has resulted in significant changes to the stock of buildings and the types of uses occupying this stock. As noted above, growth has occurred in a sporadic and dispersed pattern concentrating in two segments of the strip (see Figure 4.10). The area between Oak Street and Cambie Street accounts for the bulk of the office space along the study area, while the area between Fir Street and Burrard Street at the western edge of the strip consists of a smaller concentration of office uses. The retail and service uses concentrated here have created a complex network of commercial land-uses.

The retail component of commercial land-use along the strip has grown and today accounts for about 40 percent of the ground floor establishments along Broadway. The majority of this component occupies older premises, with newer establishments locating in space provided by major office complexes. Retail continuity is interrupted by large-scale automobile lots and a large number of vacant lots. Specifically, in respect to the retail component, retail food outlets have remained a minor use along Broadway and have continued to show a dispersed pattern. Changing practices of grocery shopping and fluctuations in the surrounding residential populations may account for this lack of growth. In contrast, retail establishments of household and clothing goods have evolved into a complex spatial relationship
<table>
<thead>
<tr>
<th>Land Use by Location Matrix - 1981.</th>
<th>M.A. THESIS UBC.</th>
<th>BLAKE B. HUDEMA</th>
<th>FIG. 4.10</th>
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*FIG. 4.10*
among themselves and with other land-uses within the area. These shops have clustered both among themselves (nearest-neighbour values of less than 0.90 [see Figure 4.11 and Maps 4.4 & 4.5]) and in areas proximal to major office functions. The increasing specialization of these shops may account for their need for linkages with other establishments. Growing concentrations of retail stores are creating an identity for these clusters. For example, in the area of Granville and Broadway, household retail shops appear to be extensions of the Granville concentration of similar land-uses. Other retail establishments show less of a pattern towards supporting proximity and implied linkages. Retail office supply locations do appear to be least consistent with the relationships presented in this thesis. Most of these establishments are located east of Cambie Street in an area of lower density retail uses. From the evidence presented so far in this thesis, a proximal location of these retail uses to the office establishments would be expected. The retail nature of these shops, as opposed to the wholesale uses on which most offices rely, may account for the pattern. Occupying the largest sites and probably least reliant on surrounding uses are the retail automobile uses. These uses, located primarily in the 200,300,900, and 1000 blocks of West Broadway, like similar uses along the strip, will probably give way to more intensive developments over the next few years.

Service commercial land-uses along Broadway display a much more dispersed pattern than the retail uses (See Maps 4.6 - 4.8 and the indices of the nearest-neighbour analysis, Figure 4.11). The services offered are very diverse and show little tendency
RANKING OF COMMERCIAL ACTIVITY OVER THIRTY YEARS

(in descending order of Nearest Neighbor Value)

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* values with less than ten observations.
TYPE: RETAIL - MISCELLANEOUS

1951
1961
1971
1981

TYPE: RETAIL - OFFICE SUPPLY

1951
1961
1971
1981

TYPE: RETAIL - AUTOMOBILE

1951
1961
1971
1981

POINT PATTERN - RETAIL

M.A. THESIS UBC
BLAKE B. HUDEMA
MAP
4.5
to cluster. This may be a result of the greater number of prearranged contacts characteristic of these uses as opposed to the less formal "shopping" behaviour characteristic of retail uses. Personal-business and business service establishments, for example, have nearest-neighbour values of one and slightly greater than one, respectively (Figure 4.11), indicating that proximal locations may not be important to these establishments. Restaurants and hairdressing salons, despite being spread over the whole strip, cluster around the major office complexes. A large number of these shops are located between Yukon Street and Willow Street, with a secondary node adjacent to the Granville Street intersection. Again, the proximity of the Granville Street commercial complex is suspected as an influence over land-use patterns along this section of Broadway.

Office establishments exhibit the greatest clustering of commercial establishments along Broadway (see Maps 4.9 & 4.10). Ground floor office establishments indicate this clustered pattern, while the addition of upper floor data (though beyond the scope of this study), solidifies this relationship. The long-established health service complex on the strip distributes itself among two nodes, one proximal to the General Hospital, between Ash Street and Oak Street, and a second, smaller node between Fir Street and Burrard Street in the westerly most portion of the study strip. Recent office establishments occupied with health service uses have reinforced established medical uses in these two areas. General offices and professional offices have, however, shown a tendency to disperse. Business offices are becoming increasingly abundant in
TYPE: OFFICE - GENERAL

1951
1961
1971
1981

TYPE: OFFICE - PROFESSIONAL

1951
1961
1971
1981

TYPE: OFFICE - MEDICAL

1951
1961
1971
1981

POINT PATTERN — OFFICE

M.A. THESIS UBC
BLAKE B. HUDEMA
MAP 4.9
the west, between Fir Street and Burrard Street (and beyond to the Arbutus segment of Broadway), as well as in the already concentrated office district between Cambie Street and Oak Street.

From the analysis of location of individual uses, patterns do become evident. The strip, rather than being a homogeneous commercial district as suggested by its "blanket" zoning coverage, is composed of five distinct segments (see Map 4.11).

In the east, between Ontario and Cambie, is a unique segment because of the predominance of low buildings, aging structures, and decaying retail land uses. The area is marked by a complete absence of higher density office space and represents almost a pre-development state of commercial land-use. The large number of small shops has probably hampered redevelopment efforts. The second segment of the strip is the antithesis of the first. The area, between Cambie Street and Oak Street, is highly redeveloped to provide intense uses in multi-storey buildings. Within this segment are the bulk of office uses. In response to a number of factors, including proximity to nodes (City Hall and VGH), transportation routes into and out of the downtown peninsula and the availability of large assembled sites, office uses have located here and characterize this segment. This segment of Broadway also illustrates the disparity between the north and south sides of the strip: five of seven multi-storey buildings (above nine storeys) are located on the north side, while on the south side, vacant lots remain undeveloped. In discussions with the real estate industry, a great deal of consideration is given to the views offered along
the north side (Pierce, 1984). Retail and service establishments locating in ground level locations of these office complexes are usually offset from the street by plazas, creating a complex second "dimension" to the commercial continuity along Broadway. The types of retail and service uses locating in the office complexes appear to be doing so as a direct result of the potential of large volumes of customers from daytime work populations in the area.

West of this segment is an area typified by vacant lots and buildings. Once a predominant automobile retailing node, this area shows evidence of the exodus of these space-extensive uses. This segment only occupies three blocks, but does much to disrupt the commercial continuity of the strip. The lack of retail establishments and the many access and egress points detract from the growing character of the strip. This section, however, with its large sites, many of which are cleared of structures, is prime for redevelopment. Applications have been made on a number of locations and construction has proceeded on the north side of Broadway between Spruce and Birch Streets. The intersection of Granville creates the fourth segment of the strip. Here, the influence of the Granville commercial corridor is most evident. Pedestrian oriented shopping uses on Granville have continued a block east and west along Broadway. The connection is enhanced by the orientation of shops at the intersection which encourage the continuity. Household, clothing, and art-related uses are typical of this segment of Broadway, reflecting similar uses on Granville. The most westerly segment of Broadway is the area of the second office
concentration on the strip. This segment, west of Fir Street, has attracted offices of the health-service sector, and, more recently, strong business office groups. Separation of the two types of offices are evident here, with medical uses locating predominantly on the south side of Broadway and business offices to the north side of the Avenue. Although the study area ends at Burrard Street in the west, it is felt that a logical extension of this office node has developed in a four block area to the west of the study area and may be a more prominent office node than is indicated by the study.

Delineation of Broadway into the above segments evolved out of the analysis of nearest-neighbours and the spatial arrangements of specific uses. The discussion now turns to an investigation of the spatial affinities between establishments and within the identified land-use patterns. A cluster analysis technique was used to demonstrate these spatial relationships between uses.

4.5.5 Cluster Analysis

Cluster analysis has become a popular tool in the demonstration of spatial and functional linkages within geographical studies (Alexander, 1974; Bourne, 1971; and Goddard 1971, 1973). Variations of the technique take the form of factor analysis, principal component analysis, and information analysis. Due to the availability of the software, cluster analysis is used in this thesis. The analysis is based on the distance between each shop and its closest neighbour of all types of land-use. The distances are aggregated into a matrix of
land-use types and subjected to a cluster analysis through the BMDP (1981) statistical package. Briefly, the BMDP statistical package groups land-uses in a hierarchical manner according to similarity of clustering trends. In this application of the technique, real distances are used as the criterion of similarity. Therefore, those land-use types, with similar spatial affinities, which cluster, demonstrate patterns of similar distance. A characteristic of cluster analysis through BMDP is the manner in which elements are treated once grouped. Once a single element (land-use type) has been committed to a group, it remains there over the entire process and carries only a proportional representation within the group over subsequent levels of clustering.

The tree-diagram in Figure 4.12 illustrates the clustering of commercial land-uses along Broadway. The results reinforce the land-use patterns already discussed by showing strong affinities between certain retail, service and office uses. The diagram indicates the strong ties that retail establishments have for one another. At the lowest level of clustering, retail clothing, and retail household categories cluster in the same manner as do miscellaneous retail and office retail. The next level of aggregation brings all four of these into a single group. This seems to suggest that the retail land-uses are locating in proximity and that some spatial, if not functional, relationship exists. The service land-uses also appear to locate among service land-uses more often than among retail or office uses. Specifically, business service and personal-business service uses link at the lowest level of clustering, and
subsequent clustering brings service uses together before office or retail uses are included. Office uses show strong affinities for one another as demonstrated by low level clustering of general offices to professional offices and government offices to medical offices. Subsequent clustering attracts service and retail uses which form a network of spatial affinities between commercial uses. The distance-matrix in Figure 4.12 illustrates the strong similarity of patterns which most land-uses have with one another. The generally low values on this matrix clearly support the premise that proximal locations and spatial affinities are identifiable and indeed occur more regularly than would be expected by chance alone. The synthesis of clustering and the distance-matrix indicates that over the strip, various commercial land-uses located with a regularity as illustrated in Figure 4.13.
RELATIVE CONCENTRATION OF BUSINESSES

Burrard St. | Granville St. | Oak St. | Cambie St. | Ontario St.

