A MODEL TO FORECAST THE IMPACT OF ROAD ACCESSIBILITY ON THE ECONOMIC DEVELOPMENT POTENTIAL OF INDUSTRIAL LAND IN URBAN AREAS

by

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DECLARATION

I, the undersigned, hereby declare that the work contained in this dissertation is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

SUMMARY

The dissertation firstly outlines the findings of recent studies that have recorded the relationship between transport and economic development. This includes the assessment of a number of economic evaluation techniques that are available to predict the impact of improvements in transport on economic development.

An historic overview is provided of the role that transport has played in the development of Cape Town. Due to the fact that the phases of development followed international development trends, it is concluded that development in Cape Town will follow the global trend. A number of economic growth scenarios are developed for Cape Town to assess how the City will be able to cope with the socio-demographic challenges facing it in the next century.

The relationship between land price and the economic development potential of land is outlined, as are the factors that determine industrial land price, namely the demand and supply of industrial land. The process of determining the economic value of industrial land is described. This includes the collection and analysis of occupation rent of industrial townships in Cape Town, the calculation of property values and the calculation of the shadow price of land.

A procedure of determining accessibility to industrial townships in Cape Town was developed. Firstly, accessibility was defined in broad terms. This was followed by a discussion of each of the elements of accessibility namely proximity, access and mobility in order to understand the factors that may impact on the level of accessibility. Finally, the level of accessibility is quantified in terms of generalised cost.

A regression analysis was undertaken to establish a statistical relationship between the economic value of industrial land and accessibility to the industrial townships. The development of a numerical model was based on the regression analyses to forecast changes in industrial land price given a change in accessibility. The model was then tested on a case study.

The main conclusions of the study are as follows:

(a) The accessibility of industrial land in Cape Town is linked closely to its CBD / Port (it was not possible to separate the CBD and the port), which is typical of a monocentric city structure.

(b) There is a positive, significant, quantifiable relationship between accessibility as quantified by means of generalised cost and the economic value of industrial land, which was calculated by means of the shadow price technique.

(c) There are a number of conditions that should be met for an increase in local industrial production potential to be translated into an equal amount of economic output.

OPSOMMING

Die proefskrif som eerstens die bevindings van onlangse studies op wat die verwantskap tussen vervoer en ekonomiese ontwikkeling dokumenteer. Dit sluit die taksering van `n aantal ekonomiese evaluasietegnieke in wat beskikbaar is om die impak van vervoer op ekonomiese ontwikkeling te voorspel.

`n Historiese oorsig word verskaf van die rol wat vervoer gespeel het in die ontwikkeling van Kaapstad. As gevolg van die feit dat die fases van ontwikkeling in die verlede internasionale ontwikkelingstendense gevolg het, word tot die gevolgtrekking gekom dat Kaapstad die globalisasie markera, wat tans internasionaal gestalte kry, sal navolg. `n Aantal ekonomiese groeiscenarios word vir Kaapstad ontwikkel ten einde te bepaal hoe die stad die sosio-demografiese uitdagings van die volgende eeu sal hanteer.

Die verwantskap tussen grondprys en die ekonomiese ontwikkelingspotensiaal van grond word omskryf, asook die faktore wat industriële grondprys bepaal. Die proses van die bepaling van die ekonomiese waarde van industriële grond word beskryf. Dit sluit die insamel en analise van besettingshuurdata van industriële dorpsgebiede, die berekening van eiendomswaarde en die berekening van die skaduprys van grond in.

`n Prosedure is ontwikkel vir die berekening van die toeganklikheid van industriële dorpsgebiede in Kaapstad. Eerstens is toeganklikheid in breë trekke gedefinieër. Dit is gevolg deur 'n bespreking van elk van die elemente van toeganklikheid, naamlik nabyheid, aansluiting en mobiliteit ten einde die faktore wat op die vlak van toeganklikheid mag impakteer te verstaan. Laastens is die vlak van toeganklikheid gekwantifiseer in terme van veralgemeende vervoerkoste.

`n Regressie-analise is onderneem ten einde die statistiese verwantskap tussen die ekonomiese waarde van industriële grond en toeganklikheid na industriële dorpsgebiede te bepaal. Die ontwikkeling van 'n numeriese model is op die regressie-analise gebaseer ten einde veranderinge in industriële grondpryse te voorspel, gegewe 'n verandering in toeganklikheid. Die model is op `n gevallestudie toegepas.

Die vernaamste gevolgtrekkings van die studie is :

(a) Die toeganklikheid van industriële grond in Kaapstad is nou gekoppel aan die sentrale sakekern / hawe (dit was nie moontlik om die sentrale sakekern en hawe te skei nie), wat tipies is van n monosentriese staduitleg.

(b) Daar is `n noemenswaardige positiewe kwantifiseerbare verwantskap tussen toeganklikheid, soos gekwantifiseer in terme van veralgemeende koste, en die ekonomiese waarde van industriële grond wat deur middel van die skaduprystegniek bereken is.

(c) Daar is `n aantal voorwaardes waaraan voldoen moet word alvorens `n toename in plaaslike industriële produksiepotensiaal tot 'n soortgelyke toename in ekonomiese ontwikelingspotensiaal sal lei.

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GLOSSARY OF TERMS AND DEFINITIONS

Accessibility. Accessibility is the ease with which the geographical gap between a location and all other locations with which it requires physical interface can be bridged in order to create place utility for people, goods and services. Accessibility indicates the attractiveness of a place (subject node) with respect to its main origin and destination (accessibility node). As the generalised cost of movement between the subject node and the accessibility node decreases, accessibility between these places increases. Accessibility therefore increases as generalised transport cost decreases.

Accessibility node. The accessibility node is the node or combination of nodes that can be considered as the centre of economic activity of a specific land use in the study area. It can be regarded as the node towards which the majority of the physical interface of the subject nodes is directed. Both the subject nodes and the accessibility nodes are specific geographical areas.

Benefit/cost ratio. The present worth of the benefits of a project divided by the present worth of their investment costs. (All proposals with a ratio value greater than one are viable.)

Consumer surplus. The difference between what a consumer is willing to pay and the price that the consumer actually pays for a product. The maximum amount of money that a consumer is willing to pay is subjectively derived from the total utility that a product is expected to offer the consumer. Given a declining utility perceived per unit from consuming extra units of a product in a given period, this surplus arises because the consumer will be willing to pay for additional units up to the point that the value derived from the utility of the last unit is equal to the unit price of the product.

Cost-benefit analysis. The conceptual procedure to determine the viability of investment projects by considering all benefits and costs regardless of to whom they accrue within a country. A benefit is regarded as any gain in utility emanating from the operation and use of a facility, and a cost is any loss of utility associated with the implementation of a project, where utility is measured in terms of opportunity costs. (The term cost-benefit analysis is used interchangeably with social cost-benefit analysis and economic evaluation. It does not include financial evaluation.)

Demand. The quantity of a product that able consumers are willing to buy at all possible prices over a particular period, often referred to as the demand schedule. Graphically a demand schedule is portrayed by a demand curve.

Demand curve. A graphical representation of the relationship between the demand for a product and its price (usually with price on the vertical axis, and quantity demanded measured along the horizontal axis). The negative relationship between these two variables is reflected by the fact that the demand curve slopes downward from left to right. It is assumed to be downward sloping because of the belief that the utility attached to an extra unit of any product diminishes as more and more of that product is purchased or consumed over a particular period.

Development. An improvement in the living conditions of the various social groups that live in an area.

Discounting. The process of converting a future value or values into an equivalent present worth by using an appropriate interest (discount) rate. (In intermediate discounting calculations, values occurring far into the future can be expressed in an equivalent worth at a common date closer in the future. However, ultimately all values are discounted to year zero in economic evaluation.)

Discount rate. The time value of money deemed appropriate under specific conditions to calculate the present worth of a future value, usually expressed as a percentage per annum.

Disposable income. Personal income plus transfer income (e.g. social pensions), after deduction of all taxes levied on incomes; i.e. personal income available for expenditure and saving.

Distributive equity. A measure of the way the allocation of economic resources among groups or individuals within a country (or community) contributes to an equitable or a socially desirable distribution of welfare. (Distributive equity is often simply called "equity".)

Disutility. A negative satisfaction, e.g. discomfort, frustration, inconvenience, irritation, pain, tiredness, time lost through waiting and delay.

Economic development. An increase in the economy's productive capacity and output, as well as changes in the technical and institutional arrangements by which it is produced.

Economic growth. An increase in the economy's productive capacity and output.

Externality. The consequences of an activity that affect others who are not party to the activity, for better or worse, without those others paying or being compensated for the consequences of the activity as a result of the failure of the market to arrange for payment or compensation.

External cost. Uncompensated cost or disutility imposed on someone, who is not party to an activity, as a result of that activity. (External costs are also known as "negative externalities", "negative spillovers" or "external diseconomies".)

Factors of production (economic means). The resources of society used in the process of production. These are usually divided into four main groups: land, labour, capital and entrepreneurship. Land includes all natural resources, e.g. land itself, mineral deposits, water and utilisable fauna and flora. Labour includes all the human physical and mental talents employed in production. Capital includes all man-made aids to production, such as infrastructure (e.g. railway lines, pipelines, roads, pedestrian facilities, airports, seaports and transport terminals) and durable means of production (e.g. vehicles and handling equipment). Entrepreneurship includes the organisation of the other three factors for productive purposes through management skills, expertise, innovation, ingenuity and the bearing of the risks of the business operation. Since all economic resources are relatively scarce and limited in supply, they all receive some type of income for their services. The income for the use of land is rent, the income of labour is wages, the income for use of capital is interest, and the income for entrepreneurship is profits.

Generalised (transport) cost. The degree of perceived disutility, based on user sacrifice, which leads to resisting the undertaking of or participation in a trip. It typically includes a monetary cost, travel time and negative quality aspects (for example, discomfort and inconvenience endured, safety risks, exposure to frustration, unreliable service, walking and waiting).

Gini coefficient. The ratio of the area between the diagonal and the Lorenz curve divided by the total area of the triangle in which the curve lies. The Lorenz curve is constructed by plotting the numbers of income recipients, starting with the poorest, on the horizontal axis in cumulative percentages and with cumulative personal income percentages on the vertical axis. The lower the Gini coefficient, the better (closer to equity) the income distribution.

Independent projects. Projects that fulfil different functions. They do not form alternatives to one another and are therefore not mutually exclusive. The selection of a certain (functionally) independent project can at most postpone, but not exclude, the selection of another (functionally) independent project.

Internal rate of return. The discount rate that will equalise the present worth of the investment costs of a project and the present worth of its benefits, i.e. the discount rate at which the net present value (NPV) of a project will equal a value of zero, or the benefit/cost (B/C) ratio will equal a value of one. (A project that yields an internal rate of return (IRR) greater than the social discount rate is regarded as viable.)

Investment costs. The cost of the factors of production sacrificed in the process of producing or forming capital stock. In the supply of transport infrastructure it represents the scarcity value of all resources needed to supply a facility complete and ready for use. These include the opportunity costs of (1) direct planning and design to establish a facility, (2) the land reserve and its preparation for development, and (3) the construction of the facility (including the installation of appurtenances, construction of access links, and landscaping) and project management. (Note that the opportunity cost of the factors of production includes their normal income obtaining to provide them through transactions in a fully competitive market. Investment costs are also known as "capital costs" or "initial costs" or "one-off costs".)

Macroeconomics. The study of the behaviour of the economy as a whole. It analyses economic aggregates, such as national income, total consumption, investment, the money supply, the price level and unemployment.

Microeconomics. The study of the economic behaviour of part(s) of an economic system, especially a household, a firm or an industry. The major issues discussed are matters of pricing, distribution, investment, welfare economics, demand and supply.

Mutually exclusive projects. Technically feasible projects that will fulfil the same function if implemented. Because they are substitutes or alternatives, the selection of any one of the proposals will exclude the need for others.

Net present value. The difference between the present worth of a project's benefits and the present worth of its investment costs. (If the present worth of a project's benefits exceeds the present worth of its investment costs, it has a positive net present value (NPV) and is therefore regarded as viable.)

Opportunity cost. The value of the most favourable (i.e. best) alternative forgone by choosing a particular activity. Opportunity cost arises from the scarce or limited nature of resources. If resources were limitless no action would occur at the expense of any other - all could be undertaken - and the opportunity cost of any single action, the value of the next best alternative, would be zero. (Opportunity cost is also known as "alternative cost".)

Perceived monetary trip cost. The amount of money that the vehicle user or possible user believes he sacrifices or would sacrifice for a trip, as based on his awareness of the monetary input required to bring about the trip or participate in it.

Place utility. 1. The value derived by a person from being at a specific location or by reaching a destination. 2. The value added to goods by transporting them from a place where they are not needed to a place where they are needed.

Present value. See *Present worth.*

Present worth. The worth of a specified future value or of specified values occurring in different time periods expressed as a single amount at the present moment (i.e. year zero). (Present worth is also known as "present value".)

Present worth of costs. The sum of the present worth of the investment costs and the recurring costs (i.e. user and maintenance costs). (The mutually exclusive project that yields the smallest present worth of costs (PWOC) is regarded as the best alternative.)

Private cost. The cost of acquiring or providing goods and services as it appears to the party that acquires or supplies them. This reflects actual transaction prices paid in the market and excludes external costs.

Recurring costs. Repetitive costs (as opposed to one-off cost), for example, user costs and facility maintenance costs.

Shadow price. A value that represents the social opportunity cost of (1) an input or output whose transaction price in the market does not represent its scarcity value, or (2) an item that has no market price. (The shadow price that acts as proxy for the social opportunity cost of a non-market item (in (2) above) is also known as a "surrogate price".)

Social discount rate. The intensity of a society's preference for present consumption over future consumption, expressed in real terms. (The social discount rate is also known as the "economic discount rate" or the "social time preference rate".)

Social time preference rate. See *Social discount rate*.

Subject areas/nodes. The subject areas/nodes are geographical areas or nodes within a defined study area which has a uniform land use and similar transport demand characteristics.

Subsidy. A payment by a government to members of the public for which it does not receive products in return. The purpose of such payments is to afford recipients the ability and/or willingness to pay for or supply a product whose consumption or utilisation is regarded as desirable by the government. Payment is made either to the provider or to the consumer of the product. For example, in the case of public transport subsidies — the aim being to enhance society's accessibility and mobility — payments are made either to service providers (usually in the form of capital, deficit, input or output subsidies) or to users, in the form of rebated travel fares.

Sunk cost. A cost that cannot be recovered. It is the difference between the cost incurred on an item prior to an economic analysis and the value of the best alternative use of that item at the time of the analysis. (Costs incurred prior to an economic analysis on items that have no alternative use are regarded as sunk costs and are disregarded in the economic analysis.)

Surrogate price. See *Shadow price.*

Time utility. 1. The value of a person's time. (Time of a person travelling as a passenger may, for example, be valued higher than his time spent driving if he manages to spend his time while being a passenger more productively or desirably.) 2. The increase in value created by the availability of a product at the time it is required for consumption or use in whatever alternative way.

Transport user benefits. Enlargement of the existing consumer surplus ascribable to the user cost savings gained by current traffic (i.e. existing, diverted and transferred traffic) and normal-growth traffic, and the newly generated and developed consumer surplus gained by induced traffic (i.e. generated and developed traffic) resulting from the implementation of a new or improved facility.

Transport user costs. These include vehicle running costs, value of vehicle occupants' time and accident costs. (Some of the costs of accidents and damage to the environment caused by users are not recovered from them by the market and are borne by society.)

User charge. A charge paid by users of a product provided by a government or by a public enterprise. It is applied so that those who make use of and obtain the benefits of goods and services repay (or partially repay) the cost thereof to the government, for example, (1) road user charges, which generally take the form of tolls, vehicle licence fees and fuel levies, and (2) travel fares charged for the use of public transport. (Note that not all vehicle licence fees and fuel levies represent user charges; they may also represent indirect taxes used as general government revenue.)

Utility. The satisfaction derived from a product or an activity, particularly consumption or usage of it in whatever desired way.

Value. The price (i.e. money value) that an able buyer (user or consumer) is willing to pay for a product or an activity.

Wealth. The stock of assets held by all members of a society to which a financial value can be ascribed. Wealth equals the value of all assets less liabilities, and is measured at a specific date and not over a period as is the case with income. (Wealth contributes to "economic welfare" and it forms a subset of (social) welfare.)

Welfare. The general condition or quality of well-being of a society. Social welfare takes account of such things as the measure to which spiritual, mental and bodily life fulfilment can be attained, the cultural level, the state of law and order, the opportunity to participate in desired activities, health, standard of living, etc.

Willingness to pay. The money value which an individual is willing to pay for a product. This value is subjectively derived from the utility obtained through the satisfaction gained from consuming or using the product in whatever desired way. (Total utility is created by form utility, possession utility, place utility and time utility. The latter two types of utility are provided and enhanced by the transportation process.)

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CHAPTER 1

INTRODUCTION

1.1 Need for the study

Quantitative studies generally approach the relationship between transport and economic development from a macro-economic perspective. The relationship between transport investment and economic growth is typically based on time-series data that track the level of investment spending and the level of economic growth over a number of years, or on cross-section data which compare the transport system of countries with different levels of development. In both instances government spending on transport infrastructure in a region is linked to an increase in economic growth as measured by the gross domestic product of that region. Transport lobby groups often use these results to convince government authorities to increase the general level of spending on transport infrastructure.

However, development takes place at a local rather than at a global level. At a local level, which is the level of the individual township or land use pocket, the relationship between transport and development is mostly explained in a qualitative manner. Spatial planning studies often view the provision of transport and accessibility as an essential element to stimulate specific nodal or corridor developments. However, in this context the provision of transport infrastructure and services often rely on preconceived notions and ideas that are not tested properly through empirical evaluation.

From a transport planning and implementation perspective the investment in and management of transport infrastructure is evaluated empirically by means of the economic evaluation procedures described in documents such as the Guidelines for Conducting the Economic Evaluation of Urban Transport Projects (*City of Cape Town, 2002*) and the Highway Development Manual (*World Bank, 2000a*). However, one of the major shortcomings of these procedures is that they do not have a mechanism to properly quantify the benefits stemming from an increase in the development potential at a local level. The current mechanism through which this is done is basing development benefits on the assumption that a certain amount of traffic will be generated as a result of growth that is stimulated by the transport improvement.

In addition to the need for introducing "economic development" into the economic evaluation procedure, there is also a need for private property investors and property brokers to improve their understanding of the relationship between accessibility and property values. Investment in property is a long-term decision, irrespective of whether the property is to be rented out or whether it is to be developed. The growth in the asset value of the property is determined by, amongst other things, its future accessibility. However, property investors often pay little or no attention to future accessibility. Even those who do consider accessibility assess it qualitatively, for example, by guessing which roads will be completed in the immediate vicinity of the land, rather than to calculate the exact impact of the completion of the road network on land values.

It was also observed that current literature on economic development emphasises the tertiary or services sector (tourism, financial services, retail and information technology) as the major drivers of development in Cape Town. There is thus a need to put into perspective the role that the industrial sector plays, or should play, in the achievement of Cape Town's overall development goals. There is therefore a need to establish a solid empirical base to explain the relationship between accessibility and industrial land value, as well as between industrial land value and economic development.

The following groups of individuals can benefit from the results and findings of the study:

a) Property developers
b) Property owners
c) Academics and researchers
d) Spatial (town and regional) planners
e) Transport planners
f) Road authorities
g) Economic and land development authorities
h) Property consultants and property analysts.

1.2 Hypothesis of the study

This study approaches the relationship between transport and economic development from a micro-economic perspective, with the focus being on how the individual firm would react to improvements in accessibility, and how those actions ultimately contribute to the overall level of economic development. In order to achieve the stated aim of the study, the following two hypotheses and one postulation have been formulated:

a) A metropolitan area has an accessibility node on which access to industrial sites is based. The accessibility node could either be a single geographical location, in the case of cities with a monocentric layout, or it could consist of a combination of nodes in the case of cities with a strong decentralised spatial layout. It should also be recognised that the accessibility node may not be the same for different land uses. This hypothesis is proven by means of a regression analysis using computed economic land values of industrial townships as the dependent variable and proximity to various potential industrial accessibility nodes as the independent variable.

b) There is a positive quantifiable relationship between accessibility to the industrial accessibility node and the economic value of industrial land. An improvement in accessibility will therefore have a positive impact on industrial development at a local level. In this context "local" refers to the industrial output of an industrial township or land use pocket. This hypothesis is proven by means of a statistical correlation between the accessibility (see Glossary of Terms for definition of accessibility) of industrial townships to the industrial accessibility node (see Glossary of Terms for definition of accessibility node) and the economic value of industrial land.

c) A change in the economic value of industrial land due to an improvement in accessibility to the economic hub will result in an equal change in the economic development potential of the land, if all the other requirements for development are present in sufficient quantity and quality. This postulation is proven through conclusions drawn from a literature analysis on land price theory, as well as from an analysis of the industrial development potential of the study area.

1.3 Aim and objectives of the study

The aim of the study is to develop a model to quantify the increase in economic development potential of an individual industrial township, if accessibility to it is improved.

In order to reach the above aim the following study objectives were defined:

a) Formulate a definition of "economic development" in terms of the macro-economic and micro-economic approach respectively, and how the level of economic development is quantified.

b) Define and quantify accessibility.

c) Compute the economic value of industrial land by means of the shadow price method using occupation rent data of industrial floor-space.

1.4 Study methodology

1.4.1 Overview of the approach to the study

From a micro-economic perspective rent/value is a function of the income that can be generated for the owner of that land, i.e. by the productivity of the land. Productivity of land is determined by the value of the production output of the land as reflected in (a) the type of land use (agricultural, business or residential) as indicated by the zoning classification of the land and (b) the intensity with which the land is used, which is referred to as the bulk. Productivity of land can therefore be measured in gross income per square metre.

Given that the supply of any particular piece of land is fixed because the amount of land at that location cannot be changed, the intensity of land use is determined by two factors: (a) the demand for individual firms to locate there, and (b) external and institutional factors, i.e. the land use type as well as the bulk which authorities allow on the land.

Ignoring for the moment the external factors that influence land prices, the demand for the land is determined by the productivity gains for the firm(s) who locate there. Because land supply is fixed in the short term, an increase in demand will lead to an increase in land income as firms are bidding to take advantage of the productivity gains that the land offers.

It is the objective of this report to illustrate that the improvement of accessibility to individual portions of land increases the productivity of the land, as well as to measure the extent to which accessibility improvements increase productivity.

The macro-economic relationship between improvement in transport and economic development can therefore be traced back to the micro-economic relationship between the improvement in accessibility and the productivity gains in the industrial sector, which will ultimately lead to productivity gains by the individual firm. Productivity gains by the individual firm will lead to productivity gains by the economy as a whole. Productivity gains in the economy of a country or a region lead to economic growth, which is one of the key elements of economic development.

Productivity gains in the economy of a region will thus be reflected in the land prices of that region if the supply of land is fixed. Therefore, if a relationship between land prices and accessibility can be proven it, can also be proven that transport increases the level of economic development of a country or region.

The fact that transport improvements manifest themselves in land prices also means that ultimately one will be able to measure the degree to which economic development improves as the result of specific transport improvements by the degree to which the improvements influence land prices.

1.4.2 Specific tasks

Below follows list of specific tasks that were undertaken during the study in chronological order, bearing in mind that an iterative approach was required to review research undertaken earlier in the study:

a) Study inception

- Identify the need for the study;
- Develop the aim and objectives of the study;
- Formulate the hypotheses and postulation;
- Identify the study area.

b) Literature review

Following the study inception, a comprehensive literature review was undertaken in order to:

- Establish a theoretical basis for the study in order to explain the relationship between local economic development and land value;
- Determine the shortcomings of existing research on the impact of transport on economic development, and how the findings of this study would extend the boundaries of the current pool of knowledge on the subject;
- Consider how practical knowledge in the field of logistics, and in particular location theory, can be combined with economic theory on the subject;
- Undertake an extensive review of the current economic evaluation procedures to assess how the findings of the study can be used in the economic evaluation of transport infrastructure projects.

c) Data collection

- Identify the industrial townships in the primary study area;
- Establish what data should be collected;
- Evaluate the potential sources of data and select the most reliable and comprehensive source of data;
- Capture the data in a database;
- Refine and enhance the data;
- Test the statistical significance of the data.

d) Data analysis and interpretation

- Compute the economic value of industrial land for each industrial township based on the shadow price method using the occupation rent data;
- Compute the accessibility cost for each industrial township in the primary study area;
- Establish the statistical relationship between the economic value of industrial land and accessibility cost;
- Build a model to predict changes in industrial land values if accessibility changes.

e) Presentation of data, research findings and results, as well as a practical application of the model in a case study.

f) Formulate conclusions and make recommendations based on the findings and results of the analyses.

1.5 Demarcation and definition of the study area

1.5.1 Primary study area

The primary study area is the municipal area of the City of Cape Town, excluding the Helderberg Administration district (Strand and Somerset West) and Atlantis. The exclusion of Atlantis was necessitated by the fact that it was created artificially as a decentralised Coloured township with an industrial component. Its location was therefore politically inspired rather than based on sound economic and land use principles. Strand and Somerset West were excluded on the grounds that they developed historically as satellite towns, similar to Paarl and Stellenbosch, rather than as suburbs of Cape Town. It is believed that their inclusion in the Cape Town municipal area was founded on political rather than economic reasons.

The reasons for selecting Cape Town as study area are as follows:

a) The general economic growth trend in Cape Town is consistently higher than the rest of the country (see <u>Section 3.6</u>).

b) The Cape Town CBD is the only major metropolitan CBD which has not been characterised by decay resulting from non-transportation factors (*Rode, 1994:9*). This could be attributed mainly to the fact that there is little low-cost housing in and around the CBD (due largely to scenic beauty in and around the CBD, which largely sheltered it from the negative effect of crime and degradation which is usually associated with such housing).

c) Cape Town has an advanced transportation network, including freeways and railway lines. It also has good direct national and international connections via air, sea and overland (see <u>Chapter 6</u> and <u>Figure 6.3</u>).

d) It is isolated from direct spillover influence of other major metropolitan areas. Its economy therefore operates largely independently from the other metropolitan areas, although it trades with the rest of South Africa in a similar fashion to which it would trade internationally, if there were no trade barriers and restrictions (see <u>Figure 1.1</u>).

e) It serves a vast but well-developed agricultural hinterland (see Figure 1.1).

f) It has a broad-base economy that is not centred on only one sector such as mining. The Cape Town economy includes services (tourism, financial institutions), manufacturing (textiles, agricultural produce) and agriculture (see Figure 3.2).

g) It has a high per capita income and education level compared to other provinces in South Africa (see Section 3.4).

h) Its CBD is not the geographical centre of the metropolitan area (see Figure 1.3).

1.5.2 Secondary study area

The demarcation of the secondary study area was based on the following criteria (*Van Zyl, 1999:12*):

a) The level of support that Cape Town provides to its immediate hinterland. In this context "support" is considered to be a combination of social, economic and administrative support. In terms of the classification put forward by Welgemoed (*1970:171*) Cape Town is regarded as a first–order town that could provide the full range of support services and facilities to its hinterland.

b) The proximity of other first-order towns. The closest first-order towns to Cape Town are Port Elizabeth and Bloemfontein. The boundaries of the secondary study area were therefore fixed by plotting concentric distance intervals for Cape Town, Port Elizabeth and Bloemfontein. The boundary points were fixed where the distance intervals intersect.

The boundaries of the secondary study area are depicted on Figure 1.1 and can be described as follows:

NORTH:	the Namibian border with South Africa along the Orange River;
WEST:	the west coast between the Orange River mouth and Cape Town;
SOUTH:	the south coast between Cape Town and George;
EAST:	a line between George and Kakamas passing through the towns of Beaufort West, Loxton, Carnarvon, Van Wyksvlei and Kenhardt.

1.5.3 External study area

This is the area with which the primary study area has direct interaction in addition to its immediate hinterland. Due to the fact that Cape Town has both an international airport as well as a major sea port, it has direct physical access to all the significant world markets. The economic development potential of Cape Town has therefore been assessed in terms of its good global accessibility.

1.5.4 Subject areas

The functional areas consist of a number of development nodes as defined in the Cape Town Metropolitan Spatial Development Framework (*CMC, 1998b:13*), external connection points (the port, airport or main external road connections), as well as the subject areas (industrial townships) for which the economic land value was determined (see Figure 1.3). The most important development node is referred to as the industrial accessibility node, which in the case of Cape Town was identified as the CBD development node and the Port of Cape Town. The location of the industrial accessibility node was confirmed through an empirical analysis process (see Chapter 6).

All the major industrial townships in the primary study area were identified for the purposes of the analysis process. However, some of the townships were excluded from the final analysis for a variety of reasons. All these exclusions are motivated in Chapter 5. The following are the reasons for basing the study on industrial land values:

a) Good accessibility implies lower generalised cost to reach other destinations. This directly affects the price of manufactured goods due to the fact that transport cost is a component of the production cost. This is the reason why industrial location is considered to be such an important cost consideration in the supply chain of products. An "exclusive", "upmarket" or "luxury" location with a lower level of accessibility would be more acceptable for office, retail and residential location than for industrial location.

b) Industrial production and manufacturing industry forms the basis for economic growth, particularly in developing economies, and it is therefore a major stimulus for further development. This is recognised by the government through the establishment of industrial development zones (IDZ), which focus on attracting and stimulating industrial development. The relationship between industrial output and economic development is thus far clearer than is the case with some other sectors.

c) In the context of development, industrial areas make more use of both high- and low-skilled workers. The location of an industrial area close to large supplies of labour will therefore provide jobs to those people, whereas the services sector often does not create the same range of employment opportunities to low-skilled workers.

d) Although not immune to crime, industry is not so much affected by environmental location attributes such as crime, scenic beauty and "address". It can therefore be expected that location choice is based primarily on the degree of accessibility. It is expected that the industrial location choice is more rational as it directly affects production cost.

e) Once industry has been divided into light industrial and heavy industrial, then industrial land use is fairly uniform.

f) Physical features play less of a role in the choice of site. Firstly, seeing that the age of the building structures do not play a major role, as long as the building is functional, there is no price penalty for age. Secondly, the demolition cost and construction cost of industrial buildings are therefore generally fairly low as in most instances they consist of steel structures.

g) The need for industrial accessibility has remained constant since the industrial revolution. That of office and, to a degree, retail accessibility has diminished because of the information age and improvements in telecommunications. Personal contact in the latter instances has become less essential, with the result that the distinction between workplace and place of living is diminishing. This trend will accelerate even more in the future.

1.6 Layout of the document

The dissertation has eight chapters. Chapter 1 deals with the preliminaries such as the need for the study, scope of the study, study methodology and demarcation of the study area.

Chapter 2 first provides a description of the concept "economic development" and outlines the findings of recent studies that have recorded the relationship between transport and economic development. Secondly, a number of economic evaluation techniques are assessed which measure the impact of transport and economic development, particularly the impact of industrial development at a local level.

Chapter 3 provides a historic overview of the role that transport has played in the development of the Western Cape in general and Cape Town in particular. Due to the fact that the phases of development followed international development trends, it is concluded that development in Cape Town will follow the global market era which is currently taking shape. It is therefore important to assess the importance of industrial development in the global market era. It is also important to take a long-term view of developments in the transport field. Lastly, a number of economic growth scenarios are developed for Cape Town to assess how the City will be able to cope with the socio-demographic challenges facing it in the next century.

Chapter 4 investigates the relations between land price and the economic development potential of land by providing an overview of land price theory. Attention is also paid to the factors that determine land price, namely the demand and supply of industrial land.

The process of determining the economic value of industrial land is described and undertaken in Chapter 5. This includes the collection and analysis of occupation rent of industrial townships in Cape Town, the calculation of property values and the calculation of the shadow price of land.

Chapter 6 describes the procedure of determining accessibility to industrial townships in Cape Town. Firstly, accessibility is defined in broad terms. This is followed by a discussion of each of the elements of accessibility, namely proximity, access and mobility in order to understand the factors that may impact on the level of accessibility. Finally, the level of accessibility is quantified in terms of the generalised cost of accessibility.

A regression analysis is undertaken in Chapter 7 to establish a statistical relationship between the economic value of land and accessibility. It was found that the relationship between economic land value and accessibility is explained by a linear function on which a model is based that would predict changes in land value if the accessibility changes. The model was then applied in a case study.

Finally, Chapter 8 draws conclusion and makes recommendations based on the findings and results of the study.

Demarcation of the Secondary Study Area

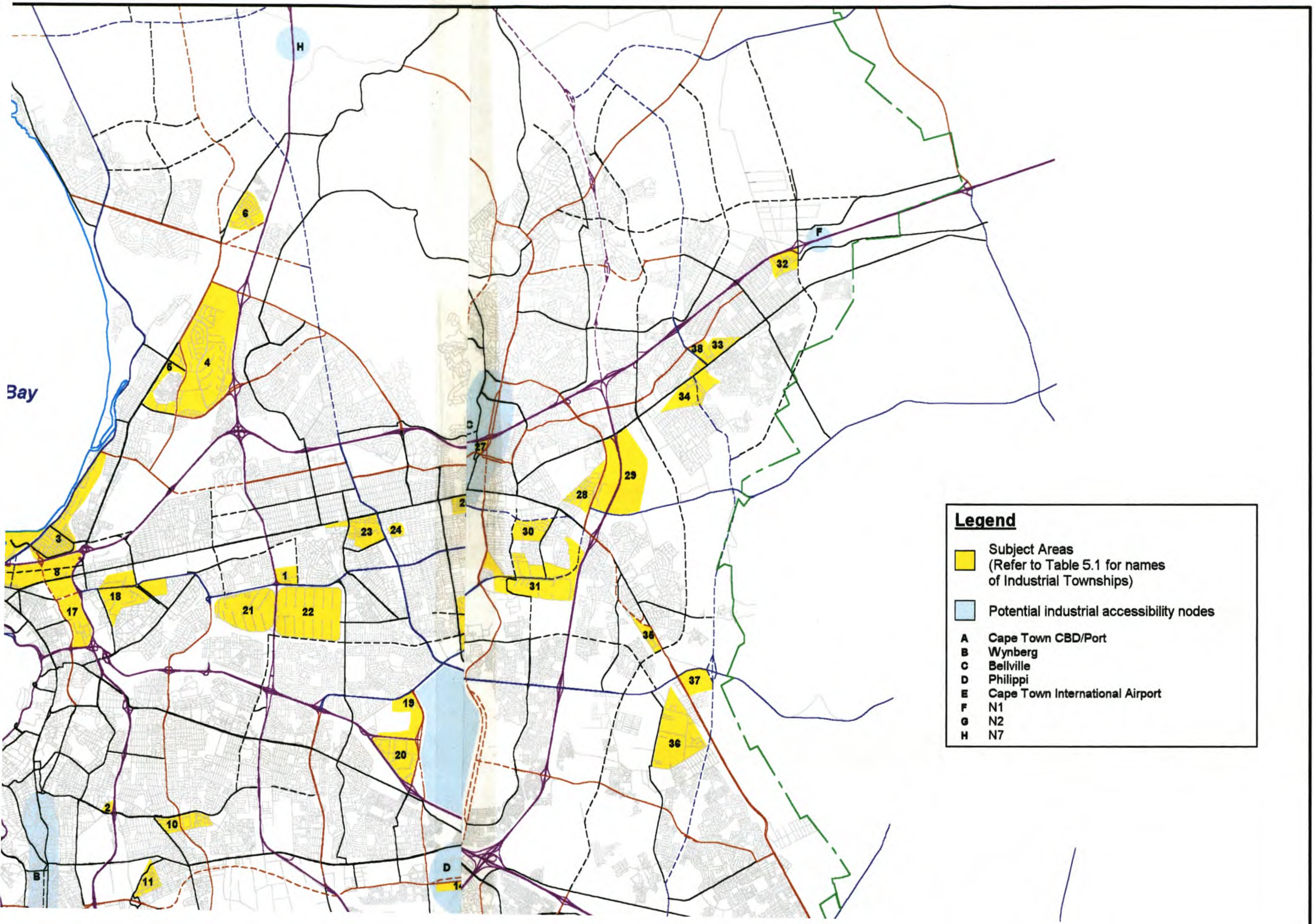
Fig. 1.1

PJS - 23.10.2002

Demarcation of the Primary Study Area

Fig. 1.2

PJS - 23.10.2002


Bay
Legend
Subject Areas
(Refer to Table 5.1 for names
of Industrial Townships)
Potential industrial accessibility nodes
A Cape Town CBD/Port
B Wynberg
C Bellville
D Philippi
E Cape Town International Airport
F N1
G N2
H N7

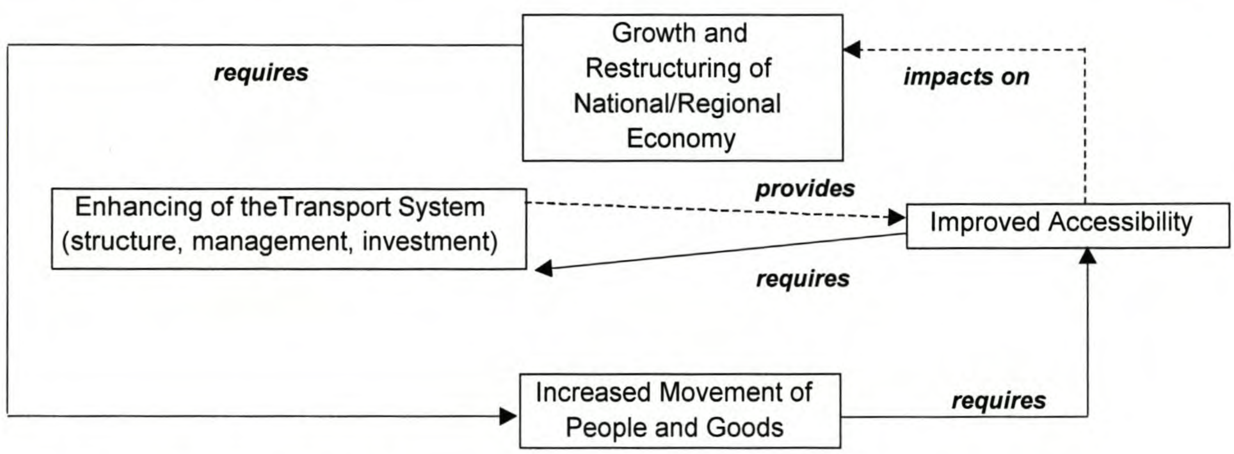
CHAPTER 2

MEASURING THE IMPACT OF TRANSPORT ON ECONOMIC DEVELOPMENT

2.1 Introduction

In order to understand the role of transport in economic development, transport should be viewed as being synonymous with accessibility. The concept of transport accessibility will be defined and quantified in Chapter 6. As illustrated by Figure 2.1 transport accessibility has a direct impact on economic development.