M.A. THESIS UBC
BLAKE B. HUDEMA

FIG 4.13
5.1 Conclusions

The purpose of this thesis is to investigate the land-uses of inner city commercial strip districts. The review of a body of literature pertaining to general land-use, commercial land-use and in particular strip commercial districts and a case study of Central Broadway Avenue, have revealed a number of observations about the theory of commercial land-use and the reality of commercial land-use in strip districts.

Initially, the review of the literature has revealed the fragmentary nature that commercial land-use assumes in the broader theory of urban land-uses. Although the study of commercial land-use by Berry, Goddard, and Gottman has resulted in positive strides for planning, the bulk of work pertaining to commercial land-use has oriented itself to the classification of land-uses. In the elaboration of classification, only cursory attention has been given to the underlying forces and processes inherent in commercial land-use districts. The classification scheme proposed by Berry groups commercial configurations on the basis of physical structure into nodes, strips, and isolated clusters. Garner, on the other hand, proposes a classification based on the functional mix of establishments within commercial districts, building a hierarchy of neighbourhood, community and regional shopping complexes.

While it is generally true that planning within commercial districts is conspicuous by its "lack of sophistication", 
planning within inner city locations does appear to be the exception. Historically, inner city locations were comprised of residential and industrial land-uses, but through the processes of dispersion and decentralization, these areas have been subjected to change, decay, and blight. The problems of the inner city have resulted in renewal, rehabilitation, and redevelopment efforts as countermeasures. Efforts to date have, in many or most cases, been less than successful in arresting these problems. It is indicated that land-use regulations, including zoning, have not been aimed at the underlying factors causing decay and blight.

Growth, as a form of change, operates within commercial districts. Evolution of land-uses within these districts has occurred through an expansion of land-uses at the periphery and through an internal reorganization of uses within districts. Changes of use are incremental additions to the structural and functional nature of the district, and range from the replacement of use to major redevelopment projects. Conclusions within the literature indicate that the aggregate of incremental change may lead to unplanned and undesirable land-use structure.

Two components of land-use structure and functional character are the external economies and the linkages between establishments. In this thesis, external economies are expressed as benefits accruing to establishments which locate in proximity to other "linked" establishments. Linkages are defined as the movement of goods, services, information, and people which convey these benefits. The literature shows that establishments are linked by necessity for suppliers and ancillary services and
by a desire to capitalize on the sharing of customers through complementary and competitive forces. The results of linkages and benefits through external economies has precipitated land-use patterns within urban environments. The most evident clustering is that of industrial plants, but similar processes and patterns appear to operate in the retail, service and office components of commercial land-uses. It is, therefore, concluded that rather than being homogeneous aggregations of "closed state", randomly-oriented establishments, commercial districts are composed of a variety of structures and activities within a network and conspicuous by their land-use patterns.

The case study of Central Broadway Avenue has produced some affirmations of land-use patterns through historical processes of growth and change and through what is believed to be functional associations.

Over the course of the three decades, 1951-1981, Central Broadway has evolved from a low-order, convenience natured commercial strip to a highly structured and specialized commercial area. Residential uses once occupied over a quarter of the locations along Broadway; today they have been replaced by a complex network of offices, retail and service establishments. Also evident over the three decades is the disintegration of locational stability. In the earliest time segment of the study, changes of use at particular locations were minimal: shops generally occupied a location for five to ten years. The evidence for the final time segment of the study indicates that changes were much more numerous and that shops in general remained on the strip for shorter periods of time, in
the order of less than five years.

The patterns of land-uses on the strip were investigated from two angles, first the relationships between similar uses were examined and second, the relationships between different uses were considered.

The relationships of similar uses indicated a broad range of patterns. Uses, such as retail automobile and service automobile as well as retail food outlets lacked clustering and were dispersed over the strip. On the other hand, personal service establishments tended to cluster. The bulk of the remaining uses showed little tendency towards clustering or regularity, but rather, were randomly distributed.

Conclusions regarding the relationships between different uses are more definitive. Retail land-uses tend to be located closer to other retail uses than service or office uses. The same is true of service and office uses, locating closer to service and office uses respectively. The distance matrix enhances these relationships further by showing that in terms of similarity of distance between each establishment and its nearest-neighbour of other types, the spatial patterns of retail, service, and office establishments are remarkably similar. As Figure 4.14 shows, the high concentration of office establishments between Oak and Cambie is mirrored by a relatively high concentration of retail and service establishments. Conversely, between Oak and Granville, a low number of office establishments are accompanied by a proportionately low number of service and retail establishments. A 'spin-off' effect appears to exist between the number of
office establishments and service and retail establishments. Retail and service uses align themselves spatially with office uses: retail and service uses catering to health services are located close to medical offices, while business and personal service establishments show some affinity to business offices.

The analysis of growth, change and patterning of land-uses along Central Broadway has led to the conclusion that the study strip is not a homogeneous strip nor randomly sorted, but rather a strip composed of five distinctive segments.

The segment of highest redevelopment intensity and that of greatest redevelopment is the segment between Cambie and Oak. The proximity to the Hospital has attracted the medical offices and associated retail and service establishments. The intensity of use and the density of buildings decrease to the west and to the east of this segment. East of Cambie to Ontario Street, low buildings and a predominance of retail uses gives this segment its distinctive character. West of Oak Street, the intensity of use also diminishes; in this segment the high vacancy rate of buildings and land makes this area prime for redevelopment. The area surrounding Granville Street derives its character from the Granville commercial strip with its specialty retail and service establishments. The western most segment of the study strip lies to the west of Pine Street and represents the secondary office node of the strip. This segment appears to be spatially associated with uses to the west of the study area.

In general, the case study has provided some support for the ideas and conclusions arrived at in the literature. The results must be viewed with caution as indicated by the
following limitations.

5.2 Limitations

Through the course of this thesis a number of limitations have become evident, which caution the reader from drawing definitive conclusions or causal relationships. The limitations are of a general nature and are common to most studies of such new material and of such narrow a focus.

The greatest limitation was the boundaries used for the study. The limits were set around an eighteen block area, somewhat arbitrarily, as the study intended to uncover spatial and functional land-use arrangements. It is now apparent that the area should have been extended two blocks to the west.

The lack of data bases has limited the study to considering only the type and number of establishments, giving no weight to size, number of employees, or sales volumes. Suitable data records for land-use analysis are often not available, and where they are, they tend to be fragmentary.

Time and resource limitations precluded the exploration of other classification systems. As is the case for almost all taxonomies, weaknesses do arise. The system used, however, is considered the most applicable to the study data.

5.3 Implications

The existence and role of commercial districts have been acknowledged in most theories of urbanization and the location of land-uses, but little in the way of structure and functional associations have been extended. This thesis has implications
within the realm of academics in pursuing an understanding of commercial structure and function, and with practitioners of urban planning in their quest to control and guide land-use.

From an academic standpoint, it is seen that commercial districts are composed of a wide variety of uses, all functioning within a network of compatibility, cooperation, competition and complementarity. Individual establishments are not "closed" states but rather, are characterized by a mass of linkages with other establishments. The strength of these connections appears to play a significant role in the spatial affinities and proximities these establishments assume.

Complementing this viewpoint is the constant internal reorganization of land-uses within commercial districts. Due, in part, to the benefits of proximal locations (external economies) and a whole host of other factors, land-uses are constantly moving in and out of commercial districts. As has been observed in the study, the locational influences on small specialized retail and service establishments appears to develop from larger trends, in this case from the location of office establishments. The interrelationship of establishments, therefore, appears to have some effect upon the structure and functioning of a commercial district.

From a policy orientation, this thesis has implications for the improved recognition of land-use dynamics and ultimately to an improved sense of planning of commercial districts. Historically, commercial districts have evolved primarily as a consequence of market forces; recent weaknesses in the functioning of the market have forced planners to take active
roles in the control and guidance of land-uses.

The urban renewal efforts of the Sixties and Seventies have indicated that urban design issues alone are not the answer to the disintegration of commercial structure. Clearly, the solution must be based upon an investigation of the trends of growth and change and of the functional associations between establishments in commercial districts. Policies governing these districts should reflect a knowledge of dynamics and functional associations in attaining community goals.

In addition to their use in reactive planning, the ideas presented in the thesis may have some applicability in proactive planning. The understanding of spatial and functional associations between establishments is essential to the planning of large scale developments. Limited success in the planning of new towns and other regional growth nodes may be overcome through an improved understanding of structure and function and an expression of this knowledge in land-use control devices. As is evident in the case study, land-use controls, and zoning in particular, must reflect the differential growth nodes of commercial districts. Rather than trying to 'swim upstream', planning should cooperate with and coordinate its efforts to the market forces which have such a dominant influence in commercial districts.

5.4 Further Research

Through the course of this thesis, it will have become apparent that land-use change and patterns are a result of the interrelationship of a myriad of factors. This thesis has looked
at a few, as well as at the spatial outcome of many. The course for further research must, therefore, bring together these other factors and assess the relative importance of these factors.

The most obvious beginning, in light of this thesis, would be to determine the actual role of linkages in the locational decisions of establishments and, ultimately, of spatial patterns. Several studies have been conducted which use movement data of people, goods, services, and information between establishments. Goddard's study of office locations in which he assessed the magnitude of business meetings between executives of establishments is a prime example. This sort of survey can be modified to determine the movement of goods/services or customers between establishments.

A second aspect, which would complement this thesis, would be a comparison of the findings of this study with those of other commercial districts, particularly strips within the region and between strips of other cities. A "Central Broadway" exists in most cities, for example, Bloor Street in Toronto, Whyte Avenue in Edmonton, and MacLeod Trail in Calgary, any of which could provide an interesting comparison.

One further continuation of research in this area, which would contribute directly to the validity of the study, would involve the use of different classification systems and the use of higher quantities and qualities of data. Within the literature, it has become apparent that there are as many classification systems as there are studies. The improved range of data might improve the choice of a classification system.
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Carolina.