Figure 2.1: Interaction between socio-economic growth and overall accessibility



Source: City of Cape Town, 2002:1-1

Although the diagram illustrates a good conceptual relationship between transport accessibility and economic development, there are a number of issues that need to be addressed in this chapter. These issues can be summarised as follows:

- How do we define and measure economic development?
- Is there any empirical evidence to suggest that transport improvements lead to an improvement in economic development?
- What is the impact of an individual transport improvement at a local level, say on the development of an individual industrial township or land use pocket?
- Which evaluation techniques are available to calculate the impact of transport accessibility improvements and can one of these techniques measure the impact of transport on the economic development potential at a local level?

2.2 The meaning of development

For many years, particularly after the Second World War when many former colonies were liberated, economic development was viewed primarily as a growth in economic output. Economic growth is usually measured in terms of the year-on-year increase in the gross geographic product (GGP), where the GGP is the sum of the values of all goods and services produced in a region. In terms of this definition the output which is not reflected in national statistics, such as wealth that is generated in the informal sector, as well as the non-monetory benefits (externalities) which contribute to welfare, such as good housing and medical care to the impoverished, is not included in this definition. According to this narrow definition, economic development does not take the increase in population into account, with the result that growth in the total economy may not signify growth in output per capita. In other words, economic development occurs when the value of goods and services produced in an economy increases more rapidly than the population of that country or region.

Lombard, Sinha and Brown (*1992:9*) define economic development as the bringing of more business sales, employment, personal income and population growth to a region, which brings about other financial impacts such as investment in land development, which increases property values. Pienaar, however, pointed out that development of one region should not take place to the detriment of development in other regions of the country (*Pienaar, 1999:4*). An increase in property value can be seen as a direct result of an increase in economic development if there is a total net increase in the level of economic development both within and outside the study area. However, writing within the context of a developed economy, this increase in population mentioned by Lombard *et al (1992:9)* should be seen as an influx of skilled individuals which can add value to the economy. In developing economies an increase in population often has the opposite effect as the individuals who are attracted reduces the per capita income, as they do not have the necessary skills or entrepreneurial spirit to make a contribution to the economy.

It is also important to make a distinction between economic growth and economic development. Whilst economic growth means more output, i.e. it is concerned primarily with the increase in the economy's productive capacity and output, economic development implies both more output and changes in the technical and institutional arrangements by which it is produced. In other words, economic development is a wider concept that is also concerned with the improvements in the quality of life of the people living in the area.

Fromm (*1965:4*) defines the goals of economic development as follows:

a) Growth in the national income and an equal distribution of the income;

b) A growth in the variety of final goods and services to consumers, industry and government;

c) Development of an industrial structure that can earn foreign exchange and which can serve local markets;

d) Introduction and sustaining of high levels of employment.

In addition to the concepts "economic growth" and "economic development", there is also the concept of "development" to consider. The level of development in the urban context is often seen as an improvement in living conditions of various social groups, with a particular focus on the social and built environment (*Uduku, 1999:95*). These definitions of development are of little use in an empirical investigation as development is often measured by qualitative measures such as "improvement in urban quality" or "gentrification" to appraise the improvement in the status of the neighbourhood and the people living there (*Uduku, 1999:96*). The level of development is measured in terms of the Human Development Index (HDI). The HDI consists of three basic human development indicators, namely longevity, knowledge and standard of living. Longevity is measured by life expectancy, knowledge by a combination of adult literacy (two thirds) and years of schooling (one third). Standard of living is measured by purchasing power, which is based on GGP per capita adjusted for the local cost of living (*Roux, 2002:2-6*). The HDI indicates a minimum and maximum for each dimension which then indicates where a country stands in relation to these scales – expressed as a value between zero and one. Therefore, if the minimum adult literacy rate is 75 percent, the literacy component of the index is 0,75. In the case of life expectancy, the upper and lower boundaries are 25 years and 85 years respectively. A life expectancy of 55 years would therefore mean an index of 0,5. Income boundaries are between US$200 and US$40 000. The scores for the three components are averaged in an overall index.

Todaro (*1986:61*) views development as a multi-dimensional process that involves the reorganisation and reorientation of the entire economic and social system. It is therefore not possible to separate economic from non-economic phenomena when dealing with development (*Todaro, 1986:88*). Low income, low productivity and low levels of living are mutually reinforcing aspects of the same "circular and cumulative causation" (*Todaro, 1986:89*).

On the basis of the above analysis, a growth in industrial output would contribute directly to economic growth, economic development and development in general for the following reasons:

a) An increase in industrial output will lead to economic growth through an increase in the production of goods and services.

b) Goods can be exported to earn foreign currency. Employment in the industrial sector will also see a growth in income to workers, particularly to low-income workers, if good labour policies are being pursued. This would lead to an increase in the variety of goods available on the local market.

c) A growth in the industrial sector would have a direct impact on development because it will result in an increase in the GGP per capita. There is, however, also an indirect impact on development, as the taxes paid by industry help in the funding of government education and health projects. Industries also contribute directly to social upliftment through skills training (education) for workers and the provision of health care facilities and benefits to workers and their families.

2.3 The impact of transport on economic development

2.3.1 A theoretical perspective

According to Kraft (*1971:8*), the theoretical relationship between transport and economic development can be derived by means of two applications of the international trade theory. The first relationship is based on the trade theory of Ricardo, which states that growth in a particular region is directly related to the fact that regions will trade goods in which they have a competitive advantage. The volume and direction of the flow of goods between regions are determined by the fact that a region has a competitive advantage in the manufacture of goods, when it can produce those goods more cheaply than another region. This trade results in an international trade multiplier effect, which stimulates economic development.

The second application is the relationship between trade theory and location theory, which sees the cost structure of transport as a variable in the production process. Total cost of the product is determined by the production cost as well as the transport cost of goods. One region can thus obtain a competitive advantage over another if transport cost decreases, despite the fact that its production cost is higher. Once a region has obtained a competitive advantage, industries would also be more likely to locate there in order to take advantage of this competitive advantage, which encourages even more production. Kraft implies that the development of one region is directly related to its ability to market its goods outside its boundaries.

One of the major criticisms of trade theory as a basis for explaining the development of a region is the fact that the recent growth in many developed countries results from the growth in the service sector rather than the manufacturing sector. The argument is that growth in, for example, information technology (IT) is not dependent on the transport sector. According to Tiebout (*Kraft, 1971:9*), however, the quality of the service sector and the export (manufacturing) sector depend on one another. Computer-simulated and controlled just-in-time logistics practices require efficient transport linkages to allow predictable delivery times, almost to the hour (in industrial terms), in order to reduce the need for large stockpiles of input materials in the production process. Similarly e-commerce requires the prompt delivery of goods to consumers who order items via the World Wide Web. In both these instances it can be deduced that increases in productivity would not have occurred were it not for the availability of both the availability of technologically advanced information technology systems **and** highly efficient transport linkages.

It can be concluded that trade theory provides the best explanation for the relationship between transport and economic development and that the so called "big push" (or first development step) of a developing country can only occur by means of the establishment of an export base for manufactured or value-added goods through the gaining of an international competitive cost advantage.

2.3.2 Recent empirical evidence for the relationship between transport and economic development

The impact of transport on economic development is one of the most extensively researched and debated issues in the field of transport and development economics, particularly in the era after World War Two. Numerous studies have been conducted internationally by independent researchers and/or with sponsorship from development banks and aid agencies. In a South African context Aspeling studied the relationship between transport and economic development in the underdeveloped regions of Southern Africa. He identified three possible impacts that transport may have on economic development (*Aspeling, 1982:298*):

a) Positive – economic development takes place through the supply of transport;

b) Neutral – the opportunity cost of transport infrastructure is too high for it to result in a net investment benefit;

c) Negative – the supply of transport results in a decrease in per capita output.

Maasdorp studied eight Southern African countries and concluded that it would be in the interests of economic development if policies on international transport were to be formulated in terms of the underlying principles of economic efficiency (*Maasdorp, 1984:250*).

Ross (*1998:10.10*) investigated the impact of transport infrastructure on the development on Namaqualand. He concluded that transport improvements have been the result of economic development rather that a catalyst for them. However, once a transport facility has been provided, it has as a side effect made other developments possible. This illustrates the classic chicken-and-egg relationship between transport and economic development.

Although not always directly applicable to South Africa, the findings of a number of studies conducted abroad do provide an indication of the relationship between investment in transport infrastructure and economic development. One of the first empirical studies to determine an empirical relationship between transport investment and economic development was undertaken by the World Bank in Uganda. The results of this study clearly showed that the increase in agricultural production led to an increase in road building, not vice versa. Roads in this country did not "open up" new areas for cotton and rubber production, but the spread of these industries created a demand for the expansion of the secondary and feeder road network.

Similar empirical case studies were undertaken by Wilson, George, Bergman, Hirsch & Klein (*1966:174*) in Africa and South America during the 1960s, after the results of the initial post-war wave of infrastructure investment in developing countries would have had at least an initial effect on the economy. In a South American study, for example, they found that cotton production in El Salvador and Nigarqua increased well before the construction of the Pacific Littoral Highway (*Wilson et al, 1966:175*), suggesting that the need for improved transport networks follows an increase in production rather than stimulating it directly.

Currently one of the main proponents and providers of recent evidence of the link between investment in transport infrastructure and regional economic development is the American economist David Aschauer. Whereas the earlier studies focussed on determining the impact of specific large-scale projects on development, Aschauer compares historical time-series data of total investment in transport infrastructure and then compares it with the economic growth indicators over that period (*Aschauer, 1989:178*). Based on the findings of these studies, he proposes that public investment in physical infrastructure such as transport stimulates private sector productivity, increases profitability of firms and increases private investment (*Aschauer, 1989:199*). This impact on the micro-economic performance of the private sector can be attributed to the fact that transport provides productive services to firms in the form of reduced travel cost, including vehicle operating cost and time cost to both goods and people.

Aschauer bases his hypothesis on studies conducted mainly in the United States. As an example he (*Aschauer 1993:380*) sites the period during the 1950s and 1960s when the increase in public stock increased with a corresponding increase in the labour productivity growth rate. The peak of this increase occurred in 1968, after which the growth rate in public stock declined with a resultant decline in the rate at which labour productivity increased. He implies that a one percent increase in public capital stock will increase private sector output by a third of a percentage point.

Others (*Nadiri & Maimuneas, 1996*) found evidence of causation in both directions, i.e. it could have been the growth in labour productivity which stimulated investment in public infrastructure. They asked the question why a slowdown in public spending caused a decline in the growth of labour productivity but not in other capital stock such as office buildings, hospitals and schools.

Based on a general equilibrium model where cities with many industrial sectors are linked with a transport network, it was found that a reduction in transport cost improves the welfare of people, especially when it leads to a change in the industrial structure and the size of the city (*Mun, 1996:220*). Pienaar (*1981:13*) suggests that the place and time utility created by transport infrastructure is such an essential component of economic activity that it can almost be regarded as a fifth factor of production after labour, land, entrepreneurial skills and capital.

Cox (*1996*) summarises the findings of a number of the more recent studies conducted elsewhere in the world which provide an indication of the relationship between investment in transport infrastructure and the economic development of a region. These research findings suggest that, even though transport improvements alone are unlikely to result in significant economic benefit, there is strong evidence that if investment in transport is combined with other essential elements for development, the following benefits are likely to be achieved:

a) Public investments in transport and communication networks are important ingredients in promoting economic growth. This statement is supported by two independent studies, including a World Bank analysis of East Asia, which suggests that growth has been strongly supported by public investment in transport infrastructure, whilst another study shows that paved road lengths in most countries have increased roughly in proportion to their economic activity.

b) An increase in transport infrastructure decreases the cost of industrial production. In the industries that were studied, this decrease in the cost of production in turn led to an average increase in industrial output of about 1,2 percent for every 100 percent increase in transport infrastructure expenditure. In addition, a study conducted in the United States has found that investment in roads has about twice the effect on private sector efficiency than investments in social infrastructure, such as housing.

c) Public and private investments are highly complementary. However, although there is a strong influence of public investment on private investment levels, public capital shows almost no response to increases in private output. There is evidence from the United States, Europe and other countries that government expenditure which is directed towards investment in core infrastructure such as water, transport and communications services can and does increase the productivity of the private sector. Another study also indicates that public capital in those countries has been consistently under-funded since 1980. It was estimated that since 1990 any additional investment transferred from the private to the public sector would have increased business returns by a factor of 1,25. In addition, the social rate of return from these infrastructure investments should be even higher than the results of macro-economic studies suggest.

d) Investment in transport infrastructure improves the trading performance and economic competitiveness of a country. The reduction in transport costs allows firms to be competitive and to develop trade, both locally and internationally. The fact that firms are able to specialise allows them to reap the benefits of economies of scale.

From the above theoretical perspective and empirical evidence it can be concluded that transport plays a key role in the achievement of development objectives. Economic development will not take place if the transport network and services are inefficient; however, the provision of an elaborate transport system alone is not a guarantee for sustained economic development. This has lead Owen (*1964:19*) to proclaim that "transport, then, is a necessary but not a sufficient condition for economic development".

It should also be considered that economic growth is normally measured statistically for each year, whereas investment in transport infrastructure is usually incurred to provide capacity for a nominal period of 20 years or more. The establishment of a relationship between transport investment and economic growth would therefore be meaningless if allowance is not made for the lag between the time of the investment and when the economic influence occurs. This would complicate the accuracy of the measurement as it is very much project or area specific, and it increases the impact of external influences.

2.3.3 Summary

The role of transport in economic development can be placed in the following four categories.

Firstly, transport bridges the geographical location gap between the different factors of production; in other words, it acts as a **catalyst for economic development**. As a catalyst transport per se does not stimulate development, but if all the other production factors, namely entrepreneurship, labour, land and capital, are present then transport would provide a bridge between the geographical separation of the production factors. However, in the more developed economies the emphasis on transport in the development process has progressed from merely the provision of a link to improvements to the transport linkages in order to achieve increasing levels of efficiency in the production process. It is in this context that the transport network of a region needs to be assessed, together with the availability of other factors of production as well as its level of economic development, especially in determining whether or not, as well as the extent to which, transport is creating a bottleneck in the development process.

Secondly, transport fulfils a **social role** in the provision of access to facilities such as health care and education.

Thirdly, transport fulfils a **private role**. People need to interact with one another, with the surrounding environment, recreational amenities as well as educational and health care facilities. The private function of transport is therefore important in achieving the broader developmental goals.

Lastly, transport has a **public role** in the advancement of the political process, social and cultural awareness and national defence.

2.4 Techniques to calculate the expected impact of transport on economic development

Despite the shortcomings in the empirical studies on the relationship between transport and economic development, it can safely be concluded that transport does have a significant role in the development of a region. However, the main criticism against these studies is that they at best provide an autopsy of events that have occurred in the past and provide little if any clues as to the impact of a proposed investment in transport. For this purpose various techniques have been developed to assess whether an investment in a specific transport improvement is warranted given its cost and benefits, what the impact of this investment is compared to other proposed investments, and how an investment in transport compares to investments in other non-transport infrastructure projects.

In order to make such assessments a variety of models and methodologies have been developed to estimate the economic impact of projects. Following is a list of the most commonly applied models, followed by a concise description of each model, the procedure which it uses to calculate the economic impact and an appraisal of the methodology:

- Multiplier analysis
- Cost-benefit analysis
- Input-output models
- Location theory
- Inter-regional programming
- Opportunity value method.

2.4.1 Multiplier analysis

2.4.1.1 Background and description

Multiplier analysis is based on the work by Keynes (*Miernyk, 1957:42*) which postulates that external investment in the economy will increase consumer expenditure, which is then re-invested over a number of consecutive investment cycles. The amount by which the consumer expenditure increases is, however, smaller than the investment during that particular cycle, so that the investment of the next cycle is smaller than that of the previous one. The reason for this is that investment funds leak from the circular flow of income and are not spent because individuals and firms use some of the funds for savings, tax and for imports. The number of times that an investment amount is thus recalculated in the economy is called the multiplier and is dependent on the particular community's marginal propensity to save, marginal propensity to import (export funds) and the marginal tax rate.

2.4.1.2 Estimation of the multiplier

The procedure for calculating the economic multiplier is based on the theory of national income (*City of Cape Town, 2002:B-1*) and on the notion that the additional income generated by an investment in transport infrastructure will exceed the initial amount invested. An investment in transport would give rise to a multiplier effect when a portion of the invested amount is reinvested in the economy through the purchase of goods and services. Retailers would again invest some of their takings and so forth, with the result that the initial investment is reinvested during a number of expenditure cycles. The number of cycles during which investment occurs is referred to as the investment multiplier. The fiscal multiplier with fixed investment describes the relationship between the investment expenditure and the change in regional income that it generates (*Musgrave & Musgrave, 1989:500*). A clear distinction should be made between the economic multiplier, which is project specific, and the economic accelerator, which is region specific (see Section 2.4.3.1 for a more detailed description of the accelerator effect).

As was mentioned above, not all income is reinvested during the following expenditure cycle due to the fact that funds are leaked out of the expenditure cycle, which causes the amount available for reinvestment to decline during each successive cycle. These leakages are identified by Pienaar (*City of Cape Town, 2002:B-5*) as being (1) taxation, (2) financial savings, and (3) imports. The tax rate, import level and savings practices of a community therefore have a direct bearing on the multiplier, as it would determine the amount available for reinvestment.

According to Pienaar (*City of Cape Town, 2002:B-5*), the regional income multiplier can be formulated as follows:

$$M = \frac{1}{1-(1-T)(MPC-MPI)} \quad \text{.......(2.1)}$$

where

M = regional multiplier;

T = taxation payments included in the investment amount, expressed as a ratio of the total investment amount;

MPC = marginal propensity to consume $(=1-MPS)$;

MPI = marginal propensity to import

MPS = marginal propensity to save

(Note: *T, MPC, MPI* and *MPS* are project-specific. Equation 2.1 implicitly assumes that all the project-specific marginal propensities also pertain to the country or region.)

The net additional one-off regional income stemming from autonomous investment in a region is equal to the product of the investment amount and the value of the regional multiplier, minus the investment amount (*City of Cape Town, 2002:B-6*) The present worth of this income (EM_0) is formulated as follows:

$$EM_0 = C_A \times (M-1) \quad \text{.......(2.2)}$$

where:

EM_0 is the present worth of the net additional one-off regional income stemming from an autonomous investment in transport infrastructure;

C_A is the present worth of the investment amount;

M is the regional income multiplier of the investment.