APPENDIX A
DATA

A.1 Data

The data collected for the thesis came primarily from the City Directories. The directories provided a nearly complete record of establishments in the study area over the past thirty years. The Greater Vancouver Regional District supplied a printout of buildings in the area which aided in determining the actual locations of individual establishments. Rounding out the data sources, the City of Vancouver Planning Department supplied a detailed listing of establishments along Broadway.

The year 1981 was used as a base year, with additional data collected at five year intervals back to 1951. Business types were determined and coded with the three-digit code illustrated below. Ground floor establishments have complete listings back to 1951. Where multi-storey buildings have replaced single storey commercial or residential sites, the upper floors of more recent structures are not given temporal data dating prior to construction. It would be erroneous to list the previous use of an upper storey office as residential when the house only covered a storey or two. The analysis of the data has generally been limited to the ground-floor oriented establishments for all methods.
The land-use code

The code used by the Perth City Council in their 1968 land-use survey is listed below. The code has been applied in a few other studies (see City of Hobart 1966) in recent years, and was devised by Clark Gedal and Associates of Melbourne. In this listing a few modifications have been effected.

Any land-use classification system has certain merits and faults. The major positive and negative attributes of the Perth City Council code are:

1. ADVANTAGES

1. It is a flexible three-digit code, and thus can be viewed at three levels.
2. It is much more detailed than codes often employed in central-area studies (e.g. Murphy & Vance 1954b, 1955, Davies 1965); this enables a fine level of scrutiny of activity patterns.
3. It is easily adaptable for computer programming.

4. The classification system is generally fairly well categorized with minimum overlap. It is based on conventional activity sets, and thus makes comparisons with previous studies easier.

2. DISADVANTAGES

1. Many classifications are questionable. The most notable are: (a) the public category—in many cases the activities included are not public at all, but are rather government-owned service facilities of a restricted access nature (e.g. utilities, military). Others are more akin to commercial establishments than to 'public facilities' and are only included in this category because of government ownership—e.g. government depots (714) should really be included under 'wholesale and storage facilities'; (b) in the 'cultural and recreational' category certain uses, e.g. lottery sales (856), billiard halls (611), etc., are operated on a commercial basis and thus display functional linkages and location patterns more akin to retail-service premises than to recreational facilities; (e) the 'office' category: many uses in this category in fact perform services. That the activities are carried out in an office is incidental, for their major function is more akin to service activities (e.g. professional offices). The 'service' category is as it stands, somewhat unsatisfactory since it is not really complete. On the other hand it could be argued that certain activities, e.g. 'personal service' are in fact quasi-retail activities and should thus be included in other categories.

2. The above points raise the question of the code's basis. It is, generally, based on conventional activity sets, i.e. residential, retail etc. As mentioned above, this facilities some comparisons (although sparks frustration). However, some attempts have apparently been made to incorporate the functional basis of activities (cf. Rannells 1957) into the system—witness the 'service' classification. As plausible as this goal may be, it has resulted in a somewhat confusing system, since the two approaches do not readily coincide and thus some ambiguities are evident.
**4 Wholesale and Storage**

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**5 and 6 Manufacture**

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<td>514</td>
<td>White-lead paints, varnishes</td>
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<tr>
<td>515</td>
<td>Chemical fertilizers</td>
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<tr>
<td>516</td>
<td>Inks, polishes, etc.</td>
</tr>
<tr>
<td>517</td>
<td>Matches</td>
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<tr>
<td>518</td>
<td>Chemical products (NEC)</td>
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<td>Vegetable oils</td>
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<td>Mineral oils, by-products</td>
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<td>522</td>
<td>Animal oil</td>
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<tr>
<td>523</td>
<td>Rolling down works, tallow</td>
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<tr>
<td>524</td>
<td>Soap &amp; candle machinery</td>
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<tr>
<td>530</td>
<td>Iron &amp; steel smelting, rolling</td>
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<tr>
<td>531</td>
<td>Iron foundries</td>
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<tr>
<td>532</td>
<td>Machine manufacturing, structural steel</td>
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<td>533</td>
<td>Machinery, motors, west furniture, nes.</td>
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<td>534</td>
<td>Jewellery engineers</td>
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<td>535</td>
<td>Non-ferrous metal rolling</td>
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<td>Non-ferrous metal rolling/processing</td>
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<td>537</td>
<td>Electrical/machinery cables</td>
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<td>538</td>
<td>Radio &amp; electronic equipment</td>
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<td>540</td>
<td>Construction &amp; repair railway rolling stock</td>
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<td>541</td>
<td>Vehicles, accessories, construction &amp; assembly</td>
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<td>542</td>
<td>Aeronautical &amp; parts manufacturing</td>
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<tr>
<td>543</td>
<td>Shipbuilding &amp; maintenance</td>
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<tr>
<td>544</td>
<td>Cutlery and small hand tools</td>
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<td>545</td>
<td>Agricultural machines and implements</td>
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<td>546</td>
<td>Sheet metal working, galvanising</td>
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<td>547</td>
<td>Pipes, tubes &amp; fittings</td>
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<td>Wire, wire working and units</td>
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<tr>
<td>549</td>
<td>Metal works (NEC)</td>
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<tr>
<td>550</td>
<td>Cotton, spinning &amp; weaving</td>
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<td>551</td>
<td>Wool, spinning &amp; weaving</td>
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<td>552</td>
<td>Hosiery &amp; knitted goods</td>
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<tr>
<td>553</td>
<td>Silk</td>
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<tr>
<td>554</td>
<td>Synthetic fibres</td>
</tr>
<tr>
<td>555</td>
<td>Rope &amp; cordage</td>
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<tr>
<td>556</td>
<td>Canvas, goods, carpentry, tent</td>
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<tr>
<td>557</td>
<td>Bags &amp; sacks</td>
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<tr>
<td>558</td>
<td>Textile printing</td>
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<td>559</td>
<td>Textile (NEC)</td>
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<tr>
<td>560</td>
<td>Ready-made clothing</td>
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<tr>
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<td>Waterproof clothing</td>
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**7 Public Utilities**

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<tbody>
<tr>
<td>700</td>
<td>Electricity-generating station</td>
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<tr>
<td>701</td>
<td>Electricity sub-station</td>
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<tr>
<td>702</td>
<td>Gas works</td>
</tr>
<tr>
<td>703</td>
<td>Gasometer &amp; substation</td>
</tr>
<tr>
<td>704</td>
<td>Water-supply dam</td>
</tr>
<tr>
<td>705</td>
<td>Water-supply reservoir</td>
</tr>
<tr>
<td>706</td>
<td>Water-supply pumping station</td>
</tr>
<tr>
<td>707</td>
<td>Sewage-treatment works</td>
</tr>
<tr>
<td>708</td>
<td>Sewage-pumping station</td>
</tr>
<tr>
<td>709</td>
<td>Power stations, water pipes, etc.</td>
</tr>
</tbody>
</table>

**8 Special Public Use**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>800</td>
<td>Telephone exchange</td>
</tr>
<tr>
<td>801</td>
<td>Radio &amp; TV station</td>
</tr>
<tr>
<td>802</td>
<td>Fire station</td>
</tr>
<tr>
<td>803</td>
<td>Ambulance station</td>
</tr>
<tr>
<td>804</td>
<td>Govt. works depot</td>
</tr>
<tr>
<td>805</td>
<td>Municipal govt. works depot</td>
</tr>
<tr>
<td>806</td>
<td>Carriage incinerator, dump, etc.</td>
</tr>
<tr>
<td>807</td>
<td>Sanitary depots</td>
</tr>
<tr>
<td>808</td>
<td>Other special uses (NEC)</td>
</tr>
<tr>
<td>809</td>
<td>Public conveniences, change rooms</td>
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</table>

**9 Public Service Facilities**

<table>
<thead>
<tr>
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<th>Description</th>
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<tr>
<td>900</td>
<td>Police station</td>
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<tr>
<td>901</td>
<td>Court house</td>
</tr>
<tr>
<td>902</td>
<td>Post office</td>
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<tr>
<td>903</td>
<td>Baby health centre</td>
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</table>

**10 Mines and Quarries**

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<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>100</td>
<td>Coal mines</td>
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<tr>
<td>101</td>
<td>Iron mines</td>
</tr>
<tr>
<td>102</td>
<td>Copper mines</td>
</tr>
<tr>
<td>103</td>
<td>Lead and zinc mines</td>
</tr>
<tr>
<td>104</td>
<td>Nickel and cobalt mines</td>
</tr>
<tr>
<td>105</td>
<td>Tin mines</td>
</tr>
<tr>
<td>106</td>
<td>Platinum mines</td>
</tr>
<tr>
<td>107</td>
<td>Uranium mines</td>
</tr>
<tr>
<td>108</td>
<td>Uranium ore processing</td>
</tr>
<tr>
<td>109</td>
<td>Rare earth elements processing</td>
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</table>

**11 Forestry**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Cabinet &amp; furniture making</td>
</tr>
<tr>
<td>111</td>
<td>plywood, wallboard, etc.</td>
</tr>
<tr>
<td>112</td>
<td>Furniture, drapery</td>
</tr>
<tr>
<td>113</td>
<td>Picture frames</td>
</tr>
<tr>
<td>114</td>
<td>Blinds</td>
</tr>
<tr>
<td>115</td>
<td>Furniture, etc. (NEC)</td>
</tr>
</tbody>
</table>

**12 Printing and Publishing, Paper**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>Newspapers &amp; periodicals</td>
</tr>
<tr>
<td>121</td>
<td>Printing &amp; bookbinding</td>
</tr>
<tr>
<td>122</td>
<td>Stationery manufacture</td>
</tr>
<tr>
<td>123</td>
<td>Typewriting &amp; electrotyping</td>
</tr>
<tr>
<td>124</td>
<td>Process &amp; poling-engraving</td>
</tr>
<tr>
<td>125</td>
<td>Paper making</td>
</tr>
<tr>
<td>126</td>
<td>Newspaper boxes, cartons etc.</td>
</tr>
<tr>
<td>127</td>
<td>Paper bags</td>
</tr>
<tr>
<td>128</td>
<td>Pencils, crayons, paper treatment (NEC)</td>
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</table>

**13 Rubber Goods**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
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<tbody>
<tr>
<td>130</td>
<td>Rubber goods</td>
</tr>
<tr>
<td>131</td>
<td>Tyre retreading, etc.</td>
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</table>

**14 Miscellaneous**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>Gramophones &amp; records</td>
</tr>
<tr>
<td>141</td>
<td>Musical instruments, etc.</td>
</tr>
<tr>
<td>142</td>
<td>Jewellery</td>
</tr>
<tr>
<td>143</td>
<td>Watches, clocks, etc.</td>
</tr>
<tr>
<td>144</td>
<td>Linoleum &amp; related products</td>
</tr>
<tr>
<td>145</td>
<td>Plastic mouldings &amp; plastic products</td>
</tr>
<tr>
<td>146</td>
<td>Brooms &amp; brushes</td>
</tr>
<tr>
<td>147</td>
<td>Surgical &amp; scientific instruments</td>
</tr>
<tr>
<td>148</td>
<td>Photographic materials &amp; processing</td>
</tr>
<tr>
<td>149</td>
<td>Spectacle makers</td>
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**15 Special Industries**

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>150</td>
<td>Army camp &amp; barracks</td>
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<tr>
<td>151</td>
<td>Military aerodrome</td>
</tr>
<tr>
<td>152</td>
<td>Naval station</td>
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<td>153</td>
<td>Hosiery</td>
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<td>154</td>
<td>Animal health</td>
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**16 Railways**

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<td>160</td>
<td>Railway workshops</td>
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<td>Railway workshops</td>
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**17 Transport Terminals**

<table>
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<th>Description</th>
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<tbody>
<tr>
<td>170</td>
<td>Bus station</td>
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<tr>
<td>171</td>
<td>Railway station</td>
</tr>
<tr>
<td>172</td>
<td>Railway passenger terminal</td>
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<tr>
<td>173</td>
<td>Airports terminals</td>
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<tr>
<td>174</td>
<td>Ferry wharves</td>
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<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
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<tr>
<td>775</td>
<td>Heliport</td>
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<tr>
<td>776</td>
<td>Airports</td>
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<tr>
<td>78</td>
<td>Transport Terminals</td>
</tr>
<tr>
<td>780</td>
<td>Railway-goods terminal</td>
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<tr>
<td>781</td>
<td>Ocean wharves</td>
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<tr>
<td>782</td>
<td>Truck-traffic terminals</td>
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<tr>
<td>783</td>
<td>Bus garage</td>
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<tr>
<td>784</td>
<td>Truck garage &amp; depot</td>
</tr>
<tr>
<td>785</td>
<td>Railway marshalling yards</td>
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<td>786</td>
<td>Railway goods terminal</td>
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<td>787</td>
<td>Parcel offices</td>
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<tr>
<td>79</td>
<td>Car Parking</td>
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<tr>
<td>790</td>
<td>Car park open, free &amp; private</td>
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<tr>
<td>791</td>
<td>Car park in building, commercial public</td>
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<tr>
<td>792</td>
<td>Car park in building, private</td>
</tr>
<tr>
<td>793</td>
<td>Car park open, commercial public</td>
</tr>
<tr>
<td>794</td>
<td>Car parks open, commercial private</td>
</tr>
<tr>
<td>795</td>
<td>Car park in building, commercial private</td>
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<tr>
<td>796</td>
<td>Car parking in association with residential building</td>
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<td>Cultural and Recreational</td>
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<tr>
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<td>806</td>
<td>Other secondary schools</td>
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<td>Schools for handicapped children</td>
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<td>Universities</td>
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<td>Teachers colleges</td>
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<td>Church halls</td>
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<td>Other public halls</td>
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<td>Public library</td>
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<td>Cinemas</td>
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<td>Tourist information centres</td>
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<td>Museums &amp; historical societies</td>
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<td>85</td>
<td>Private Clubs</td>
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<td>Indoor Amusement</td>
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<td>Gymnasium</td>
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<td>862</td>
<td>Stadium</td>
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<td>Dance halls, ballrooms</td>
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<td>864</td>
<td>Bowling alleys</td>
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<td>865</td>
<td>Skating rinks</td>
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<td>866</td>
<td>Squash &amp; indoor court games</td>
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<td>867</td>
<td>Billiard rooms, table tennis, etc.</td>
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<tr>
<td>88</td>
<td>Outdoor Recreation Facilities</td>
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<td>880</td>
<td>Outdoor amusement centres</td>
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<td>881</td>
<td>Public swimming pools</td>
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<td>882</td>
<td>Recreational swimming pools</td>
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<tr>
<td>883</td>
<td>Bowling greens</td>
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<tr>
<td>884</td>
<td>Golf driving ranges, mini-golf</td>
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<tr>
<td>885</td>
<td>Playgrounds</td>
</tr>
<tr>
<td>886</td>
<td>Basketball courts</td>
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<td>887</td>
<td>Trampolines</td>
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<td>Open space among freeways</td>
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<td>Public Open Space</td>
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<td>Public golf course</td>
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<td>Private golf course</td>
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<td>Beach reserves</td>
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<td>Parks &amp; reserves</td>
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<td>894</td>
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<td>Botanical gardens</td>
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<td>896</td>
<td>Zoological gardens</td>
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<td>897</td>
<td>Rifle range</td>
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<tr>
<td>9</td>
<td>Vacancy and Construction</td>
</tr>
<tr>
<td>9/26</td>
<td>Vacant Premises</td>
</tr>
<tr>
<td>9/260</td>
<td>Vacant flat in commercial premises</td>
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<td>9/261</td>
<td>Vacant shop</td>
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<tr>
<td>9/262</td>
<td>Vacant office space</td>
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<tr>
<td>9/263</td>
<td>Vacant warehouse space</td>
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<tr>
<td>9/264</td>
<td>Vacant factory space</td>
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<tr>
<td>9/265</td>
<td>Vacant house</td>
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<td>9/266</td>
<td>Vacant flat</td>
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<tr>
<td>9/267</td>
<td>Vacant space (NEC)</td>
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<tr>
<td>9/268</td>
<td>Vacant Showrooms</td>
</tr>
<tr>
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<td>Buildings under Construction</td>
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<td>Flat under construction</td>
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<td>9/271</td>
<td>House under construction</td>
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<tr>
<td>9/272</td>
<td>Shop under construction</td>
</tr>
<tr>
<td>9/273</td>
<td>Warehouse under construction</td>
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<tr>
<td>9/274</td>
<td>Office under construction</td>
</tr>
<tr>
<td>9/275</td>
<td>Factory under construction</td>
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<tr>
<td>9/276</td>
<td>Institutional building under construction</td>
</tr>
<tr>
<td>9/277</td>
<td>Recreational building under construction</td>
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<tr>
<td>9/278</td>
<td>Educational building under construction</td>
</tr>
<tr>
<td>9/279</td>
<td>Other building under construction</td>
</tr>
<tr>
<td>9/280</td>
<td>Vacant commercial land</td>
</tr>
<tr>
<td>9/281</td>
<td>Vacant industrial land</td>
</tr>
<tr>
<td>9/282</td>
<td>Vacant residential land</td>
</tr>
<tr>
<td>9/283</td>
<td>Vacant Govt land</td>
</tr>
</tbody>
</table>
A.2 Format

The format of data coded on computer disc space is as follows:

- columns 1 - 4: street address.
- 6 - 9: suite number.
- 11 - 11: floor number.
- 13 - 13: north or south side of street.
- 15 - 18: location in feet from Ont. St.
- 20 - 23: area in sq. ft. of the business.

The street address, suite no., and floor no. are all listed as is. Any floor above nine (9) is listed as (9). The side of the street variable lists the north side of the street as a one (1) and the south side as a zero (0). The location variable gives each establishment a point location on a line. Starting from Ontario St. the line extends approximately 8300 feet to Burrard Street in the west. Distances across streets are omitted in the measurement.

A.3 Coding

The coding of land-uses from 1951 to 1981 follows the classification system used by Alexander (1972). The large number of categories are recoded into approximately 30 more generalized groups for the purposes of this thesis:

- 001 - 034: Residential.
- 100 - 113: Retail - Food.
- 120 - 129: Retail - Clothing.
- 130 - 159: Retail - Household.
- 160-163, 165-169: Retail - Miscellaneous.
- 164: Retail - Office Supplies.
- 180 - 196: Retail - Auto/Hardware.
<table>
<thead>
<tr>
<th>Code Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 -</td>
<td>Service - Restaurants.</td>
</tr>
<tr>
<td>202,203</td>
<td>Service - Hairdressers.</td>
</tr>
<tr>
<td>204 - 209</td>
<td>Service - Personal.</td>
</tr>
<tr>
<td>210 - 219</td>
<td>Service - Personal Business.</td>
</tr>
<tr>
<td>220 - 226</td>
<td>Service - Business.</td>
</tr>
<tr>
<td>230 - 236</td>
<td>Service - Financial and Banking.</td>
</tr>
<tr>
<td>240 - 249</td>
<td>Service - Building Contractors.</td>
</tr>
<tr>
<td>250 - 253</td>
<td>Service - Automobile.</td>
</tr>
<tr>
<td>270 - 276</td>
<td>Service - Repair.</td>
</tr>
<tr>
<td>300 - 308</td>
<td>Office - General.</td>
</tr>
<tr>
<td>310-313,318,319</td>
<td>Office - Professional.</td>
</tr>
<tr>
<td>314 - 317</td>
<td>Office - Medical.</td>
</tr>
<tr>
<td>320 - 325</td>
<td>Office - Government.</td>
</tr>
<tr>
<td>330 - 332</td>
<td>Office - Business Advisory.</td>
</tr>
<tr>
<td>400 - 482</td>
<td>Wholesaling.</td>
</tr>
<tr>
<td>500 - 699</td>
<td>Manufacturing.</td>
</tr>
<tr>
<td>700 - 789</td>
<td>Public.</td>
</tr>
<tr>
<td>800 - 897</td>
<td>Cultural/Recreational.</td>
</tr>
<tr>
<td>790 - 798</td>
<td>Parking.</td>
</tr>
<tr>
<td>260 - 268</td>
<td>Vacant - Building.</td>
</tr>
<tr>
<td>290 - 299</td>
<td>Underconstruction.</td>
</tr>
</tbody>
</table>

The complete listing of land use codes used in the thesis was taken from Alexander (1972), *The City Centre*. 
Appendix B

Methods

Three statistical methods were chosen for this thesis, as outlined in the introductory chapter, for their applicability, ease of use and interpretation, and the availability of software for the computer. Figure A.1 outlines the sequence of application.