By adding the recurring benefits which are generated by induced traffic to the one-off regional income stemming from the investment in transport, the present worth of the overall increase in economic development can be calculated by means of the following equation:

$$EA_0 = \sum_{t=k}^{n} \frac{EA_t \times (M-1)}{(1+i)^t} \quad \text{.....(2.3)}$$

where

EA_0	is the present worth of the additional regional income emanating from accelerated economic activity during the analysis period;
EA_t	is one-half of the saving accruing to each journey on the new facility undertaken by existing users in year *t* multiplied by the number of induced trips in year *t*;
M	is the regional multiplier (calculated by using Equation 2.1);
i	is an annual rate of discount expressed as a decimal fraction;
k	is the first year of operation (i.e. the year following the end of the construction period);
n	is the number of years in the analysis period;
t	is any particular year in the analysis period.

2.4.1.3 Appraisal of the technique

There are two main constraints in the above approach:

a) The calculation of the recurring increase in economic development is based on the amount of induced traffic that is generated by the improved transport facility. Therefore, the amount of induced traffic is directly related to the increase in economic development. An assumption about the impact that the improved transport facility will have on economic development has to be made before the induced traffic is determined. This results in some form of circular reference, which means that induced traffic per se cannot be regarded as an objective measure to estimate economic development.

b) The smaller the study area the more difficult it becomes to keep track of resource inflows into the area and of expenditure outside the area. Multiplier analysis of smaller regions, such as an individual township or land use pocket in an urban area, is therefore not feasible, which means that it is restricted to provincial and national levels and cannot be considered for the evaluation of developmental impact at a local level.

2.4.2 Cost-benefit analysis

2.4.2.1 Background and description

Cost-benefit analysis is a comparison of total resource project cost and benefits over the life of the project to the economy as a whole and to the community directly involved.

The overall objective of the economic evaluation of transport projects is to help select an efficient transport investment plan both for the economy as a whole and for communities directly involved. This type of evaluation is concerned with the assessment of justification for a project implementation (it should not be seen as a means to justify the proposed improvement), and assessment of the relative worth of projects. It may be regarded as a guide or an aid to the decision-making process, thereby helping to ensure that public funds are spent judiciously.

While the economic evaluation is primarily concerned with quantifiable (tangible) consequences of implementation of transport projects, this does not imply that the intangible consequences are unimportant. However, the latter consequences, including all the other economic and social factors (such as the likely impacts on industrial and trade development, employment, land values, natural environment, etc.), are considered separately and given such weight as the decision-maker may consider reasonable. These considerations may in some cases be of equal importance in reaching a decision, but they should always be considered in conjunction with the results of the economic evaluation.

2.4.2.2 Evaluation techniques

2.4.2.2.1 Overview

The techniques used for cost-benefit analysis are all based on the principle of discounted cash flows analysis. The four most common techniques are:

- present worth of cost (PWOC);
- net present value (NPV) technique;
- benefit/cost ratio (B/C) technique;
- internal rate of return (IRR).

The PWOC technique determines the minimum total transport costs, whilst the NPV technique determines the net benefit. The relative economic benefit of the project is determined by either the B/C ratio technique or the IRR technique. In the case of the PWOC technique, only the cost of each alternative is calculated, with the result that the alternative with the least cost would be superior. In the case of the NPV, B/C ratio and IRR both benefits and investment costs of project alternatives are calculated.

The following is a more detailed description of the above techniques as provided by Pienaar *(City of Cape Town, 2002:2-19)*.

2.4.2.2.2 Present Worth of Cost (PWOC) Technique

This technique selects the lowest cost alternative among mutually exclusive projects. All economic costs (i.e. the opportunity costs) associated with the provision, maintenance and use of each possible alternative project are discounted to their present worth. Given the objective of economic efficiency, the alternative that yields the lowest PWOC is regarded as the most beneficial proposal. This method can be expressed as follows:

$$PWOC = \sum_{t=0}^{j} \frac{C_t}{(1+i)^t} + \sum_{t=k}^{n} \frac{(M+U)_t}{(1+i)^t} \qquad (2.4)$$

where:

PWOC is the present worth of cost;

$\sum_{t=0}^{j} \frac{C_t}{(1+i)^t}$ is the present worth of all project implementation costs;

$\sum_{t=k}^{n} \frac{(M+U)_t}{(1+i)^t}$ is the present worth of all facility maintenance costs and user costs.

(Note that in the case of the null alternative, PWOC = present worth of facility maintenance costs and user costs only. This is due to the fact that the investment tied in the existing facility is regarded as sunk.)

When a proposed project will, due to lower user cost, induce additional traffic over and above normal-growth traffic, the above-mentioned criterion of lowest total transport cost presents a contradiction in terms. Any induced traffic will increase the facility's PWOC, thus defeating the objective of minimum cost.

2.4.2.2.3 Net Present Value (NPV) Technique

This technique provides an economic performance measure that is used to select the best alternative among the mutually exclusive projects.

Net present value (NPV) is a technique whereby the present worth of investment cost (= C) is subtracted from the present worth of all future project benefits (= B) (i.e. annual savings relative to the null alternative plus the consumer surplus gained through additional usage induced by the proposed facility). The present worth of both costs and benefits is calculated by using the official social discount rate. All projects reflecting a positive NPV are economically viable, while the project alternative with the highest such value is most suitable for implementation as this will maximise net benefit for society as a whole.

The technique can be expressed thus:

$$NPV = \sum_{t=k}^{n} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{j} \frac{C_t}{(1+i)^t} \quad \text{.........(2.5)}$$

where:

NPV is the net present value of benefits;

$\sum_{t=k}^{n} \frac{B_t}{(1+i)^t}$ is the present worth of benefits.

2.4.2.2.4 Benefit/Cost Ratio (B/C) Technique

This technique provides an economic performance measure that is used for the selection of the most advantageous project(s) by determining the ratio between the present worth of the future project benefits and the present worth of the project investment costs. (Each year's benefit is calculated in the same manner as is done with the NPV technique.)

All proposals with a ratio value greater than one are viable, while the one with the highest ratio value is economically the most advantageous. However, when mutually exclusive projects are compared, incremental analysis must be used to identify the best alternative.

The method can be expressed as follows:

$$B/C = \sum_{t=k}^{n} \frac{B_t}{(1+i)^t} \Big/ \sum_{t=0}^{j} \frac{C_t}{(1+i)^t} \quad \text{.........(2.6)}$$

where:

B/C is the benefit/cost ratio.

2.4.2.2.5 Internal Rate of Return (IRR) Technique

This technique provides an economic performance measure that is used for the selection of the most advantageous project relative to the null alternative. The distinctive feature of this technique is that its application does not entail a singular discounting procedure with one official rate only. Future benefits ("returns") for the period under review are discounted to the beginning of the period. (Each year's benefit is calculated in the same manner as is done with the NPV and B/C techniques.) The sum of these discounted amounts is compared with the discounted project investment cost. Different rates of discount are selected iteratively and applied until at a certain rate the sum of the annual discounted returns equals discounted investment costs. This rate is then referred to as the internal rate of return.

The project with the highest internal rate of return can be regarded as the most advantageous, although the actual criterion is to compare the rate thus obtained with the opportunity cost of capital as represented by the prevailing real or social discount rate. If it exceeds the prevailing social discount rate, the alternative is economically viable. However, when mutually exclusive projects are compared, incremental analysis must be used to identify the best alternative.

The method can be expressed as follows:

IRR = *r*

when $$\sum_{t=k}^{n} \frac{B_t}{(1+r)^t} = \sum_{t=0}^{j} \frac{C_t}{(1+r)^t} \quad \text{.......(2.7)}$$

where:

IRR is the internal rate of return;

r is the rate at which the left-hand and right-hand sides of the equation are equal.

2.4.2.3 Appraisal of the technique

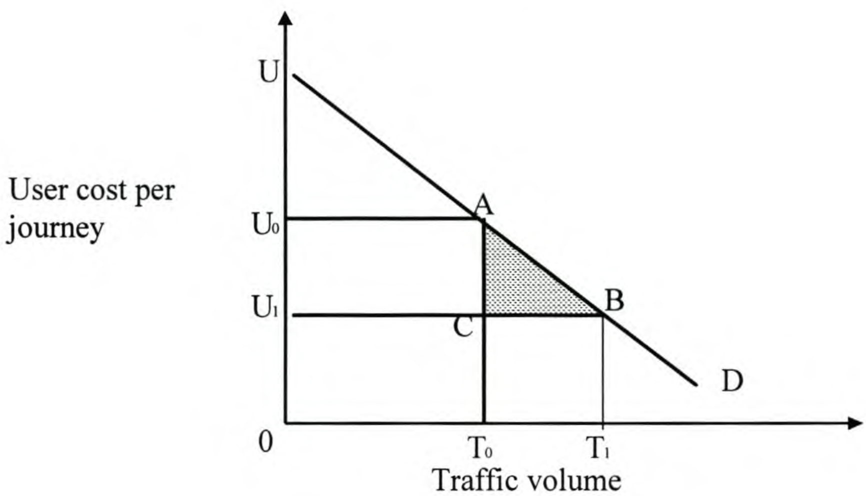
Cost benefit analysis is the most widely applied of all the evaluation techniques throughout the developed and developing world to evaluate transport projects. Various guideline documents and computer software programs have been written to standardise and automate the procedures and techniques. However, when assessing cost-benefit analysis as a tool to determine economic development, it is found to suffer from a number of constraints.

a) Cost-benefit analysis itself cannot take into account the entire range of economic impacts that can be generated as a result of the investment in transport infrastructure. This has led the Leitch committee in the United Kingdom to conclude that there is a need to complement cost-benefit analysis with other types of analyses (*Asensio & Roca, 2001:388*). This view is supported by an evaluation of Barcelona's fourth ring road, which shows an internal rate of return of below the benchmark six percent, but if the macro-economic impact is included the gross domestic product increased by 241 500 million pesetas (*Asensio & Roca, 2001:401*).

b) Benefits are based on a decrease in transport cost. It is assumed that this increases the consumer surplus, which is true. However, this is not a good measure of the level of economic development as the increase in income to road users could be leaked directly out of the economy through increased imports of luxury consumer goods. It is therefore no guarantee that reduced transport cost would lead to an acceleration of economic growth.

c) In the case of generated traffic, the assumption is made that demand for a transport facility is represented by a linear demand schedule, half of the benefit accruing to each existing journey is added to the project benefits for each newly generated trip, the so-called rule of half as illustrated by the triangle ABC in Figure 2.2.

Figure 2.2: Benefits to generated traffic in respect of a new or improved facility



However, as stated in Section 2.4.2.3 (b) above, the estimation of the generated traffic volume is based on the traffic volume which is generated by the increase in economic development. In other words, an assumption has to be made about the impact of the transport improvement on economic development **before** the generated traffic can be determined. The impact of the investment on economic development cannot be measured by the generated traffic method unless the analyst is absolutely sure of the exact number of additional trips that will be generated by new developments once the transport improvement is made **and** that these new developments will not occur if the transport improvement is not made.

2.4.3 Input-output models

2.4.3.1 Background and description

Input-output models determine how a stimulus that is provided by an external source filters through the economy, based on the interdependency of the various sectors of the economy. Although input-output models mainly deal with either a single region or are inter-regional in character, it is also possible to set up an input-output table for a single sector. It could therefore be used to indicate how the provision of transport stimulates economic growth. This method was pioneered by Leontief in the 1930s and is used not only for the storage and display of information, but above all as a tool to analyse the restructuring of the economy (*Leontief, 1986: 21*). During the 1960s and 1970s literature on input-output models was dominated by discussion of the survey-non-survey methods for the construction of input-output tables (*Dewhurst, Hewings & Jensen, 1991:2*). The 1980s saw a substantial investment in the development of new approaches in the handling of some of the major constraints, as well as the development of techniques to integrate input-output models with other types of modelling systems (*Dewhurst et al, 1991:1*).

Transport benefits usually occur in the form of less capital outflow and/or greater inflow of capital from either an increase in cost savings to existing firms, or from direct outside investment in the region. It is to be expected that the inflow of capital will encourage further spending of surplus funds that do not leave the region's economy in the form of savings, taxes, or payment for imported products from other regions, thus creating an accelerator effect. In brief, the accelerator effect stems from the fact that government spending on capital goods such as transport infrastructure not only leads to an increase in income due to the multiplier effect, but it would also encourage further investments, often from the private sector. Each of these investments would in turn be subject to a multiplier that will move the entire system towards a new income equilibrium (*Musgrave & Musgrave, 1989:529*). This knock-on effect is particularly evident in the case of transport investment, because transport is a derived demand for other goods and services. One of the primary objectives/benefits of investment in transport infrastructure is the stimulation of private sector investment. It is therefore essential that an inflow-outflow model that forecasts the relationship between transport and economic development should consider both the multiplier effect and the accelerator effect of transport interventions on the economy.

2.4.3.2 Procedure

Few input-output models have been developed specifically for transport interventions, with the consequence that the procedure has not been refined to provide a very accurate level of detail for general use. One of the most comprehensive attempts at developing an input-output model was undertaken for the National Transport Policy Study (*Department of Transport, 1984:28*). This input-output model was used to estimate, amongst other things, the impact of investment in transport on a range of issues such as labour cost, cost of materials, price of capital and inflation. Unfortunately the model was too generic to forecast the impact of transport on economic development of specific transport interventions accurately.

More recently an input-output model was developed by the author to establish the economic development impact of upgrading the gravel road network in the West Coast District of the Western Cape Province. It would be useful to explain the complexities of calculating the economic development impact of transport by means of a brief description of this case study, as it will explain why the author has become aware of the need for a model to forecast the relationship between transport and economic development more accurately.

The development of the model followed the following steps (*Botes, 2000:19*):

Step 1: Compile a socio-economic profile of the study area

All the socio-economic data and information required for the compilation of a socio-economic profile were in this case available from existing reports and databases. A number of studies have recently been undertaken on the transportation, spatial planning, demography and macro-economic environment of the West Coast District. The socio-economic profile and opportunities could therefore be largely based on existing reports. Base data from the above sources were verified and supplemented by selective surveys.

Step 2: Identify the main sources of direct investment

Based on the economic opportunities identified from the socio-economic profile of the study area, the following sources of direct investment were identified:

- Construction and maintenance of the road network;
- Improvement in the quality of agricultural produce, as well as the increase in production due to certain minimum levels of quality attained;
- Construction of holiday and retirement homes;
- Savings in transport cost;
- Increase in tourist spending.

Step 3: Quantify the economic benefits for each economic sector

Because it is standard practice to subdivide the economy of a region into a number of economic sectors when calculating and presenting the impact of an increase in direct investment on growth, the following discussion of the potential macro-economic benefits is presented according to economic sectors as follows:

a) Agriculture

The main benefits of upgrading the roads in the study area is the improvement in the quality of agricultural produce and the increase in production of produce due to greater accessibility to markets.

b) Mining

It is not expected that the improvement of the road network will have a direct impact on the mining sector. Experience shows that mining will be developed irrespective of the condition of the road network for two reasons. Firstly, mines often make use of dedicated transport links, which they provide as part of the development of the mine. Secondly, it is often uneconomical to transport mining produce by road over longer distances due to the high bulk and low value of the product.

The Namaqua Sands mine in the study area, for example, makes use of the Sishen-Saldanha rail line to transport ore to Saldanha. For the same reason it is not expected that the development of a gas field along the coast will be stimulated as a result of the proposed road upgrading.

c) Manufacturing

Reduced transport cost will increase the competitive advantage of local agricultural and fish-processing industries. This will increase the productivity of existing establishments and will serve to expand existing operations and attract additional industries to the study area.

d) Electricity, water, gas

Although there may be some improvement in the service delivery, it is not expected that there will be a major improvement in this area if the roads are upgraded. Since plans for the construction of more conventional nuclear power stations on the West Coast have been abolished, the impact of road improvements on electricity production has also been nullified.

e) Construction

Provided that local contractors undertake construction with as little importation of production factors as possible, upgrading of the road network is expected to have a major direct and indirect impact on the construction sector in the study area.

- The area will benefit directly in the short term from the investment required to undertake the planned upgrading and improving of the road network.

- As a result of the improvement in the road network, the area will become more attractive to residents elsewhere as a holiday and retirement location. Holiday and retirement homes for outsiders are built almost entirely with funds earned elsewhere, thereby increasing the level of direct investment in the area.

f) Trade

Four factors were considered in determining the impact of road construction on retail and wholesale trade in the study area:

(i) Increases in the number of tourists and permanent population (mainly retirees) will stimulate spending on household goods. This will have a considerable positive impact on the trade sector.

(ii) Road improvements often cause a reduction in retail and wholesale spending in small rural settlements. The decline in retail opportunities in many smaller rural towns during the past 50 years bears testimony to this. Larger centres can offer a wider variety of goods at more competitive prices. Improvements in the road network make these centres more accessible, with the result that business declines in smaller towns. This potential negative impact of the proposed road upgrading on trade should therefore not be ignored and has been taken into account through a possible increase in capital outflow from the area.

(iii) Some distribution effect may occur if through traffic is diverted from other routes. Money spent at roadside enterprises on other routes merely redistributes to the upgraded routes. This redistribution from outside the study area was taken into account as an increase in investment. Otherwise it was regarded as merely redistribution within the study area, which does not impact on local economic growth.

(iv) A reduction in the transportation costs of goods will have a positive impact on trade insofar as the savings in transport costs are forwarded to retailers in the form of reduced wholesale prices. However, care was taken not to double count some of these benefits. Only savings resulting from cost reduction by transport carriers based outside the study area were included, because savings in transport cost by local firms are included in the transport sector and not the retail sector of the local economy.

g) Transport, communication, storage

Benefits to the transport industry are directly related to decreases in transportation costs due to the upgrading of roads. The reduction in transportation costs was based on the output of the micro-economic evaluation from HDM 4 (*World Bank, 2000a*). Transportation costs were only taken into account insofar as they directly benefit the local economy. For example, savings in vehicle running costs for through traffic would have no positive effect on the local economy and were therefore specifically excluded. Care was also taken not to double count some of these transport cost savings.

h) Financial

The increase in the number of permanent and semi-permanent residents in the area will benefit the financial sector, as demand for financial and legal services will increase. Estate agents may also experience an increase in business as the demand for holiday and retirement accommodation takes off. Banking services to tourists may also experience growth.

i) Community, social

The social sector will benefit from increased accessibility to schools and medical care facilities.