B.1 Markov Chain Models

Despite the potential for Markov chain models in geographical studies, these have found limited use over the last twenty years (Rose, 1970). Both Rose and Clark (1965) have employed these methods in residential land-use studies, while Bourne (1971) has used the technique over a wider range of land use successions in Toronto.

The process analyzes the changes in states over a given
time period and is summarized in Clark (1965):

A Markov chain process is determined by specifying the following information: There is a given set of states \( (S_1, S_2, \ldots, S_r) \). The process can be in one and only one of these states (or classes) at a given time, and it moves successively from one state to another. Each move is called a step. The probability that the process moves from \( S_i \) to \( S_j \) depends only on the state "s" that is occupied before the step. The transition probability \( P_{ij} \) which gives the probability that the process will move from \( S_i \) to \( S_j \) is given for every ordered pair of states. Also an initial starting state is specified at which the process is assumed to begin.

For the purposes of this thesis, the states are the recorded land-use categories, the steps are five year intervals from 1951 to 1981, and the probabilities are expressed as percentages. While this model can be used for predictive purposes, it is only intended as a descriptive tool in this thesis. For further information on the general mathematical foundations of the model, refer to Bharucha-Reid (1960) and, with regard to the application of this model to geographical work, refer to Brown (1970) in addition to Rose (1970) and Clark (1965).

B.2 Nearest-Neighbour Analysis

The use of the nearest-neighbour analysis to describe point pattern distributions has been proven successful by a number of researchers in the various studies of urban geography (Clark and Evans, 1954; Dacey, 1960; Pinder and Witherick, 1972). The analysis involves determining the average distance between a point and its nearest neighbour in a set of points and comparing this distance observed with a predicted or "expected" distance if these points were randomly distributed.
Nearest neighbour analysis was developed to measure the degree of clustering or regularity between points distributed over a two dimensional plane (Clark and Evans, 1954). From their statistical formulae an R value was derived for a set of points. The R value ranged from R = 0.0 (Clustered) to R = 2.15 (Regular).

Dacey (1960) and Burghardt (1959) used a simplified version of the nearest neighbour analysis, modified to handle data along a linear point pattern. Rather than use actual distance measures between points, Dacey and Burghardt determined the percentage of reflexive pairs within the distribution. Reflexive pairs were defined as any two points which are each other's nearest neighbour. The number of reflexive pairs are expressed as a proportion of the total points, and compared to a constant or predicted value. In this analysis a predicted value of (2/3) is used for the first nearest neighbour, (2/3) is used for the second nearest neighbour and so on. The analysis is a sound statistical test, but does suffer by virtue of its simplicity and where the number of points are small.

A more rigorous derivation of the nearest neighbour formula was put forth by Pinder and Witherick (1973). They proposed a method for the prediction of distances between randomly distributed nearest neighbours, a second formula to demonstrate the probability that an observed average nearest neighbour distance differs from a random or predicted distance and finally a graph illustrating the relationship of observed and predicted values. Building on the traditional formula for the predicted average distance between nearest neighbours 0.5 a/n where
Nearest-Neighbor Analysis

(Pinder & Witherick, 1973)

Nearest-Neighbor Analysis.

M.A. THESIS U.B.C.
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FIG. A.2
a = area and n = the number of points, Pinder and Witherick (1973) modified this method to accept linear point patterns. The outcome and the formula used in this thesis is as follows:

\[ 0.5 \left( \frac{1}{n-1} \right) \]

where \( L = \) line length and \( n = \) the number of points along the line. Applying this "predicted" value to the linear nearest neighbour statistic (LRn), the whole formula becomes:

\[ LRn = \frac{D_{obs}}{0.5(L/n-1)} \]

Values of LRn range from 0.0, a clustered point distribution to 2.0 a perfectly regular point pattern. A value of 1.0 would indicate a point pattern randomly distributed. Figure A.2 illustrates this method. Note that the 95 percent significance level ends at 10 points on the left. Error levels become too great and the results meaningless at these low levels. Values lying outside the crosshatched area are considered non-random to the 95 percent level and are either clustered or regularly distributed.

B.3 Cluster Analysis

The cluster analysis used in this thesis is the BMDP software package developed at the University of California, utilizing a matrix data input created from the primary data base.

Mr. Glen Cooper of the Computing Science Center at University British Columbia was instrumental in drafting a Fortran program which transformed the raw data into an input format. The program calculates the distance from every establishment, at ground level, to its closest neighbour of
every other land-use type (28 recoded land-use types, see Appendix A). In order to compare establishments on either side of the street, a value of 30 feet is added to those distances between establishments on opposite sides of the street. The distances between all 380 establishments and their nearest neighbour of the other 28 land-use types are aggregated into a 29 by 29 matrix. Only one half of the matrix is necessary as distances are real, such that distance AB is equal to distance BA. This distance matrix was inputted into the cluster analysis option of the BMDP software.

The cluster analysis creates subgroupings of elements (a minimum of two) which show the highest degree of similarity. In this thesis, the variables (land-uses) are compared to the distances between all other variables. The clustering proceeded sequentially until all elements comprised a single group. During the hierarchical process, the subgrouping of groups is possible as once an element is committed to a group, it is confined to that group. The individual characters of elements are also altered and their influence in subsequent clustering is proportional to other elements in the group. The upper clusters of the hierarchy, therefore, can be misleading, as individual elements may not show true association with other elements of other groups. To compensate for this limitation, a distance matrix is included which gives a scaled value (0-100) for every group of two elements (land-use types) regardless of how they cluster. The use of these two outputs provides a clear picture into the spatial association of spatial proximity of various land-use types. For a detailed description of cluster analysis
and BMDP, see BMDP (1981).
Appendix C

Sections C-2, C-3, C-3A of
City of Vancouver By-Law #3575.
1. Uses permitted, conditions and regulations:

A. Uses:

Subject to all other provisions of this By-law, on any site, in any district defined, designated, or described in this By-law as a (C-2) Commercial District, development permits will be issued only for development comprising retail stores, businesses, or undertakings catering for the day-to-day needs of residents of several neighbourhoods and comprising a large district of the City, namely:

1. Advertisements, billboards and signs subject to the provisions of Section 10(21) and Section 11(9) of this By-law.

2. Auction room.

3. Bakeries retailing on the premises only, not exceeding a total of 2,200 sq. ft. of floor area.

4. Billiard and pool hall.

5. Cleaning and dyeing shop.

6. Frozen food lockers.

7. Garage, public (storage).

8. Gasoline filling station.


11. Radio and television broadcasting and receiving masts and antennae (commercial).


13. Restaurant (excluding a drive-in).

14. Retail store, business or undertaking catering for the day-to-day needs of residents of several neighbourhoods and comprising a large district of the City.

15. School (business or commercial).

16. Steam baths.

17. Swimming pool (commercial).

18. Dwelling units in conjunction with and in addition to any of the above uses provided that no portion of the first storey of a building to a depth of 35 feet from the front building line and extending across the full width of the building shall be used for residential purposes except for entrances to such residential part.

19. The keeping of not more than two boarders or lodgers or not more than four foster children in each dwelling unit.

20. A building or use which is customarily accessory to the above principal buildings or uses, except for a building or use which is only listed as a principal use in the (M-1) or (M-2) schedules, provided that:

(a) All accessory buildings are located in a rear yard;

(b) All accessory buildings shall occupy an area of not greater than ten percent of the area of the site;

(c) No accessory building shall exceed one storey or 12 feet in height;
(d) No accessory building shall obstruct the daylight access as required by this by-law for any residential use;

(e) All accessory uses of the type which would not be permitted as principal uses under Section 1 of this schedule shall occupy an area of not more than 25 percent of the gross floor area of the principal use, and shall be located within the principal building.

B. Conditions of Use:

Every business, or undertaking shall be conducted wholly within a completely enclosed building except for parking and loading facilities, a service station, and signs and advertisements.

C. Front Yard:

No front yard shall be required.

D. Side Yard:

No side yard shall be required provided, however, that where a (C-2) Commercial District adjoins any R district without the intervention of a street or lane, the following side yards shall be provided:

(a) Three feet in the case of an RA, RS or RT district.

(b) Five feet in the case of an RM district.

If a side yard in a (C-2) district be provided where not required by the provisions of this By-law, the said side yard shall be not less than three feet in width.

E. Rear Yard:

A rear yard shall be provided of not less than 10 feet; provided however that where a building contains residential uses, the building shall be set back not less than 25 feet over its full width from the rear line of the site, but such setback need not extend below the lowest storey containing residential uses; and provided further that where the rear line of a site adjoins a dedicated lane the minimum depth of the rear yard or setback, as the case may be, may be reduced by an amount equal to the distance from the ultimate centre line of the lane to the rear line of the site.

F. Height:

The height of a building shall not exceed 40 feet nor three storeys.

G. Horizontal Light Angle for Residential Use: (for illustrations see Appendix “G”)

Where part of a building is used for residential purposes:

(1) The window of every habitable room shall be not less than 10 feet from the interior side boundary of the site onto which it faces.