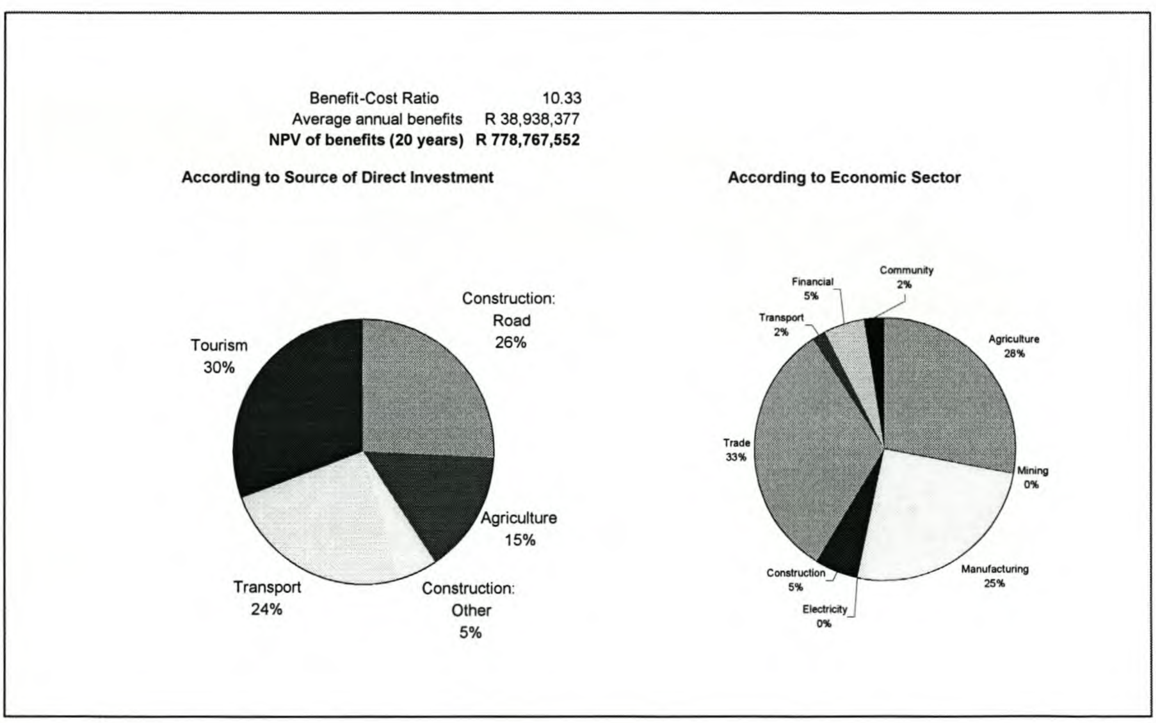
Step 4: Model development

The model was developed with the aid of a macro-economic input-output model which was developed on a spreadsheet platform. The economic impact of changes in the economic environment, such as the decrease in transport cost, can be followed through the various sectors of the economy. The model thus calculates the net growth in economic output that occurs as a result of the improvement to the road network. Due to the fact that many of the benefits will only be realised in the medium to long term, benefits were discounted over an evaluation period of 20 years and presented in terms of a net present value.

Step 5 Output of the model

The output of the macro-economic input-output model is summarised in Figure 2.3. The chart provides the overall impact of the road upgrading programme over 20 years, the average annual benefit, as well as the benefit-cost ratio of the upgrading and maintenance of roads in the study area. Overall benefits are presented according to (a) the source of direct investment and (b) the contribution made to each sector of the economy.

Figure 2.3: Results of the input-output model of the West Coast Gravel Road Improvement Project



The source of investment and the growth in an economic sector, which are merely different methods of presenting the same overall economic impact, should therefore not be confused. For example, the increase in tourism spending (a source of investment) would filter through the economy, where it would lead to growth in mostly the trade sector, but also to some extent on the transport, construction, agriculture, and manufacturing sectors. Similarly, the fact that transportation costs decrease (a source of investment) may have a small impact on the transport sector, which reflects the profitability of local transport hauliers. However, it will have a major impact on the manufacturing and agricultural sectors, as it will reduce overall production cost in these sectors.

The following is an interpretation of the macro-economic results of the West Coast Gravel Road Improvement Project in Figure 2.3 and presented in the accompanying pie diagrams.

a) The high benefit-cost ratio of 10,33 is an indication that the investment in the road improvements will be highly efficient.

b) Investment in the road network in the study area will have a considerable impact on economic development in the study area. Considering that the GGP of the West Coast District amounted to almost R7 200 million in 1999, the road upgrading programme is expected to raise the current economic growth rate by as much as 0,5 of a percentage point from the current 3,8 percent per year to 4,3 percent per year.

c) Tourism is potentially the biggest source of direct investment into the economy of the study area, followed closely by construction (mainly road construction), transport (road user benefits) and agriculture. Due to the large impact of road construction on economic development, it is important that local labour and contractors be used for the upgrading of roads. This will ensure that most of the investment in roads remains in the economy of the study area.

d) Studies done locally and abroad indicate that traffic growth is at least on a par with the economic growth rate of a region and often exceeds it, sometimes by a considerable margin. As a low scenario it can therefore be assumed that upgrading of roads in the study area will increase current traffic volumes on all the routes in the study area by a factor of at least 1,11. This excludes traffic that is diverted from routes outside the study area.

e) There is a lack of key macro-economic indicators. For example, the actual GGP of the West Coast Region is not supplied in any of the recent studies undertaken. There is no mention of the amount which tourists spend during a visit to the study area, or the duration of tourist visits to the area.

2.4.3.3 Assessment of the technique

The main benefits of the input-output models are the focus which they place on the interdependence of the different sectors of the economy. They therefore provide insight into how one sector of the economy is affected by another by tracking external influences throughout the economy. They could thus be applied to show the effect on the economy if transport improvements are made on the basis of an analytical procedure, as opposed to merely assuming that the same correlation between transport and economic development is applicable to all transport improvements.

However, the main disadvantages of the models are as follows:

a) The causal relationship between transport and economic development is an input to the construction of the input-output tables, rather than an output of the model. In other words, the demand multiplier coefficients of transport need to be determined and provided as an input to the model in order to estimate the changes in the final demand (*Dewhurst et al, 1991: 161*)

b) They suffer from the same constraint as multiplier analysis in that they can only be applied to a larger region. They are thus unsuitable for estimating the impact of transport on the economic development at a local level.

c) Factors such as the business cycle influence the short-term accuracy of the models, which means that they should ideally only be used for long-term projection (*Department of Transport, 1984:56*).

d) The models assume a particular equilibrium situation in the economy in which production capacity is fully utilised and there is a given comparative situation with other countries (*Department of Transport, 1984:56*).

e) Models are often unable to reflect the diminishing return of additional investment. The impact of a transport investment programme of R200 million on the economy of a region will not necessarily have twice the effect as a R100 million investment.

2.4.4 Location theory

2.4.4.1 Introduction

A number of techniques have been developed to assist in the decision for locating an industry. These theories should be distinguished from urban structure theories. Location theories therefore focus on the location decision process of the individual firm in terms of micro-economic theory, whilst the urban structure theories are concerned with what the combined impact is of all location decisions on the urban form. The understanding of the location decision process of an individual firm as well as urban structure theories provides an important background for the primary focus of this study, which is to determine the development potential of a particular pocket of land and to what extent that potential can be advanced through the provision of transport infrastructure. The reason for this is that location theories are all to a lesser or greater extent based on the assumption that transport cost plays the dominant role in industry location choice. Whereas this may be an obvious assumption, the exact weight to attach to transport cost is not known.

2.4.4.2 Classic location models

The German analyst J.H. von Thunen was one of the first to develop a theory on the location of facilities. Being an agriculturalist, he was mostly concerned with the location of agricultural production points (*Macmillan, 1982:274*). In the formulation of his theories he made a number of assumptions that should be considered in the impact of transport on location choice:

- He assumed a centrally located isolated city surrounded by land with equal accessibility to transport;
- Transport has a linear relationship to weight and distance;
- Transport cost is constant per ton-kilometre;
- All items can be produced everywhere at the same input cost;
- Profit to the farmer is equal to the market price of the products minus production cost minus transport cost. Given that land cost is a direct input cost to the production cost, the farmer will be willing to pay as much land rent which will optimise his profits. Production will therefore take place where he can make the highest profit with his products;
- Labour is freely available everywhere and at the same price.

Assuming that the supply of any specific piece of land is fixed, its development potential would be determined exclusively by the demand to develop on that particular piece of land. That demand is determined by a number of factors that are unique to that particular piece of land. The location of industries should be seen in the context of the three primary activities, namely:

- The procurement of raw input materials;
- Processing of the raw materials;
- Distribution of the final product.

In the case of light industry the focus is mainly on the processing and distribution functions as many of the industries focus on service provision rather than the processing of raw materials. When inputs are required, they are usually of a high–value, partly or fully processed nature. Various attempts have been made since then to explain and simulate the industrial location decision by means of three basic models:

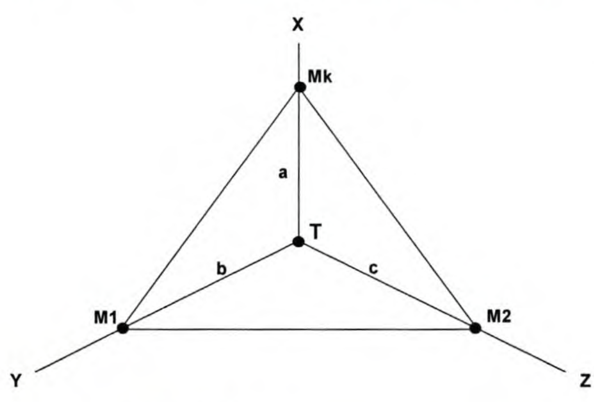
- Lowest-cost model (Weber and Hoover);
- Market-area model;
- Profit-maximisation model.

2.4.4.2.1 Lowest-cost model

Alfred Weber's point location theory is based on the unequal spatial distribution of raw input materials and the consumption of the final product. An individual firm will chose the location where the total cost to his firm is the lowest. Within the framework of a number of assumptions Weber stated that transport cost and labour cost are the primary reasons for regional distribution of industries. These factors are thus considered to be the geographic location factors. The third factor is the centralisation saving that industries achieve through price differentiation, which is not geographically dependent.

Weber considers transport cost, which he regards as the main component in the location decision, to be directly proportional to the distance that the commodity is transported and its mass. The point with the lowest transport cost is the optimum gravitational location point (*Weber, 1922*). This concept can be explained by means of Figure 2.4.

Figure 2.4 Lowest cost approach of Weber



T: Optimal location
M1, M2: Material sources
Mk: Markets
X, Y, Z: Weight of inputs and outputs
a, b, c: Distance between location, inputs and markets

Hoover (*1948*) further elaborated on and refined Weber's model to provide a more realistic approach to transport cost by building in variations due to length and direction, as well as the composition of the freight. He also gave more attention to institutional factors and categorised centralisation factors into three categories as follows:

- Cost saving within a firm by locating all functions at one point;
- Cost saving of all firms within the same industry if they are located at in close proximity;
- Urbanisation cost saving if all firms and industries are located in close proximity.

2.4.4.2.2 Market-area model

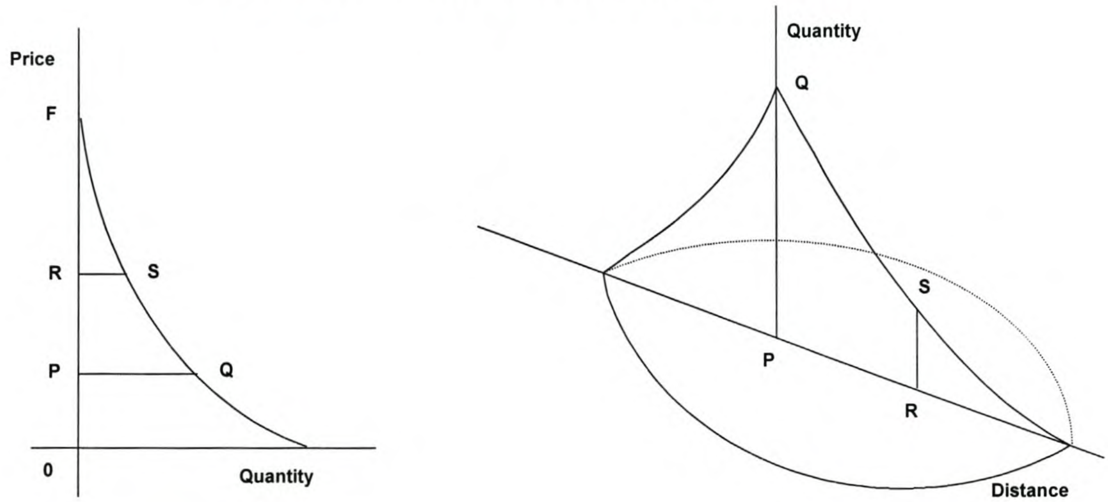
The market-area approach places greater emphasis on the demand for products with consumers who are spread over a wider area and the intensity of the demand that varies geographically.

Lösch, who was one of the theorists who spearheaded the market-area approach, concluded that the optimum location point is where profit is maximised (*Lösch, 1954*). In order to simplify the theory he made the following assumptions:

- There is no spatial variation in the raw input materials within a homogeneous area;
- There is a uniform population density with consistent preferences;
- There are no agglomeration benefits between industries.

He proceeded to explain the market-area theory by means of an adapted demand curve as depicted in Figure 2.5.

Figure 2.5: The market-area approach of Lösch

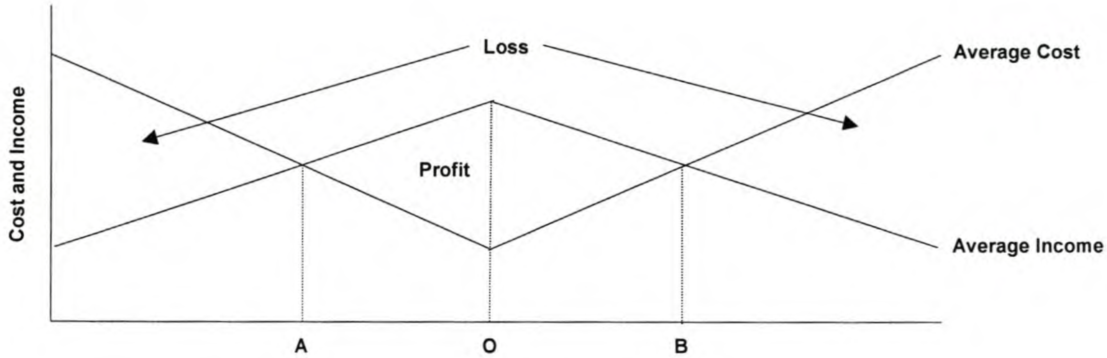


Although it suffers from the same constraint as the lowest cost approach in that it does not consider the impact of input resources, it is more applicable to light industries in urban areas, which are more customer focused.

2.4.4.2.3 Profit-maximisation model

The profit-maximisation approach considers both the input and output of firms and regards the point where profits are maximised as the most advantageous location. This approach is explained by means of Figure 2.6.

Figure 2.6: Optimum location point in terms of the profit-maximisation approach



Locations A and B represent the points where average cost and average income break even. Location O represents the point where the highest profit level can be achieved.

2.4.4.3 Assessment of the location technique

The main constraint in location techniques is that they only consider the value of a location for a specific industry given the accessibility of that site. They therefore provide no clue as to the amount to which an improvement of accessibility to a specific site can accelerate economic development, in other words to what extent it would improve the value of the site for all industries.

2.4.5 Inter-regional programming

2.4.5.1 Background and description

Economists such as Hitchcock have developed a general equilibrium theory and used an inter-regional programming technique as analytical tool. The main purpose of the programming model is to find the best method to achieve the required goals, given certain constraints. With the given supply and demand functions for each possible place of production and consumption and with a constant transport cost between each location pair, the model attempts to find a distribution pattern which minimises total transport cost and satisfies all demand functions without exceeding the supply.

The solution to the problem rests with the supply of commodities between regions that will take place for as long as the direct cost of transport is equal to or smaller than the indirect transport cost. This inter-regional equilibrium problem can be solved through linear programming (*Samuelson, 1952*). It is claimed that this method is not only useful to determine the optimum distribution pattern, but also the relative location advantages of each geographical location. In addition, it can also determine the role of transport with respect to the economy as a whole or for a particular region.

2.4.5.2 Appraisal of the technique

The main disadvantage of these models is the fact that they are complex in nature, which increases the cost of development.

2.4.6 Simulation programmes

2.4.6.1 Background and description

One of the most extensive simulation models that were developed to determine the impact of transport development on developing economies was the one by the Harvard Transport Research Program. The model uses the reduction in production cost as a result of transport improvements to estimate the increase in company profits if prices remain constant, or else the decline in prices if profits are pegged. When prices of goods decline, it means that the competitive advantage of that particular region improves, which would result in an increase in production when the demand for the goods increase.

The model thus focuses on the export base of a region and the role which transport cost plays in trade patterns. It is, in other words, based on the theoretical aspects which are discussed in Section 2.4.1 above.

2.4.6.2 Appraisal of the technique

The comprehensiveness of simulation models based on trade theory therefore makes them ideal for determining the impact of investment in transport infrastructure in developing countries which are in the process of establishing a manufacturing and export base. However, the model is costly to develop and is unable to analyse the impact of individual small transport improvements or the impact of transport improvements on a small, localised area.

2.4.7 Opportunity value method

2.4.7.1 Description

The opportunity value method analyses transport infrastructure on the basis of the idea that the most efficient way of optimising the investment in social assets such as schools and hospitals requires efficient investment in the transport network that services them. This method attempts to dispel the political-economic thinking that these social public assets are of so much value that no marginal amount should be invested in anything else until they fulfil all social needs. The opportunity value method is essentially a 'value in use' or opportunity value. Wright (*1964:85*) described this method as follows. For every road there exists an optimal rate of investment that minimises the overall cost of the road relative to the initial capital outlay in constructing it. This optimal rate of investment can be calculated using cost-benefit analysis. However, if a road is contributing to the opportunity value of another asset, referred to as the 'primary' asset, such as a school, then the most efficient way of investing in the primary asset is to ensure that investment in the road is at its efficient threshold. Investment in the road should therefore take place irrespective of whether the upgrading of the road is presently below the efficient threshold based on a cost-benefit analysis.

For example, suppose that a given road provides access to a school. Consider the allocation of an additional marginal rand to the capital budget of the school. This could be invested directly in upgrading the school or in upgrading of the road. If the authority is currently not investing efficiently in the road, then the most efficient thing to do for the school with that marginal rand is to use it to bring the road-maintenance schedule closer to its efficient optimum. Therefore, even if current political thinking favours investment in social infrastructure such as schools and hospitals, inefficient investment in economic infrastructure such as roads that service the social infrastructure would lead to a wastage of resources on the upgrading of social infrastructure. However, this applies only to some roads, namely those directly carrying people and goods to and from social infrastructure.

2.4.7.2 Procedure

The opportunity value of a secondary capital asset (e.g. a road) is the cost, loss or sacrifice which would have to be incurred if the primary infrastructure did not have the secondary asset. The procedure for calculating the opportunity value of an asset can be summarised by solving for R in the following equation (*SABITA, 2001:26*).

$$C = \sum_{n=1}^{r} [RQ(n) - E(n)](1+i)^{-n} + S(T)(1+i)^{-T} \qquad \text{.....(2.8)}$$

where:

- *C* is the capital cost of the substitute road or alternative transport mechanism;
- *Q(n)* is the contribution to the value of the network of primary assets provided by the road during the n^{th} period of its life;
- *E(n)* is the operating expense of the road during that period;
- *i* is the rate of interest, expressed as a fraction per period;
- *S(n)* is the salvage value of the road at the end of the n^{th} period;
- *T* is the economic life of the road; that is, that life which leads to a minimum value of the average unit cost of R. Hence the value of the existing road at the end of the t^{th} period of its life is given by T.