(2) Every window shall permit of an unobstructed view for a distance of not less than 80 feet, measured horizontally from its centre at sill level. Such view shall extend through either a continuous horizontal arc of not less than 50 degrees, or through two or more horizontal arcs which in the aggregate contain an arc of not less than 70 degrees; provided however the above arcs may be reduced from 50 degrees to 40 degrees, and 70 degrees to 60 degrees, respectively, in the case of buildings of two storeys or less in height; for the purpose of this subsection the following shall be considered as obstructions:

(a) The theoretically equivalent buildings if located on any adjoining sites in any R district in a corresponding position by rotating the plot plan of the proposed building 180 degrees about a horizontal axis located on the property lines of the proposed site.
(b) Part of the same building including permitted projections.
(c) Accessory buildings located on the same site as the principal building.
(d) The maximum size building permitted under the appropriate C or M schedule if the site adjoins a C or M site.

(3) Where a window is greater in area than the minimum required under the Building By-law, the above conditions may be tested against the least restrictive portion of the window equal in area to the required minimum. For the purpose of this subsection, a kitchen shall not be counted as a habitable room unless its area is greater than ten percent of the total floor area of the dwelling unit in which it is situated, or 70 square feet, whichever is the greater.

H. Floor Space Ratio:
The floor space ratio shall in no case exceed 3.00 provided however that where a building is used in part for residential purposes every square foot of the floor area used for residential purposes shall be counted as the equivalent of 2¼ square feet for the purposes of this section.

J. Off-street Parking Spaces:
Off-street parking spaces shall be provided and maintained as required by, and in accordance with the provisions of Section 12 of this By-law.

K. Off-street Loading Spaces:
Loading and unloading spaces shall be provided and maintained as required by, and in accordance with the provisions of Section 13 of this By-law.

2. Uses which may be permitted subject to special approval by the Technical Planning Board:

Notwithstanding the provisions of Section 1 of this schedule, development permits may be issued for development comprising the following uses subject to such uses first of all being approved by the Technical Planning Board. If a development permit is granted it shall be subject to such conditions and regulations or relaxations as the Technical Planning Board may decide:

Uses:
(1) Ambulance headquarters.  
(1A) Animal hospital.  
(2) Automotive repair shop.  
(3) Automobile and parts showroom.  
(4) Bakery (manufacturing of bread, pies, and confectionery), other than as provided for in Section 1 of this schedule.  
(5) Bowling alley.  
(6) Building or use required by a public authority.  
(7) Car sales lot.  
(8) Church.  
(9) Club, or lodge (fraternal).  
(10) Community centre.  
(11) Deposit or extraction of material so as to alter the configuration of the land.
(12) Hall.
(13) Home craft or occupation.
(14) Hospital, sanitorium, convalescent home, excluding a mental hospital.
(15) Hotel provided it conforms to the daylight access provisions of Section 1 of the (C-2) schedule.
(16) Institution of a religious, philanthropic, charitable or philozoic character.
(17) Kennels, or the keeping, breeding, raising, training or boarding of dogs or cats.
(18) Lithographing.
(19) Motel provided it conforms to the daylight access provisions of Section 1 of the (C-2) schedule.
(20) Park or playground.
(21) Pet shop.
(22) Public utility.
(23) Restaurant (drive-in).
(24) School (public or private), kindergarten, day-care school, crèche or day nursery.
(25) School (trade).
(26) Sign and showcard writing.
(27) Stadium, curling rink, ice rink, roller rink, race track, gymnasium, or similar place of assembly.
(28) Stamp shop (rubber and metal).
(29) Theatre (excluding a drive-in).
(30) Tires (retreading and rebuilding).
(31) Tourist court subject to the provisions of Section 11(5).
(32) Undertaking establishment.
(33) Wholesale business (only to serve local or district needs).
(34) Any other building or use which is not specifically listed in any schedule of this By-law, and which, is similar to the foregoing buildings or uses; before granting a development permit for such building or use the Technical Planning Board shall have regard to the types of buildings and uses which specifically may be permitted in this schedule. (12/3/57—*3622)
(35) The use of a site for purely residential purposes, if, the site has unusual peculiarities of location, such use to include one and two-family dwellings, apartments, boarding or lodging houses, and fraternity or sorority houses.
(36) The conversion into dwelling units of an existing building other than one granted a development permit in accordance with Section 1 of this schedule; before granting a development permit for such conversion the Technical Planning Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.
(37) The conversion of an existing building into housekeeping units in any case where such existing building, by reason of its age and size, is deemed to be unsuitable for
its present use; before granting a development permit for such conversion the Technical Planning Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.

(38) The conversion of an existing building into a boarding or lodging house in any case where such existing building, by reason of its age and size, is deemed to be unsuitable for its present use; before granting a development permit for such conversion the Technical Planning Board shall have regard to the regulations of the RM schedules and also to the amenity of the neighbourhood.

(39) A dwelling unit or housekeeping unit other than one granted a development permit in accordance with this schedule which has been installed or used prior to June 18th, 1956, with or without one or more of the required City permits may be granted a development permit limited in time. (11/12/56—*3610)

(40) A building which has been altered or used for a boarding or lodging house, other than one granted a development permit in accordance with this schedule, which has been installed or used prior to June 18th, 1956, with or without one or more of the required City permits may be granted a development permit limited in time. (11/12/56—*3610)

(41) Any building or use which can be considered as accessory to the above uses and to the uses listed in Section 1 of this schedule, other than those accessory buildings or uses for which provision is made in such Section, subject to:

(a) All accessory buildings occupying an area of not greater than ten percent of the area of the site.

(b) All accessory uses occupying an area of not greater than one third the total gross floor area of all the buildings on the site.
(C-3) Commercial District Schedule: (Medium Density)

1. Uses permitted, conditions and regulations:

   A. Uses:

   Subject to all other provisions of this By-law, on any site, in any district defined, designated, or described in this By-law as a (C-3) Commercial District, development permits will be issued only for development comprising the following:

   (1) Advertisements, billboards and signs subject to the provisions of section 10(21) of this by-law.

   (2) Auction room.

   (3) Automobile and parts showroom.

   (4) Bakeries retailing on the premises only, not exceeding a total of 2,200 sq. ft. of floor area.

   (5) Billiard and pool hall.

   (6) Book bindery.

   (7) Cleaning and dyeing shop.

   (8) Club, or lodge (fraternal).

   (9) Community Centre.

   (10) Film exchange.

   (11) Frozen food lockers.

   (12) Garage, public (storage).

   (13) Gasoline filling station.

   (14) Hall.

   (15) Institution of a religious, philanthropic, charitable or philozoic character.

   (16) Laboratory.

   (17) Office building.

   (18) Parking area (public).

   (19) Pet shop.

   (20) Radio and television broadcasting and receiving masts and antennae (commercial).

   (21) Radio broadcasting and receiving station for motor vehicles, trains, watercraft, and air craft.

   (22) Restaurant excluding a drive-in.

   (23) Retail store, business, or undertaking.

   (24) School (business or commercial).

   (25) School (trade).

   (26) Sign and showcard writing.

   (27) Steam baths.

   (28) Swimming pool (commercial).
(29) Theatre (excluding a drive-in).

(30) Tires (retreading or rebuilding)

(31) Dwelling Units in conjunction with and in addition to any of the above uses provided that no portion of the first storey of a building to a depth of 35 feet from the front building line and extending across the full width of the building shall be used for residential purposes except for entrances to such residential part.

(32) The keeping of not more than two boarders or lodgers or not more than four foster children in each dwelling unit.

(33) A building or use which is customarily accessory to the above principal buildings or uses, except for a building or use which is only listed as a principal use in the (M-1) or (M-2) schedules, provided that:

(a) All accessory buildings are located in a rear yard.

(b) All accessory buildings shall occupy an area of not greater than ten percent of the area of the site.

(c) No accessory building shall exceed one storey or 12 feet in height.

(d) No accessory building shall obstruct the daylight access as required by this by-law for any residential use.

(e) All accessory uses of the type which would not be permitted as principal uses under Section 1 of this schedule shall occupy an area of not more than 25 percent of the gross floor area of the principal use, and shall be located within the principal building.

B. Conditions of Use:

Every business or undertaking shall be conducted wholly within a completely enclosed building except for parking and loading facilities, a service station, and signs and advertisements.

C. Front Yard:

No front yard shall be required.

D. Side Yard:

Up to a height of three storeys or 40 feet whichever is the lesser, no side yard shall be required except in the following cases:

(1) Where a (C-3) Commercial District adjoins any R District without the intervention of a street or lane the following side yards shall be provided:

(a) Three feet in the case of an RA, RS, or RT District.

(b) Five feet in the case of an RM District.

(2) Where a side yard in any such district be provided where not required by the provisions of this By-law, the said side yard shall be not less than three feet in width.

For the next three storeys above a height of three storeys or 40 feet, whichever is the lesser, no part of the building shall be nearer than five feet to the side lines of the site and this distance shall be increased by one foot for every additional storey, provided however that this requirement need not apply on a flanking street of a corner site.

E. Rear Yard:

A rear yard shall be provided of not less than 10 feet; provided however that where a building contains residential use, the building shall be set back not less than 25 feet over its full width from the rear line of the site, but such setback need not extend below
the lowest storey containing residential use; and provided further that where the rear line of a site adjoins a dedicated lane the minimum depth of the rear yard or setback, as the case may be, may be reduced by an amount equal to the distance from the ultimate centre line of the lane to the rear line of the site.

F. Height:

The height of a building shall not exceed eight storeys nor 100 feet.