Equation 2.9 below also permits one to make a general qualitative comparison of depreciation values on primary assets and on secondary assets that influence the former. The depreciation during the t^{th} period *D(t)* is given by:

$$\begin{aligned} D(t) &= V(t-1) - V(t) \\ &= RQ(t) - E(t) - i(V(t-1)) \end{aligned} \qquad \text{.......(2.9)}$$

where:

$$V(t) = \sum_{n=t+1}^{T} [RQ(n) - E(n)](1+i)^{t-n} + S(T)(1+i)^{t-T}$$

Suppose that n1 denotes the primary asset (a school, hospital, etc.), which itself contributes to maximisation of the value of the favoured bundle of primary goods, while n2 denotes our secondary asset, the road. Now suppose, in keeping with the reasoning above, that D(t)n1 is partially a function of D(t)n2. What will this function be like, given certain plausible assumptions? First, for simplicity, set S(n) to 0, since the salvage values of both roads and major public assets fall so far beyond typical government planning horizons that their political-capital value is generally ignored. Second, in calling some assets 'primary', we mean that their political capital value is perceived to dominate the utility function (i.e. their opportunity cost in financial terms is perceived to be low). We may therefore assume that Q(n1) > Q(n2). Now, for every primary asset relevant to the trade-off under consideration, E(n1) will be substantially higher than E(n2). Suppose that if, for some reason, E(n2) is not paid (i.e. the road is not maintained), then Q(n2) falls. In that case, Q(n1) must fall also. Then, assuming that i is uniform and independent of the use to which borrowing is put, C1 must rise faster than C2 if R1 > R2. Therefore, if the opportunity value of the road contributes to the opportunity value of something regarded in the political utility calculus as a primary asset, and if the marginal cost on initial capital of maintaining the road is less than the marginal cost on initial capital of maintaining the primary asset; and if the interest rate on funds used to build roads is the same as the interest rate on funds used to build primary assets, then failing to minimise the capital cost efficiency of the road (i.e. failing to pay E(n2) to maintain it, thus making D(t1) and D(t2) larger than necessary) must always produce an avoidable dead-weight loss on return to total capital [C(n1) + C(n2)].

2.4.7.3 Appraisal of the technique

This method of evaluation is inconsistent with the key assumption on which the need for provision of public funds to maintain urban and provincial roads rested in the first place, i.e. to invest public funds in order to stimulate economic development. As was pointed out earlier, economic growth is a key component of development (*Holden 1989:262*).

Roads are multi-functional, with the result that sections of urban road can be isolated. There are numerous general theoretical results which indicate that attempting to select beneficiaries amongst users of an interconnected urban transport network destroys the inference basis needed to try to compute any economic optima at all (*Takeuchi 1999:107*).

If only those roads needed by the users of public services are upgraded, it would affect location and route preferences amongst the entire urban populace. This may encourage users of public assets to concentrate closer to them, which would result in other social problems and inefficient usage of land.

It is also not likely that the poor would be well served by the encouragement of high congestion on routes that are deemed less important as contributors to social welfare. These routes usually provide access to opportunities that facilitates economic growth.

2.5 Summary of findings and issues

a) There is no universally accepted definition of economic development, except that it entails economic growth plus structural changes in the economy. However, no development is possible without real economic growth as not only does it have a direct impact on per capita income, but it is needed to fund social infrastructure such as schools and hospitals. Economic growth is therefore seen as the source of all economic development.

b) Empirical studies are based on time-series data which measure the global regional or national impact over time rather than the immediate impact on the development potential on a specific localised area.

c) None of the time-series methods can provide conclusive evidence of and an accurate relationship between transport investment and economic development.

d) Transport improvements may or may not cause economic development in a specific location. The available economic models either take only benefits resulting from the actual investment into account (multiplier models), or assume that the benefits from the project will stimulate economic growth (CBA, input-output, simulation), or assume that once infrastructure is provided it should be maintained to a certain standard (engineering, value added).

e) Input variables are complex, which limits the extent of their application in a localised area.

f) There is thus a need to develop a methodology or tool which could be utilised to assess the impact which a specific transport improvement will have on the economic development potential of a specific localised area.

CHAPTER 3

THE ECONOMIC DEVELOPMENT POTENTIAL OF CAPE TOWN

3.1 Introduction

In Section 2.3.3 the role of transport in economic development was identified as being that of a catalyst; in other words, transport is regarded as a necessary but not a sufficient condition for development. The primary objective of this chapter is to investigate whether all the elements of economic development are present in Cape Town to understand whether an improvement in transport accessibility will indeed stimulate further economic development. This assessment will include the potential for economic development in the study area to confirm whether or not an increase in the industrial output at a local level as a result of improvements in transport accessibility is likely to translate into regional economic development. Improvements in transport accessibility should also stimulate additional development and should not merely transfer existing development from one area or another, or the redistribution of already existing development within the study area.

Furthermore, development opportunities in Cape Town should be considered from a global perspective. It is thus necessary to understand the nature and requirements of the global economy. Combined with this, an assessment will be made of the requirements that this new economy will place on transport accessibility and the importance of this on growth in the future economic development environment. In this respect it will also be necessary to assess the likely technological change that is likely to occur in the transport industry that will have an effect on the characteristics of transport in future.

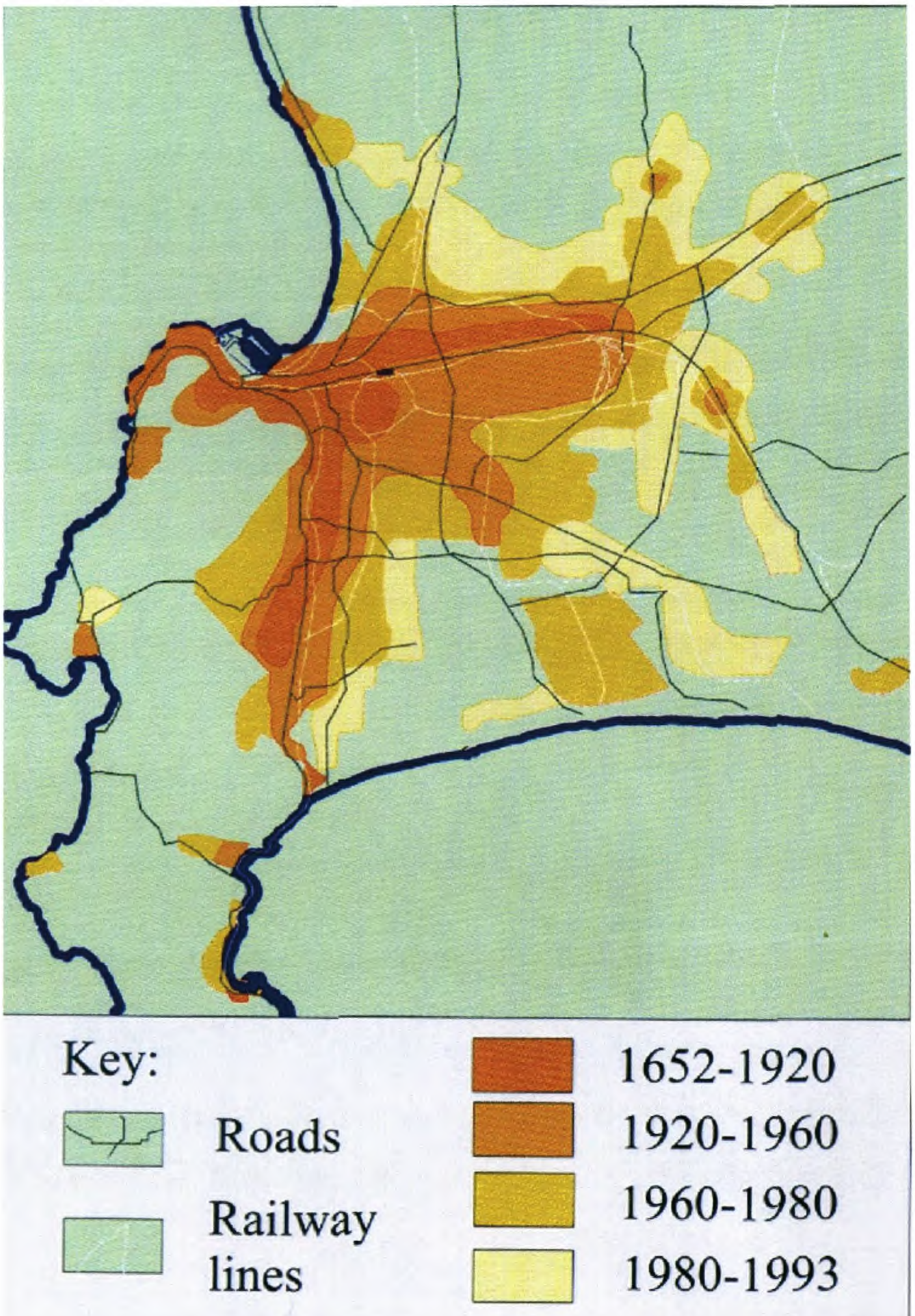
Lastly, the chapter will consider the current level of development in Cape Town *vis a vis* that of the other major metropolitan areas needs to be assessed in order to establish a "development benchmark" against which the conditions for future development in Cape Town can be measured.

3.2 Historic overview

It is extremely difficult to divide history into various compartments or eras, especially when three different aspects – in this instance land use, transportation and economic development – are being compared. Therefore, in order to make the discussion meaningful, development was loosely classified into a number of eras that would represent the phases of development. Dewar & Watson

(*1990:6*) categorised the development of Cape Town into the periods 1652 to 1920, 1920 to 1960, 1960 to 1980 and 1980 to 1993. These spatial development phases are depicted graphically on Figure 3.1.

Figure 3.1: Land use development in Cape Town



From a transport economic perspective Welgemoed classifies the historical development of South Africa into the following phases (*Welgemoed, 1970:33 – 87*), namely 1652 to 1795 (agricultural phase), 1806 to 1870 (agricultural/mining phase), 1910 to 1939 (agricultural/mining phase) and 1940 to 1970 (agricultural/mining/industrial phase). Industry therefore only started to have a significant impact on development around 1940.

From a political economic perspective Terreblanche (*1980:258*) divides the development of South Africa into three structural periods. These periods also happen to coincide with the structural changes that took place in the development of the Western economy. The Dutch commercial colonial period was between 1652 and 1795 and falls within the mercantilist world order. This was followed by the British colonial/imperialist period between 1795 and 1910 that coincided with the nineteenth-century world order. With the creation of the Union of South Africa the Afrikaner decolonisation period followed and lasted roughly for the duration of the contemporary world order. Although Terreblanche could not have foreseen it at the time, this period ended in 1994 with the election of the first majority-rule government, which heralded the beginning of the Africanist period in South Africa. Once again the history of South Africa followed international trends, as the fall of the Berlin Wall and the disintegration of the Soviet Union at the beginning of the 1990s announced the end of the contemporary world order and the beginning of the global market era.

The following is a brief account of each development phase and the role that transportation accessibility played in the development of Cape Town during that era.

3.2.1 Commercial colonialism (1652 to 1800)

The period before 1652 is of no importance to this study and the "economy" during this period consisted of hunting-gathering and subsistence farming activities (*Saunders, 1988:31*). In 1652, however, things changed dramatically with the establishment of a Dutch East India Company (DEIC) trading post at what is now known as Cape Town. Between 1652 and 1800 the main purpose of the Cape was to supply ships of the DEIC. The local economy therefore centred around the production of fresh meat, vegetables, wines and citrus for "export" and for domestic consumption (*Mountjoy & Hilliy, 1988:326*).

Although the intention of Van Riebeeck and his successors was not specifically to establish a road network, the first steps towards the creation of such a network were already evident during this period. There were four main motivations to extend the transport network during this era (*Liebenberg, 1985:160*). Firstly, in order to harvest wood for the ships Van Riebeek needed access to the indigenous forests behind Devil's Peak.

Secondly, produce needed to be transported to the Cape Town harbour from fertile valleys in the hinterland, including the Constantia valley, Stellenbosch and Drakenstein.

The third reason has to do with the supply of livestock. Early settlers soon realised that it was cheaper to source livestock from local tribesmen than to raise the animals themselves. This lead to the establishment of a number of remote trading posts such as Swellendam. Good road connections to these trading posts were essential for their efficient operation.

The fourth reason was to explore the hinterland. Simon van der Stel undertook the first very long-distance exploration trip and he discovered copper in the vicinity of Springbok while travelling into Namaqualand. These discoveries obviously led to further exploration trips in search of precious minerals.

Although the Cape established itself, perhaps unintentionally, as a wine exporter, the main constraint to economic development during the early period was indeed the lack of sufficient road connections to fertile valleys.

3.2.2 Colonial imperialism (1800 to 1910)

It was only when the British permanently annexed the Cape in 1806 that we see an expansion of the transport network. This was not only as a result of the allocation of funds to extend and maintain the road network, but also due to an improvement in the management of resources (*Liebenberg, 1985:161*). During the mid 1800s attention also focused on the establishment of the rail network at a time when there was high growth in the wool industry. By 1840 wool was the most important export product and in 1850 it accounted for almost 60 percent of the exports of the Cape Colony. The importance of good rail connections to the hinterland and the ports of Cape Town and Port Elizabeth is obvious in this achievement (*Saunders, 1988:131*).

Up to 1870 Cape Town played the dominant role in the development of Southern Africa. However, between 1870 and 1920 the economic development of South Africa shifted away from Cape Town towards the mineral-rich north of the region. Diamonds were discovered in Kimberley in 1868 and gold shortly thereafter in what has become known as the Gauteng Province (*Saunders, 1988:163*). This shifted the economic centre of gravity away from Cape Town to Gauteng and Durban as the closest port to the mineral rich hinterland. During this period rail also became the main mode of transport, both nationally as well as within the Cape Town. The first signs of urban sprawl in Cape Town became evident towards the end of this era with land uses developing along the main rail lines from Cape Town to Retreat in the south and Bellville in the east.

3.2.3 Decolonisation (1910 to 1990)

Since the 1920s, at a time when Cape Town could have declined into insignificance due to its distance from the mineral wealth which now dominated South African economic growth and development, the city reinvented itself as a financial and industrial region. Despite the fact that it is far removed from the Johannesburg Stock Exchange, it became the base for the two largest long-term insurance companies Sanlam and Old Mutual. Sanlam, for example, was established in

Cape Town with capital from mainly the local agricultural sector (*Saunders, 1988:336*). In addition, the city established itself as a centre for the processing of agricultural produce, as well as for supplying the agricultural industry.

During the second phase up to 1960 development along the through roads were further reinforced by the establishment of suburban rail lines. These lines were primarily constructed for the transportation of goods by rail. All the major industrial areas were provided with rail sidings, which means that even within the study area rail was the main mode for goods transport.

The introduction of commuter services on rail lines laid the foundation for urban sprawl and the development and growth of towns such as Goodwood, Parow and Bellville. The growth of these towns was partly due to the relatively short journey times provided by rail and partly by the large influx of rural, mainly Afrikaans-speaking people to Cape Town. This period also saw the establishment and planning of the majority of the industrial townships in Cape Town, mainly because the economy of Cape Town moved from an agriculture base to a manufacturing/industrial base. The main impact of passenger services was that it made longer distance commuting possible within the study area and therefore ensured that the labour force within larger Cape Town, and even between Cape Town and surrounding towns such as Paarl and Stellenbosch, was completely mobile.

Between 1960 and 1990 land use planning was dominated by both the influx and resettlement of mainly coloured families in townships remote from the CBD, followed by the large-scale influx of Black families since 1980. These families were also settled in townships which are far removed from the CBD. From an industrial perspective the main driving forces were the very high growth rate of the industrial sector, particularly during the 1960s. During the early 1980s the Atlantis Industrial Township was established to complement the establishment of the then Coloured residential township along the west coast approximately 50 km north of the CBD. Industries were offered considerable incentives to locate there as part of the government's decentralisation policy.

The main change that occurred during this era was the shift of goods transport away from rail to road. Although the shift occurred on both long- and short-haul services, it was even more pronounced in cities such as Cape Town, where smaller high-value loads had to be transported with a level of speed and agility which cannot be offered by rail. Although the main enabling factor for this shift was the deregulation of the freight transport industry, it has to be said that rail could not provide the required level of service required by modern logistics practices. Today most of the freight rail sidings to industrial areas are unused and many are in a state of disrepair.

3.2.4 Discussion

The following deductions can be made from the historic development patterns of Cape Town:

a) South Africa in general and Cape Town in particular have followed international development trends. It is expected that this trend will continue in future due to the open nature of the City's economy.

b) The economy of Cape Town cannot be separated from that of the Western Cape, as agriculture has always played a major part in the growth and development of the region.

c) It was only with the growth in the industrial sector that we saw a major spatial expansion of Cape Town. From this it appears that industrial development played a major role in shaping the spatial environment of the City.

d) Industrialisation in Cape Town stemmed from an agricultural base, i.e. the supply of agricultural equipment and the processing of agricultural produce, rather than a mining base, as was the case in the Pretoria/Witwatersrand/Vereeniging (Gauteng) area.

e) Transport accessibility has played a very important role in the development of Cape Town. Firstly, it is a port city, which means that it forms an interface between land transport and sea transport. Secondly, accessibility to fertile land in the hinterland was an important factor in the supply of goods to Cape Town for both local consumption and export. Thirdly, spatial expansion (urban sprawl) in Cape Town followed established roads and railway lines to the hinterland.

f) Until the establishment of a proper rail network in the nineteenth century, road transport played the dominant role in the development of the Cape. During the latter part of the nineteenth century until the late twentieth century this role was taken over by rail. Currently road transport has again superseded rail as the main mode of transport for manufactured goods.

Based on the above it has to be assumed that world events will shape the future of Cape Town as they have done in the past. Economic development in Cape Town will therefore depend on how well it can respond to global challenges. This raises two questions:

a) Will transport remain a dominant force in future economic development, and what will be the main challenges for the urban transport system to support industrial growth?

b) Will Cape Town be able to take advantage of the challenges offered in the coming global market era, particularly with regards to the industrial sector?

The remainder of this chapter therefore focuses on the main drivers of global change, to assess how well Cape Town is positioned in terms of its current development profile to take advantage of these challenges in the coming global market era, as well as to determine the role that transport will play in shaping the economy in this era.

3.3 Characteristics of the global market era (since 1990)

3.3.1 The nature of the future

Roux (*2002:7-2*) identifies the six aspects of the future as fast, urban, tribal, universal, radical and ethical.

Three of these aspects (fast, urban and universal) describe the 'capitalist', globalising, 'Western' view of the future. The other three (tribal, radical and ethical) in many ways oppose the conventional wisdom. The following is a discussion of each of these phases, based on Roux's work.

3.3.1.1 Fast

This view of the future is one characterised by cyber-medicine, the virtual campus and long-distance learning, virtual reality, the computer and information revolution and the network society.

3.3.1.2 Urban

This aspect of the future entails rapid urban population growth as a major threat, rich (but socially unhappy) city life, abuse of addictive substances, new foods and diets, urban crime, rapid growth in the underground economy, tax avoidance and rationing of health care (due to ageing populations).

3.3.1.3 Universal

The universal future is one where the whole world is trading together, often via virtual companies where knowledge management is the key and super-corporations become rivals to state power.

3.3.1.4 Tribal

This is manifested in any group of people who agree to belong together and forms the basis of all family, teams and belonging. We need tribes to exist and to make sense of the world. Tribal culture provides an understanding of people's motivation, value systems and decisions. Tribalism is the most powerful force in the world and can be either positive or negative. This will be the major reaction against globalisation and is expected to become more intense as the push towards globalisation increases.

The possible future implications of tribalism include the following:

- ethnic cleansing;
- creating unique fashions;
- opportunities for niche marketing; and the
- creation of wealth by small companies, who will resist employment legislation and who will discriminate in favour of family and friends.

3.3.1.5 Radical

The radical future is informed by a strong reaction by societies against late-20th century values. Traditional political movements will find it increasingly difficult to survive on their past values. In fact, old left/right politics may die and party politics could be replaced by single issues (such as the environment, biotechnology and abortion). Corporate ethics, particularly concerning the environment, will become increasingly important.

3.3.1.6 Ethics

Ethics deals with who we are and what we want to be, how we should behave, and our beliefs and values. These attributes are central to our being, providing context and meaning through times of turbulent change. The ethical future is shaped by issues such as the following:

- political correctness;
- concern about civil liberties;
- the family becomes more important than income;
- constant change gives added value to things that are not changing (eg, antiques, old houses);
- a struggle for beliefs (rejection of the scientific, logical, rational model of the world, and the growth of Islam and Christianity);
- symbolism becomes very fashionable;
- battle over media freedom.

3.3.2 Main drivers of change and their impact on the development of Cape Town

The main driver of change in Cape Town can be assessed in terms of the following categories (*Jeffares & Green, 2002:61*):

- socio-demographic
- technological
- environmental
- institutional.

Following is an overview of each of the above categories.

3.3.2.1 Socio-demographic

The demography of a country is one of the cornerstones of futures research. There is a worldwide trend towards declining fertility rates and thus declining population growth rates, although the rate of slowdown is far more pronounced in the more developed countries than in the less developed countries, where the majority of births will occur in future. The potential impact of the HIV/AIDS epidemic on the future size, composition and growth of the Cape Town population is also significant.

The effect of demographic trends on urbanisation in Cape Town is important, in particular the implications for the demand for transport and other infrastructure in rural and urban areas. The number of potential urban passengers in South Africa is expected to grow by 1,4 percent per annum up to 2020. In 1996 approximately nine million people were dependent on public transport (bus, rail and taxi services). Some 5,4 million people in South Africa could not afford any form of motorised transport and had to walk or cycle to their destinations. In 1996 some 2,8 million urban passengers (twelve percent of the urban population) were classified as 'stranded' because they lacked affordable basic access to motorised transport. This figure is expected to increase to 28 percent by 2020. Some 67 percent of the 'stranded' lived in townships with an average travelling distance of 20 km from CBDs or other work locations. This stranded segment (which includes school pupils and the unemployed) is unable to integrate with society or to participate in the broader economy – their principal need is for basic low-cost public transport.

During 1996 three million people in South Africa (19 percent of the urban population) used cars as their only means of transport. This group is expected to grow by 88 percent between 1998 and 2020, which will create significant challenges for urban areas in terms of road infrastructure and congestion. Although urban areas account for 68 percent of total kilometres of national roads, they carry 93 percent of congestion.

3.3.2.2 Technological

The world is well on the way towards the high-technology revolution. This technological transformation, associated with rapid changes in economic activity and socio-economic shifts, is driven by five enabling technologies and slowed by an enabling issue. An enabling technology is one which has effects well beyond those of its own domain, a past example being the effect the development and spread of the motor car had on society:

a) Currently the main enabling technology is that of developments in computer technology and the convergence of these developments with those in communications;

b) Biotechnology, led by dramatic advances in genetic engineering;

c) Materials technologies;

d) Energy technologies;

e) Transportation, which has played a major role in human and economic activity on an ongoing basis.

Environmentalism is the enabling issue which is acting as a constraint on technological development and for which a solution can only be achieved through a structural transformation in society's socio-economic and socio-technical systems. Environmentalism is a strong movement, primarily in industrialised countries. At the centre stage of environmentalism at present is the great debate about genetic engineering, particularly that of foods and crops. Some observers are questioning whether environmentalism signals a profound unease about or even significant distrust of all scientific and technological activities by humanity.

The question that needs to be answered is what the effects are of technological change on (a) the demand for transport, considering developments in communication, as well as in the type of products that are being produced, and (b) how the supply (type) of transport on offer will be affected by technological developments. These questions need to be answered in terms of environmentalism, which has been identified as the main enabling issue of the future.

a) The demand for transport services will continue to grow rapidly in developing countries, driven by population growth, economic growth, modernisation and urbanisation. It should be noted that this growth will be stimulated by computer and communications technologies (see Chapter 6), as improvements in communications tend to stimulate the need for travel and do not replace it.

b) Technological improvements can moderate the growth in the energy requirements and the corresponding environmental impact of transport systems.

c) Congestion on the road network is likely to increase, particularly during the business (inter-peak) hours. This will have major repercussions for the transportation of goods to and between industrial areas, which are currently enjoying a fairly congestion-free road network at the times when the majority of goods transport takes place. Congestion on the road network will also have an impact on the mobility of labour within Cape Town. Up till now labour within Cape Town has been regarded as completely mobile, i.e. someone can live at one end of the city and commute fairly easily to work at the other end. Labour supply is therefore currently not considered to be an determinant of industrial location within Cape Town. If the current levels of congestion increase, it is likely that the location of labour supply would increasingly impact on the location decision of industries.

d) It is expected that rail's share of the transport market within the city will continue to decline.

e) Highways will become automated with the introduction of intelligent transport systems (ITS), from toll collection to navigation to intelligent scheduling of traffic, all resulting in more efficient traffic flow.

f) Road vehicles will become more 'intelligent'. The first noticeable step in this regard is automobiles becoming wired to the Internet in a technology called Telematics.

3.3.2.3 Environmental

Roux (*2002:5-3*) summarises the environmental issues facing Cape Town as follows. Global energy consumption, of which a large proportion is used for the powering of transport vehicles, has increased nearly 70 percent since 1971, and is projected to increase by 2,1 percent annually for the next 20 years. This will raise greenhouse gas emissions by 50 percent compared to current levels unless a concerted effort is made to increase energy efficiency and move away from today's heavy reliance on fossil fuels.

Since pre-industrial times, atmospheric carbon dioxide levels have increased by 33 percent. At the same time the global average temperature has also risen by 0,44 degrees Celsius. The seven warmest years ever recorded all occurred during the 1990s. If CO_2 concentrations double pre-industrial levels during this century, global temperature is likely to rise by two degrees Celsius. Meanwhile, sea level is projected to rise by between 46 and 58 centimetres during the 21st century. This will alter every ecosystem on earth, with devastating impacts on humans.

Although nations have cut consumption of ozone-depleting substances by more than 70 percent since 1987, the ozone layer is still at peril. Phase-out of CFC gasses and other ozone-destroying chemicals has not been completed, especially in developing countries and a significant black market in illegal CFC gasses has sprung up.

Acid rain is a growing problem, especially in Asia, where sulphur dioxide emissions are expected to triple by 2020, if current trends continue.

From this snapshot of environmental trends it is clear that the world is facing a growing scarcity of renewable resources essential for sustaining the world's ecosystems and for human survival. If humankind cannot reverse these trends, environmental deterioration and economic decline could soon start to feed on each other, depriving future generations of the opportunity to support themselves. The overriding challenges facing our global civilisation as the new century begins are to stabilise population growth and climate change. Success on these two fronts would make other challenges, such as reversing deforestation, stabilising water tables, and protecting plant and animal diversity, much more manageable. There are no easy solutions and action will have to proceed simultaneously on several fronts. On the one hand, means must be found to foster development that breaks the vicious cycles of poverty, population growth and renewable resource degradation seen in many developing countries. On the other hand, policies will have to be adopted that will alter unsustainable and environmentally damaging patterns of consumption in all countries.

3.3.2.4 Institutional

Past policies may not be appropriate or effective in the 21st century. One of the reasons for this prognosis is to be found in the fact that new global economic challenges and issues are emerging. The market in which organisations find themselves on the eve of the new millennium is constantly changing, as are the rules and strategies for participating in these markets.

It may be argued that complexity and turbulence are not new phenomena and that business leaders and strategists have always had to cope with them. However, what is new is the sheer scale and rate of change that we have to deal with in an increasingly globalising and integrating economy. It has, for instance, been estimated that 300 years ago there were only a few hundred different ways of making a living; today there are 80 million different ways.

An understanding of global markets is crucial for South African organisations. Although South Africa has the 20th largest economy in the world, the country is responsible for less than 1,0 percent of both world output and world trade. It stands to reason, therefore, that changes and trends in the international business, financial and economic environment will have a distinct bearing on the future performance and development of the domestic economy.

3.4 Development profile of the study area

3.4.1 Current level of development

The Western Cape has the second highest gross geographic product (GGP) per capita after Gauteng. The level of development in a country is however measured by the Human Development Index (see <u>Section 2.2</u> for definition). The Western Cape has the highest Human Development Index in South Africa at 0,762 (*CSS, 1998:11*). This is reflected in the fact that, together with Gauteng, it has the lowest incidence of poverty in South Africa. The 1995 headcount ratio for individuals (i.e. the percentage of individuals with an income of less than US$1 per day) was 2,50 percent in Gauteng and 4,2 percent in the Western Cape, compared to the national average of 17 percent. The average is exceeded by five of the nine provinces, with the Eastern Cape at 33 percent (*SSA, 2000:58*).

Proportionately more white households found in the higher income quintiles have better access to facilities than households in the other population groups, especially black and coloured households. There are proportionately more black households in the lower income quintiles. These households have less access to electricity, water and sanitation facilities.

Black households are the poorest in the Western Cape province: twelve percent have incomes below R6 868 per annum, compared with only seven percent of coloured and two percent of white households. Looking at the top quintile of R52 801 or higher, we find 61 percent of white households are in this category, compared with 17 percent of coloured and five percent of black households. The fact that blacks tend to be the poorest in the province also holds true for the country as a whole. Nationally blacks are worse off than they are in Western Cape, since 23 percent of black households have incomes of less than R6 868 per annum, compared with only twelve percent of coloured and two percent of white households. Looking at the top quintile, 64 percent of white households are in this category nationally, compared with 16 percent of coloured and nine percent of black households (*CSS, 1998:56*). Despite these inequalities, the Western Cape has the second-best income equality (lowest Gini-coefficient) after the Northern Cape. (The Gini-coefficient measures the distribution of income within a country, province or population group. The lower the Gini-coefficient, the more even is the distribution of income). (See Table 3.1.)

The 1996 census figures show that eleven percent of the Cape Town population are in primary school and six percent are in elementary school. The census also shows the following about the level of education in Cape Town (*City of Cape Town, 2001:2*):

- Only three percent of the population have no formal education;
- Nineteen percent have completed primary school;
- Fifty-nine percent have completed secondary school;
- Thirteen percent have degrees or diplomas;
- One percent have a masters degree or higher.

Historically the establishment of "farm schools" addressed the relative inaccessibility of rural communities to school facilities in larger towns and the low population densities in these areas. There are many such "farm schools" in the Western Cape, some of which have as few as 13 learners. It appears as if the Department of Education, which has recently accepted responsibility for farm schools, is in the process of closing these schools due to a shortage of funds. This decision comes despite the fact that research has shown that less than ten percent of learners affected by the closure of farm schools continue with their education because parents can either not afford the cost of housing learners near schools or the cost of transporting them over long distances to schools (*Jeffares & Green, 1999:22*).

The Western Cape has the lowest unemployment rate of all the provinces in South Africa. The term 'economically active' refers to all those who are available for work and includes both employed and unemployed people. Those who are not available for work – those under the age of 15 years, students, scholars, housewives or home makers, retired people, pensioners, disabled people and others who are permanently unable to work are excluded from this definition of the economically active population. Worldwide they are generally regarded as being outside of the labour market. Approximately 36 percent of the population reported that they were not economically active, with about 64 percent saying that they were. The proportion of economically active people reported in Western Cape (64 percent) is relatively high, compared to the economically active population (55 percent) of those aged 15 years or more in the entire country (*CSS, 1998:14*).

Of those economically active people in Cape Town, 88 percent indicated that they were gainfully employed in either the formal or informal sectors. Those that are employed in the informal sector constitute twelve percent of the total economically active population. At least two definitions of unemployment are used in South Africa – the strict and the expanded definition. Both include people who are aged 15 years and older, who are not employed but are available for work. A requirement for the strict definition is that a given individual has taken specific steps to seek employment in the four weeks prior to a given point in time. The second or expanded definition focuses on the desire to work, irrespective of whether or not the person has taken active steps to find work. Thirteen percent of the population in Western Cape were found to be unemployed using the strict definition, while 19 percent of the economically active population was found to be unemployed when using the expanded definition (*City of Cape Town, 2001:40-44*).

The lower than average unemployment rate in the Western Cape may indicate that there are more work opportunities in the Western Cape than elsewhere in the country. It may also indicate that transport to a place of job seeking is more accessible and cheaper in Western Cape than it is in other provinces, especially those with a greater proportion of the population living in non-urban areas. Half the people (50 percent) in Western Cape who are unemployed have not had any previous jobs. In addition, a high proportion of those unemployed were previously in elementary occupations such as domestic work and gardening (23 percent), while a very small proportion of people who are presently unemployed used to be in the managerial, professional and artisan and craft occupations (one percent each).

About a third of black (31 percent) and coloured (30 percent) households have to travel a distance of five kilometres or more to get to a nearest health-care service, while one in every five (21 percent) of white households have to travel that distance or more. In South Africa as a whole 81 percent of black households make use of public health-care facilities (41 percent go to a public clinic and 40 percent to a public hospital), compared to 51 percent of coloured households (26 percent go to a public clinic and 35 percent to a public hospital). Two thirds of white households (66 percent), on the other hand, make use of private doctors and a further 14 percent make use of other private facilities when they require health-care. Only one in five make use of public facilities. Forty-two percent of black households nationally have to travel distances of five kilometres or more to get to the nearest health-care facility, compared to 29 percent of coloured and 28 percent of white households (*CCS, 1998:13-15*).

Table 3.1 summarises a number of the key development indices mentioned above for the provinces in South Africa.

Table 3.1: Development indices for the provinces of South Africa

	% of GDP	% in Poverty	Adult Literacy	% Un-employed	Housing shortage	Infant mort per 1000	Gini coefficient
Western Cape	**14,1**	**18**	**76**	**17,5**	**185000**	**25**	**0,58**
Eastern Cape	7,6	62	61	41,4	230000	57	0,65
Free State	6,2	45	62	26,1	115000	45	0,67
Gauteng	37,7	21	83	20,9	790000	33	0,61
KwaZuluNatal	14,9	49	60	33,1	*	*	0,64
Mpumalanga	8,2	43	57	33,4	60000	40	0,67
North-West	5,5	41	57	32,8	225000	41	0,60
Northern Cape	2,1	46	67	27,2	12000	30	0,57
Northern Province	3,7	68	55	41	100000	55	0,66
RSA TOTAL	***100***		***63***	***29,3***	***2100000***	***42***	***0,65***

Note: The Gini coefficient measures the distribution of income within a country, province or population group. The lower the Gini coefficient, the more even is the distribution of income.
** Indicates that no information are available.*

Source: The above table was compiled from information that was published in the following source documents:

- *CMC (2001)*
- *City of Cape Town (2001)*
- *CCS (1998)*
- *SSA (2000)*
- *Whiteford, Posel & Kelatwang, 1995: 21.*

Based on the above discussion it is possible to deduce that:

a) Overall the Western Cape outperforms all the other provinces in terms of the Human Development Index. This is despite the fact that the Western Cape has a more substantial rural component than Gauteng.

b) In international terms the Human Development Index of the Western Cape falls just below the "high" human development threshold. It is, however, outperformed by other developed countries, as well as by some developing countries in some areas. The relatively good performance in a South African context is therefore by no means reason for celebration.

c) The Western Cape is bordered by two of the three provinces that have the lowest Human Development Index in South Africa, namely the Northern Cape and the Eastern Cape.

3.4.2 Demographic trends

There are roughly 2,6 million people living in Cape Town (*City of Cape Town, 2001:2*). This accounts for 70 percent of the population of the Western Cape (*CSS, 1998:16*). On average 35 000 new immigrants per year migrate to Cape Town. The vast majority of these (47 percent) moved from the Eastern Cape, 14 percent from Gauteng, 14 percent from other parts of the Western Cape and the balance from other parts of South Africa and other countries (*City of Cape Town, 2001:4*).

About eleven percent of the South African population live in Cape Town. The Western Cape and Gauteng also have the most highly urbanised populations in the country, with rates of 79 percent and 97 percent respectively. This compares with the national average of 54 percent (*SSA, 2000:6*).

The Western Cape and Gauteng also share a number of general demographic characteristics. For example, they are the only two provinces in which the economically active constitute more than 40 percent of the population (the national average is 31 percent, while in the Northern Province and Eastern Cape only about 20 percent of the population are economically active).

The Western Cape is the fourth largest province in South Africa with a population of 4,3 million people. It is further estimated that about 60 percent of the residents outside the City are concentrated in larger urban settlements. This brings the rural component of the population to just over ten percent of the total. The rate of population growth in each of the provinces is set to decline over the next few decades, although the deceleration is likely to be more pronounced in the Western Cape and Gauteng. Consequently, the share of these two provinces in the country's total population will decline from 9,7 percent in 1996 in the case of the Western Cape to 8,7 percent in 2031, and from 18,2 percent for Gauteng in 1996 to 17,6 percent in 2001 (*SSA, 2000:8*).

On the basis of historical growth patterns it is estimated that the population of the Western Cape grows at around two percent per annum. This growth mainly occurs in the urban areas, whilst the rural population shows a decline of between one percent and three percent (*Jeffares & Green, 1999:21*). The main reason for this is that the majority of people migrating to the Western Cape settle in larger urban settlements, whilst people in rural areas are increasingly seeking employment opportunities in urban areas. The latter aspect is most evident in the relative decline of the number of people living on farms, for which the reason may be a combination of a number of factors:

a) There is a decline in the employment opportunities on farms;
b) The younger generation are attracted to established urban centres where there may be more opportunities;
c) Permanent tenure legislation has prompted farmers to provide housing for workers in established urban areas.

HIV/AIDS is the factor that would most likely have the single greatest impact on the demographic composition of South Africa, including Cape Town. Table 3.2 provides a comparison of the prevalence of HIV/AIDS in the provinces of South Africa.