G. Vertical Light Angle for all uses: (for illustrations see Appendix "G")

In the case of a building of more than three stories or 40 feet in height no part of such building above the third storey or above 40 feet shall project above lines extending toward the building at right angles from: (12/3/57—*3622)

(1) All points along the ultimate centre line of the street (or streets) in front of the site and inclined at an angle of 60 degrees to the horizontal;

(2) All points along the rear boundary line of the site or the ultimate centre line of the lane where one has been dedicated, and inclined at an angle of 60 degrees to the horizontal;

(3) All points along the interior side boundary (or boundaries) of the site at ground level and inclined at an angle of 70 degrees to the horizontal;

(4) In the case of a corner site all points along the ultimate centre line of a flanking street or lane and inclined at an angle of 60 degrees to the horizontal;

Provided however that any part of a building shall be exempt from the appropriate vertical angle control above, if the exempt part of the building:

(a) has a horizontal dimension of 60 feet or less, measured parallel to the street, lane, or boundary of the site, as the case may be, from which the said vertical angle is measured; and

(b) is not less than 80 feet from any part of the same building similarly exempt, measured in the same direction as the 60 feet specified in clause (a) of this proviso.

H. Horizontal Light Angle for Residential Use: (for illustrations see Appendix "G")

Where part of a building is used for residential purposes:

(1) The window of every habitable room shall be not less than ten feet from the interior side boundary of the site onto which it faces.

(2) Every window shall permit of an unobstructed view for a distance of not less than 80 feet, measured horizontally from its centre at sill level. Such view shall extend through either a continuous horizontal arc of not less than 50 degrees, or through two or more horizontal arcs which in the aggregate contain not less than 70 degrees, provided however the above arcs may be reduced from 50 degrees to 40 degrees, and 70 degrees to 60 degrees, respectively, in the case of buildings of two storeys or less in height; for the purpose of this subsection the following shall be considered as obstructions:

(a) The theoretically equivalent buildings located on any adjoining sites in any R District in a corresponding position by rotating the plot plan of the proposed building 180 degrees about a horizontal axis located on the property lines of the proposed site.

(b) Part of the same building including permitted projections.

(c) Accessory buildings located on the same site as the principal building.

(d) The maximum size building permitted under the appropriate C or M schedule if the site adjoins a C or M site.
(3) Where a window is greater in area than the minimum required under the Building By-law, the above conditions may be tested against the least restrictive portion of the window equal in area to the required minimum. For the purpose of this subsection, a kitchen shall not be counted as a habitable room unless its area is greater than ten percent of the total floor area of the dwelling unit in which it is situated, or 70 square feet, whichever is the greater.

J. Floor Space Ratio:

The floor space ratio shall in no case exceed 5.00 provided, however, that where a building is used in part for residential purposes every square foot of the floor area used for residential purposes shall be counted as the equivalent of 1\(\frac{2}{3}\) square feet for the purpose of this subsection.

K. Off-street Parking Spaces:

Off-street parking spaces shall be provided and maintained as required by, and in accordance with the provisions of Section 12 of this By-law.

L. Off-street Loading Spaces:

Loading and unloading spaces shall be provided and maintained as required by, and in accordance with the provisions of Section 13 of this By-law.

2. Uses which may be permitted subject to special approval by the Technical Planning Board:

Notwithstanding the provisions of Section 1 of this schedule, development permits may be issued for development comprising the following uses subject to such uses first of all being approved by the Technical Planning Board. If a development permit is granted it shall be subject to such conditions and regulations or relaxations as the Technical Planning Board may decide:

Uses:

(1) Ambulance Headquarters. (12/3/57—*3622)

(1A) Animal hospital.

(2) Automotive repair shop.

(3) Bakery (manufacturing of bread, pies, confectionery), other than as provided for in Section 1 of this schedule.

(4) Bottling plant (milk or carbonated beverages).

(5) Bowling alley.

(6) Broom and brush manufacturing.

(7) Building or use required by a public authority.

(8) Candy manufacturing.

(9) Car sales lot.

(10) Church.

(11) Clothing and garment manufacturing.

(12) Dairy products manufacturing (except cheese).

(13) Deposit or extraction of material so as to alter the configuration of the land.
(14) Food products manufacturing, processing and packaging excluding fish and a cannery.
(15) Home craft or occupation.
(16) Hospital, sanitarium, convalescent home, excluding a mental hospital.
(17) Hotel provided it conforms to the daylight access provisions of Section 1 of the (C-3) schedule.
(18) Ice manufacturing.
(19) Jewellery manufacturing.
(20) Kennels or the keeping, breeding, raising, training or boarding of dogs or cats.
(21) Lithographing.
(22) Motel provided it conforms to the daylight access provisions of Section 1 of the (C-3) schedule.
(23) Motion picture and television studio.
(24) Park or playground.
(25) Printing shop.
(26) Public utility.
(27) Radio and television broadcasting and receiving station (commercial).
(28) Restaurant (drive-in).
(29) School (public or private), kindergarten, day-care school, crèche, or day nursery.
(30) Sheet metal or tinsmith shop.
(31) Stadium, curling rink, ice rink, roller rink, race track, gymnasium, or similar place of assembly.
(32) Stamp shop (rubber and metal).
(33) Taxidermy.
(34) Tourist court subject to the provisions of Section 11(5) of this By-law.
(35) Toy and novelty manufacturing.
(36) Undertaking establishment.
(37) Warehouse (general).
(38) Wholesale business.
(39) Any other building or use which is not specifically listed in any schedule of this By-law, and which is similar to the foregoing buildings or uses; before granting a development permit for such building or use the Technical Planning Board shall have regard to the types of buildings and uses which specifically may be permitted in this schedule. (12/3/57 – 2622)
(40) Buildings of more than eight storeys or 100 feet in height, subject to all other regulations of Section 1 of this schedule.
(41) The use of a site for purely residential purposes if the site has unusual peculiarities of location, such use to include one and two-family dwellings, apartments, boarding or lodging houses, and fraternity or sorority houses.
(42) The conversion into dwelling units of an existing building other than one granted a development permit in accordance with Section 1 of this schedule; before granting a development permit for such conversion the Technical Planning Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.

(43) The conversion of an existing building into housekeeping units in any case where such existing building, by reason of its age and size, is deemed to be unsuitable for its present use; before granting a development permit for such conversion the Technical Planning Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.

(44) The conversion of an existing building into a boarding or lodging house in any case where such existing building by reason of its age and size, is deemed to be unsuitable for its present use; before granting a development permit for such conversion the Technical Planning Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.

(45) A dwelling unit or housekeeping unit other than one granted a development permit in accordance with this schedule, which has been installed or used prior to June 18th, 1956, with or without one or more of the required City permits may be granted a development permit limited in time. (11/12/56—*3610)

(46) A building which has been altered or used for a boarding or lodging house other than one granted a development permit in accordance with this schedule which has been installed or used prior to June 18th, 1956, with or without one or more of the required City permits may be granted a development permit limited in time. (11/12/56—*3610)

(47) Any building or use which can be considered as accessory to the above uses and to the uses listed in Section 1 of this schedule other than those accessory buildings or uses for which provision is made in such section, subject to:

(a) All accessory buildings occupying an area of not greater than ten percent of the area of the site.

(b) All accessory uses occupying an area of not greater than one-third the total gross floor area of all the buildings on the site.
Uses permitted, conditions and regulations:

Subject to all the provisions of this By-law on any site within any district defined, designated or described in this By-law as a (C-3A) District, the only uses permitted, and the only uses for which development permits may be issued, are those contained in Sections 1, 2 and 3 hereof.

A. Uses:

(1) Auction room.
(2) Bakeries retailing on the premises only, not exceeding a total of 2,200 square feet of floor area.
(3) Billiard and pool hall.
(4) Book bindery.
(5) Cleaning and dyeing shop.
(6) Club, or lodge (fraternal).
(7) Community centre.
(8) Film exchange.
(9) Frozen food lockers.
(10) Hall.
(11) Institution of a religious, philanthropic, charitable or philozoic character.
(12) Laboratory.
(13) Office building.
(14) Parking area (public).
(15) Pet shop.
(16) Radio and television broadcasting and receiving masts and antennae (commercial).
(17) Radio broadcasting and receiving station for motor vehicles, trains, watercraft and aircraft.
(18) Restaurant (excluding a drive-in).
(19) Retail store, business, or undertaking.
(20) School (business or commercial).
(21) School (trade).
(22) Sign and showcard writing.
(23) Steam bath.
(24) Swimming pool (commercial).
(25) Theatre (excluding a drive-in).
(26) Dwelling units in conjunction with and in addition to any of the above uses provided that no portion of the first storey of a building to a depth of 35 feet from the front wall of the building and extending across the full width of the building shall be used for residential purposes except for entrances to such residential part.
(27) The keeping of not more than two boarders or lodgers or not more than five foster or day-care children in each dwelling unit.
(28) A building or use which is customarily accessory to the above principal buildings or uses, except for a building or use which is only listed as a principal use in the (M-1) or (M-2) schedules, provided that:
   (a) All accessory buildings are located in a rear yard.
   (b) All accessory buildings shall occupy an area of not greater than ten percent of the area of the site.
   (c) No accessory building shall exceed one storey or 12 feet in height.
   (d) No accessory building shall obstruct the daylight access as required by this By-law for residential use.
   (e) All accessory uses of the type which would not be permitted as principal uses under Section 1 of this schedule shall occupy an area of not more than 25 percent of the gross floor area of the principal use, and shall be located within the principal building.

B. Conditions of Use:
Every business or undertaking shall be conducted wholly within a completely enclosed building except for parking and loading facilities, a gasoline service station, subject to the provisions of Section 11.10 of this By-law.

C. Front Yard:
No front yard shall be required.

D. Side Yard:
No side yard shall be required, except in the following cases:
(1) Where a (C-3A) District adjoins any R District, without the intervention of a street or lane, the following side yard shall be provided:
   (a) 3 feet in the case of an RA, RS or RT District;
(b) 5 feet in the case of an RM District.

(2) Where a side yard in any such district be provided, where not required by the provisions of this By-law, the said side yard shall be not less than 3 feet in width.

E. Rear Yard:

A rear yard shall be provided of not less than 10 feet; provided however that where a building contains residential use, the building shall be set back not less than 25 feet over its full width from the rear line of the site, but such setback need not extend below the lowest storey containing residential use; and provided further that where the rear line of a site adjoins a dedicated lane the minimum depth of the rear yard or setback, as the case may be, may be reduced by an amount equal to the distance from the ultimate centre line of the lane to the rear line of the site.

F. Height:

The height of a building shall not exceed two storeys, or 30 feet. The Development Permit Board may, in its discretion, increase the height set forth herein, provided that the said building complies in all other respects with the regulations contained in this section.

G. Horizontal Light Angle for Residential Use:

Where part of a building is used for residential purposes:

(1) The window of every habitable room shall be not less than ten feet from the interior side boundary of the site onto which it faces.

(2) Every window shall permit of an unobstructed view of not less than 80 feet, measured horizontally from its centre at sill level. Such view shall extend through either a continuous horizontal arc of not less than 50 degrees, or through two or more horizontal arcs which in the aggregate contain not less than 70 degrees, provided however the above arcs may be reduced from 50 degrees to 40 degrees, and 70 degrees to 60 degrees, respectively, in the case of buildings of two storeys or less in height; for the purpose of this subsection the following shall be considered as obstructions:

(a) The theoretically equivalent buildings located on any adjoining sites in any R District in a corresponding position by rotating the plot plan of the proposed building 180 degrees about a horizontal axis located on the property lines of the proposed site.

(b) Part of the same building including permitted projections.

(c) Accessory building located on the same site as the principal building.

(d) The maximum size building permitted under the appropriate C or M schedule if the site adjoins a C or M site.

(3) Where a window is greater in area than the minimum required under the Building By-law, the above conditions may be tested against the least res-
trictive portion of the window equal in area to the required minimum. For the purpose of this subsection, a kitchen shall not be counted as a habitable room unless its area is greater than ten per cent of the total floor area of the dwelling unit in which it is situated or 70 square feet, whichever is the greater.

H. Floor Space Ratio:

(1) Subject to (2) below, the floor space ratio shall not exceed 1.00.

(2) The Development Permit Board may, in its discretion, permit a building at variance with subsections F and H (1) of Section 1 of this District Schedule. In the exercise of its discretion, the Development Permit Board shall also have due regard to:

(a) The provisions of the By-law, the amount of open space, views, plazas, pedestrian needs and interests, the height and bulk of the building and its location in relation to the site and surrounding streets and buildings, the effect on traffic, the provision of off-street parking and loading, its overall design, preservation of the character, and general amenity desired for the Broadway and South Granville areas.

(b) For buildings approved under this clause only, the Development Permit Board shall determine the maximum Floor area which shall be allowed, having particular regard to the factors noted above. In no case, however, shall the floor space ratio exceed 3.00.

(3) For the purposes of this schedule, in computing the floor space ratio, the floor area of the building shall include the total area of all the floors of all buildings on the site including accessory buildings (measured to the extreme outer limits of the building), except for the following:

(a) Areas of floors used for off-street parking and loading, heating and mechanical equipment or uses which in the opinion of the Development Permit Board are similar to the foregoing, where such floors are below the lowest building grade of the abutting streets or lanes as established by the City Engineer.

(b) Balconies, canopies, sundecks and other appurtenances which, in the opinion of the Development Permit Board, are similar to the foregoing, may be excluded from the floor area measurement, provided that the total floor area of all such excluded items does not exceed 8 per cent of the permitted floor area.

(c) Ancillary facilities for social and recreational amenities primarily for the enjoyment of residents and employees, such as facilities for physical fitness, general recreation, or providing a service to the public, may be excluded from the floor area measurement provided that:

i) the areas of such excluded facilities contained in this section does not exceed 20 per cent of the allowable floor space ratio or 10,000 square feet, whichever is the lesser;
ii) that the need for a day care centre be established in a particular location satisfactory to the Director of Social Planning.

Where a need for any public, social or recreational facility has been demonstrated to the satisfaction of the Development Permit Board, the Board may authorize for any one building, which includes one or more of such facilities, an increase in the permitted floor space ratio or density of a building, subject to prior approval by City Council.

In determining the increase in floor area or density that may be authorized, the Development Permit Board shall consider:

a) the construction cost of the facility, and
b) any costs to the developer of continuing maintenance required for the facility;
c) the rental value of the increased floor area;
d) the value of any authorized relaxation of other restrictions.

If appropriate, such facilities shall be preserved in the public domain by way of a registered agreement and operated by the City or its delegates. (14/12/76 - No. 5050)

J. Off-street Parking Spaces:

Off-street parking spaces shall be provided and maintained as required by, and in accordance with the provisions of Section 12 of this By-law.

K. Off-street Loading Spaces:

Loading and unloading spaces shall be provided and maintained as required by, and in accordance with the provisions of Section 13 of this By-law.

2. Uses which may be permitted subject to special approval by the Development Permit Board:

With the approval of the Development Permit Board, development permits may be issued for the following uses. If the development is granted, it shall be subject to such conditions and regulations as the Development Permit Board may decide.

Uses:

(1) Aircraft landing place.
(2) Ambulance headquarters.
(3) Animal hospital.
(4) Automobile and parts showrooms.
(5) Automotive repair shop.
(6) Bakery (manufacturing of bread, pies, confectionary), other than as provided for in Section 1 of this schedule.

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(7) Bottling plant (milk or carbonated beverages).
(8) Bowling alley.
(9) Broom and brush manufacturing.
(10) Building or use required by a public authority.
(11) Candy manufacturing.
(12) Car sales lot.
(13) Church.
(14) Clothing and garment manufacturing.
(14A) Community Residential Facility, provided that such adjacent property owners as may be deemed necessary by the Director of Planning be notified. (15/3/77 – No. 5061)
(15) Dairy products manufacturing (except cheese).
(16) Deposit or extraction of material so as to alter the configuration of the land.
(17) Food products manufacturing, processing and packaging excluding fish and a cannery.
(18) Gasoline service station, subject to the provisions of Section 11.10.
(19) Home craft or occupation.
(20) Hospital or personal care home, excluding a mental hospital.
(21) Hotel, or Motel, provided all sleeping units and dwelling units conform to the daylight access provisions of Section 1 of this schedule.
(22) Ice manufacturing.
(23) Jewellery manufacturing.
(24) Kennels or the keeping, breeding, raising, training or boarding of dogs or cats.
(25) Lithographing.
(26) Motion picture and television studio.
(27) Park or playground.
(28) Parking garage.
(29) Printing shop.
(30) Public utility.
(31) Radio and television broadcasting and receiving station (commercial).
(32) Restaurant: Drive-in (Car-service).
(33) Restaurant: Drive-in (Self-service).
(34) School (public or private), kindergarten, day-care school, creche or day nursery.
(35) Sheet metal or tinsmith shop.
(36) Stadium, curling rink, ice rink, roller rink, race track, gymnasium, or similar place of assembly.
(37) Stamp shop (rubber and metal).
(38) Taxidermy.
(39) Temporary parking area (public).
(40) Tires (retreading or rebuilding).
(41) Tourist court subject to the provisions of Section 11.12 of this By-law.
(42) Toy and novelty manufacturing.
(43) Undertaking establishment.
(44) Warehouse (general).
(45) Wholesale business.
(46) Any other building or use which is not specifically listed in any schedule of this By-law, and which is similar to the foregoing buildings or uses; before granting a development permit for such building or use the Development Permit Board shall have regard to the types of buildings and uses which specifically may be permitted in this schedule.
(47) The use of a site for purely residential purposes if the site has unusual peculiarities of location, such use to include one and two-family dwellings, apartments, boarding or rooming houses, and fraternity or sorority houses.
(48) The conversion into dwelling units of an existing building other than one granted a development permit in accordance with Section 1 of this schedule; before granting a development permit for such conversion the Development Permit Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.
(49) The conversion of an existing building into housekeeping or sleeping units in any case where such existing building, by reason of its age and size, is deemed to be unsuitable for its present use; before granting a development permit for such conversion the Development Permit Board shall have regard to the regulations of Section 1 of this schedule and also to the amenity of the neighbourhood.
(50) The conversion of an existing building into a boarding or rooming house in any case where such existing building by reason of its age and size, is deemed to be unsuitable for its present use; before granting a development permit for such conversion the Development Permit Board shall have regard to the regulations of the RM schedules and also to the amenity of the neighbourhood.
(51) A dwelling unit or housekeeping or sleeping unit other than one granted a development permit in accordance with this schedule, which has been installed or used prior to June 18th, 1956, with or without one or more of the required City permits may be granted a development permit limited in time.
(52) A building which has been altered or used for a boarding or rooming house other than one granted a development permit in accordance with this schedule which has been installed or used prior to June 18th, 1956, with or without one or more of the required City permits may be granted a development permit limited in time.

(53) Any building or use which can be considered as accessory to the above uses and to the uses listed in Section 1 of this schedule other than those accessory buildings or uses for which provision is made in such section, subject to:

(a) All accessory buildings occupying an area of not greater than ten percent of the area of the site.

(b) All accessory uses occupying an area of not greater than one-third the total gross floor area of all the buildings on the site.

3. Uses which may be permitted subject to special approval by the City Council:

(1) Elderly Citizens' Multiple Dwelling Unit Development (Apartment Building).

A building to be occupied and used solely as a residence for elderly citizens may be approved as a conditional use subject to such conditions, regulations or relaxations as the Council may deem appropriate, having due regard to the height, bulk, density, over-all size of development, or any other feature which, in the opinion of the Council, may affect the general amenity and welfare of the area, and after Council has received a report regarding the proposed development from the Development Permit Board provided the development meets the following conditions:

(a) that the development comprises only low rental housing units for the exclusive use of elderly citizens of low income who are unable to purchase adequate accommodation according to their needs;

(b) that the owner and operator of the project is a non-profit corporation within the meaning of the "Elderly Citizens' Housing Aid Act";

(c) that the development qualifies for a grant-in-aid from the Province of British Columbia under the provisions of the "Elderly Citizens' Housing Aid Act".

Before approving the issuance of a development permit for an elderly citizens' multiple dwelling unit development, the Council shall hold a special public meeting to hear representations concerning the proposed development from such adjacent owners of real property as the Council deems are likely to be affected; and the Council shall direct that due notice of the special public meeting shall be given to such adjacent owners.