Table 3.2: Estimated HIV prevalence as a percentage of the population based on antenatal clinic attendees by province in South Africa, 1993-2000

Province	1993	1996	2000
Eastern Cape	1,9	8,1	20,2
Free State	4,1	17,5	27,9
Gauteng	4,1	15,5	29,4
KwaZulu-Natal	9,4	19,9	36,2
Mpumalanga	2,4	15,8	29,7
Northern Cape	1,1	6,5	11,2
Northern Province	1,8	8,0	13,2
North West	2,2	25,1	22,9
Western Cape	0,6	3,1	8,7
South Africa	**4,0**	**14,2**	**24,5**

Source: Department of Health, 2000:14-15

From Table 3.2 it is clear that the HIV/AIDS epidemic in South Africa is at different stages in different parts of the country, depending on factors such as urban-rural differences and differences in the level of migration and other social circumstances. KwaZulu-Natal continues to be the epicentre of the disease, with a prevalence rate of 36,2 percent amongst antenatal clinic attendees, followed by Mpumalanga (29,7 percent) and Gauteng (29,4 percent). The Western Cape has the lowest prevalence rate of 8,7 percent; however, this rate has increased by a factor of 13,5 since 1993.

3.4.3 Summary

It is unlikely that any community could afford the cost of having all their transportation needs fulfilled and the Western Cape is no exception in this regard. In order to prioritise the needs for the supply of transport infrastructure and services, it is therefore envisaged that the following demographic factors will be the main drivers of transport demand:

a) The Western Cape has the highest Human Development Index (HDI) in South Africa on which to build further human development.

b) The rapid urbanisation occurring in the Western Cape means not only that more people than ever before will be living and working in cities, but also that more people and more goods will be making more trips in urban areas, often over longer distances.

c) Migration to larger towns in the Province and the City of Cape Town will not only occur from rural areas within the Western Cape, but also from rural areas in neighbouring provinces, mainly the Eastern Cape. This will place additional pressure on the supply of transport in urban centres. Traffic congestion in daily commuter traffic will increase as a result of marked increases in the urban population. This will result in more transport trips, increased distances between homes and CBDs, and an increase in car ownership.

d) Migration of highly skilled individuals from the City of Cape Town to larger neighbouring towns where a “country style” living is experienced. Push factors such as the general living conditions and crime in the City of Cape Town and pull factors such as technological advancements which makes home offices feasible and the aging of the skilled workforce who remain active in their field will be the main drivers of this demographic change. This will bring about increased travel over medium distances as well as changes in travel patterns, such as an increase in the amount of business travel during the day relative to AM and PM peak-period travel. An increase in goods traffic could also occur as a result of increased demand for consumer goods in these towns.

e) There will be large-scale immobility for large numbers of poor people, both in urban and rural areas who are too poor even to afford travel by public transport. This will increase the number of pedestrians and cyclists on high-order roads with the resultant increase in the risk of accidents.

f) The AIDS pandemic will have a major impact on the unskilled workforce in the construction industry, as well as the provision of transport to basic health care facilities.

It can therefore be **concluded** that from a infrastructure and sectoral perspective Cape Town has a developed economy comparable with that of other developed cities in the world. However, from a demographical perspective Cape Town has a developing economy which suffers from a low per capita income level and poor distribution of income, coupled with a high population growth of primarily poorly educated people.

3.4.4 Economic development trends

Three provinces – in descending order of importance, Gauteng, KwaZulu-Natal and the Western Cape – are jointly responsible for two-thirds of the country's economic output. The City of Cape Town's economy contributes almost eleven percent of South Africa's GDP, making it the country's second-largest city economy. Between 1991 and 2000 the Cape Town economy grew at an average rate of 2,6 percent per annum; the national average during this period was 1,8 percent (see Table 3.3) (*City of Cape Town, 2001*).

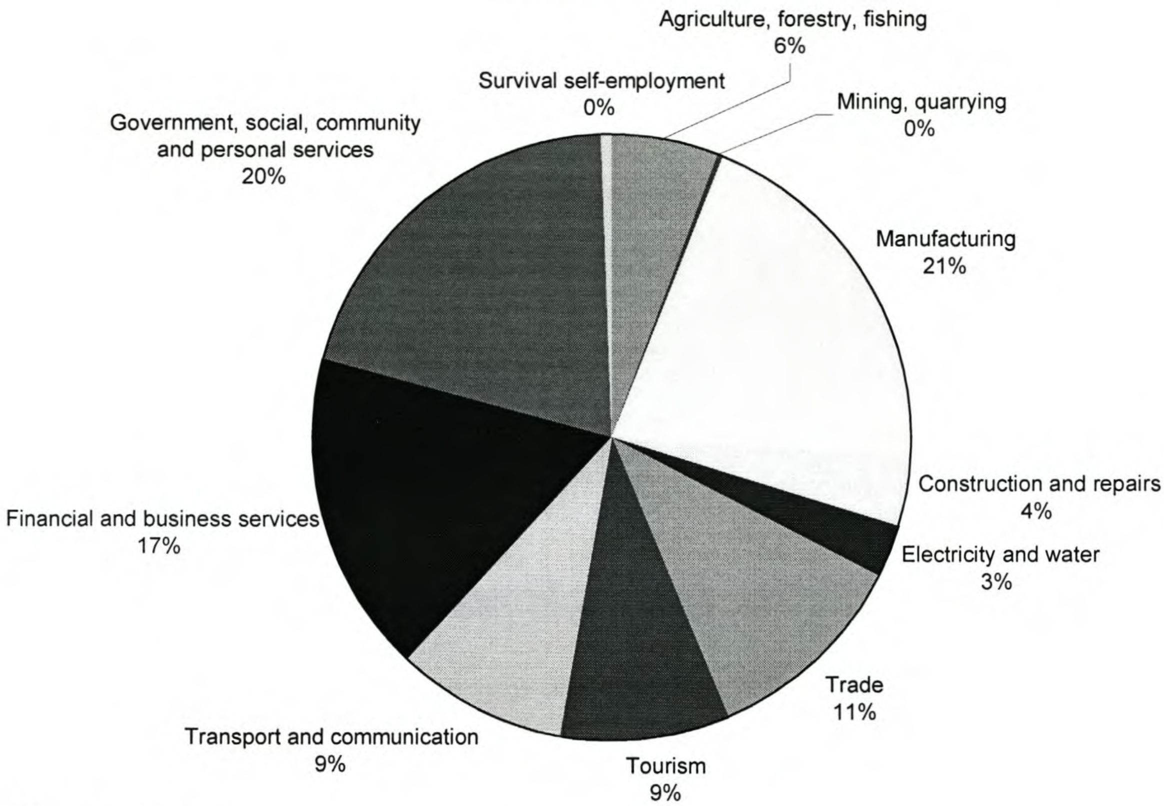
Table 3.3: Economic growth statistics

	GDP in South Africa		GGP in Western Cape	
Year	**R million**	**Real Growth**	**R million**	**% of RSA**
1994	385092	2,5%	53874	13,9%
1995	430872	2,9%	60500	14,0%
1996	484057	3,1%	67600	14,0%
1997	529557	1,7%	74600	14,1%
1998	575000	1,8%	81800	14,2%

Source: Wesgro, 2001

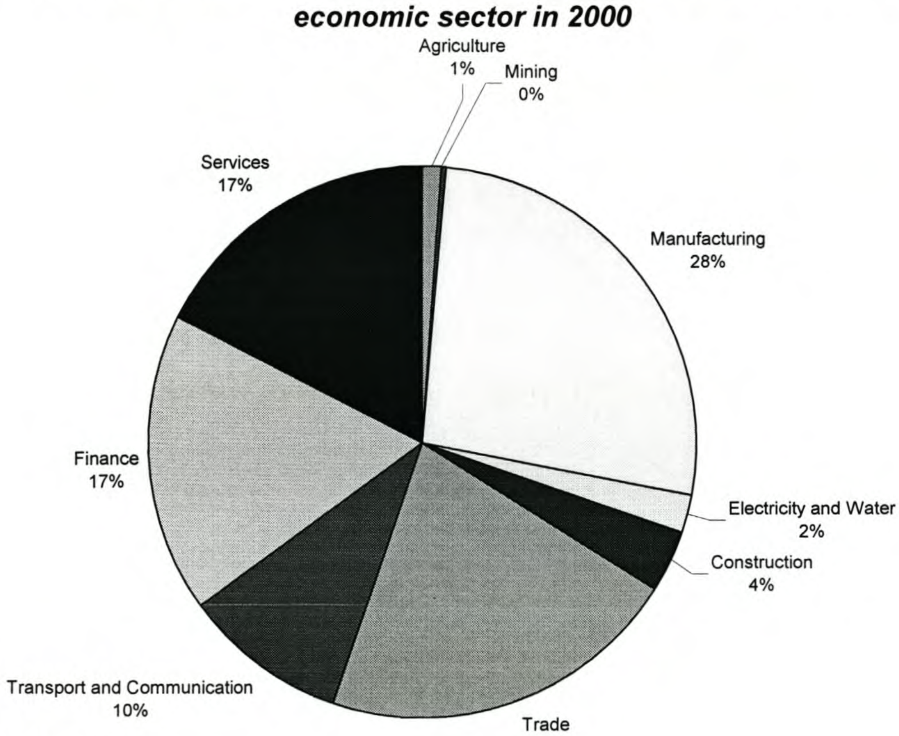
Manufacturing (industry), commerce and finance account for more than 70 percent of wealth created in the Western Cape (see Figure 3.2). The manufacturing sector contributes 28 percent to the GGP of Cape Town (see Figure 3.3). Textiles and clothing (19%) and food and beverages (16%) constitute the most important activities in a well-diversified manufacturing sector (see Figure 3.4).

Figure 3.2: Relative gross geographic product of the Western Cape by economic sector in 2000



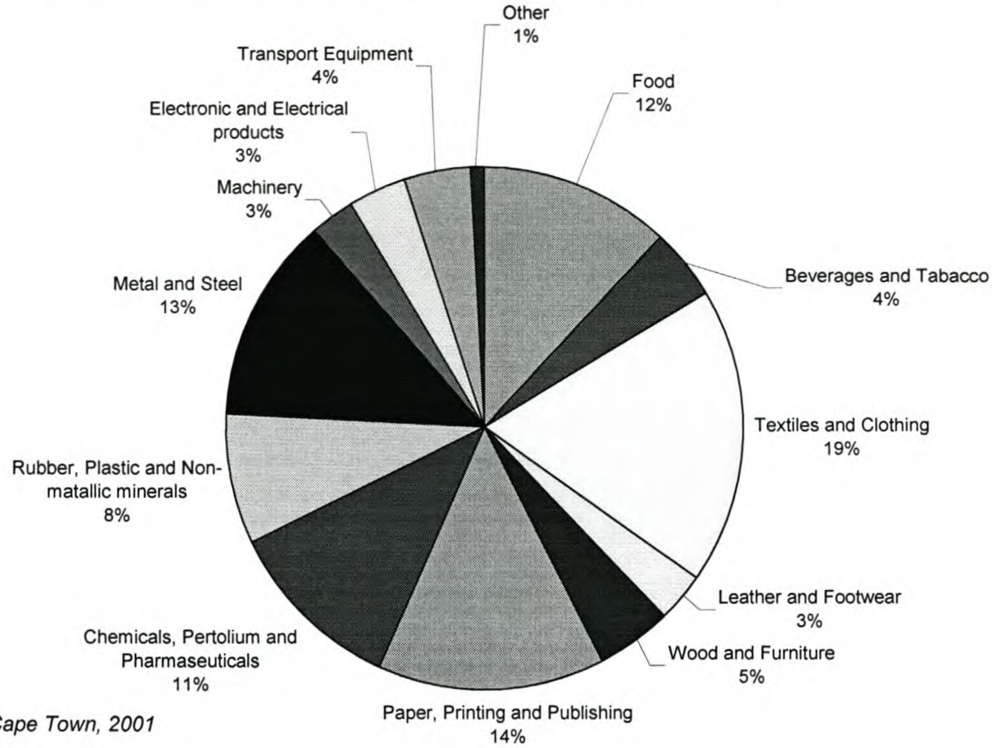
Source: Wesgro, 2001

Figure 3.3: Relative gross geographic product of Cape Town by economic sector in 2000



Source: City of Cape Town, 2001

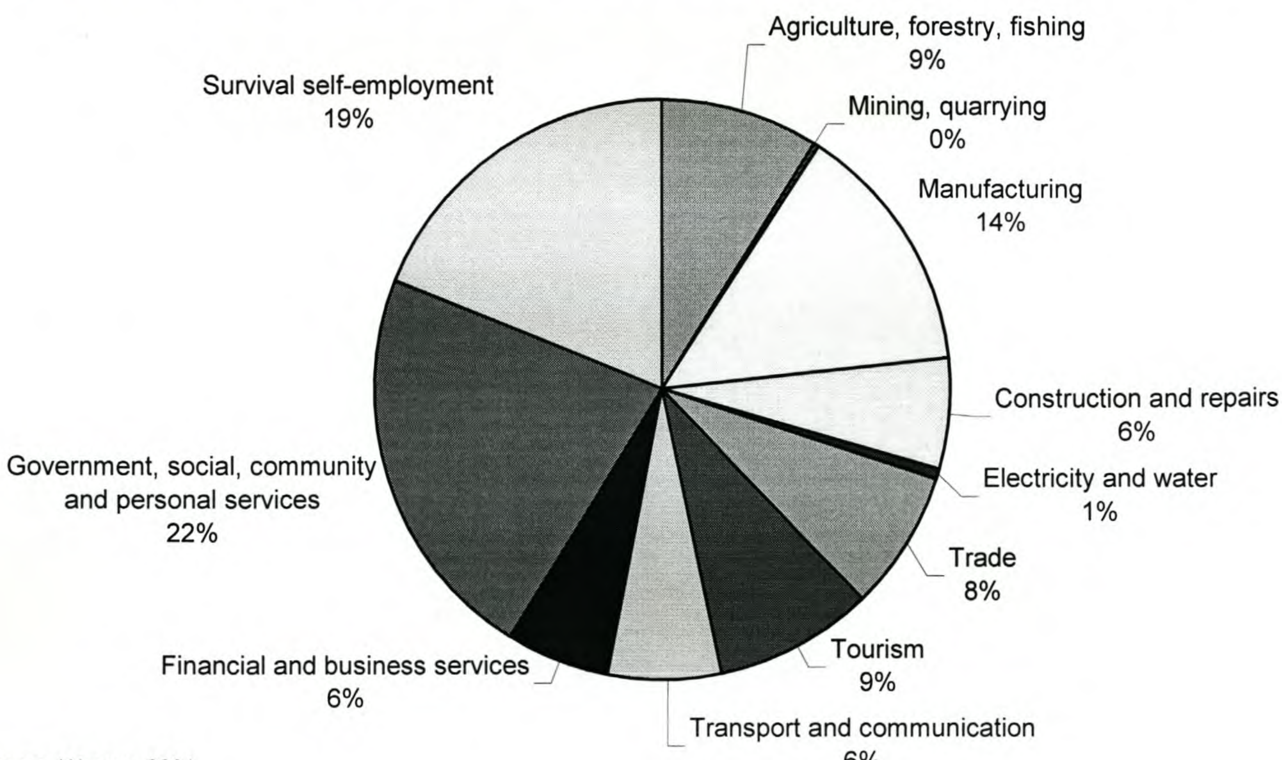
Figure 3.4: Breakdown of the manufacturing sector in Cape Town in 2000



Source: City of Cape Town, 2001

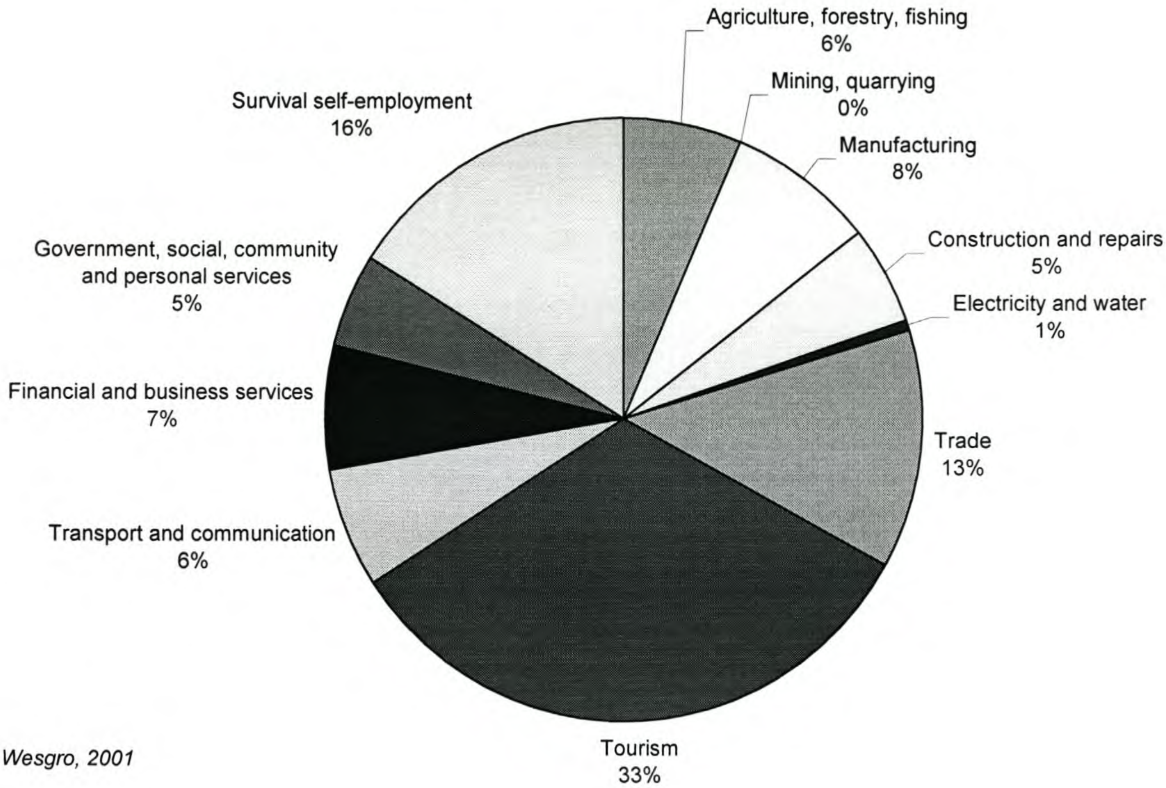
Although only nine percent of the Western Cape's population is employed in the tourism industry (see Figure 3.5), it is the sector in which employment is the fastest growing (see Figure 3.6). Tourism (especially eco-tourism) is therefore one of the most significant employment growth sectors in the economy (*Wesgro, 2001*).

Figure 3.5: Relative employment in the Western Cape by economic sector in 2000



Source: Wesgro, 2001

Figure 3.6: Relative growth in employment in the Western Cape by economic sector between 1994 and 2000



Source: Wesgro, 2001

3.4.5 Exports and imports to and from Cape Town

3.4.5.1 The Port of Cape Town

Pienaar (*Janse van Rensburg, 1997:34*) divides the functions of a port broadly into operational aspects (transfer, storage and trade), industrial aspects (attraction of industrial and commercial development) and strategic aspects (sea rescue and defence). As such ports are important linkages in the total logistics chain. There are two reasons for this. Firstly, a large portion of international trade is transferred at sea ports. Secondly, in terms of total cost, ports are a more important transport linkage than the actual maritime transport.

The importance of ports are illustrated by the fact that the main economic centres of the major trading nations are located at port cities such as New York, Los Angeles, Hamburg, Rotterdam, London, Singapore and Hong Kong (*Janse van Rensburg, 1997:37*). African ports, including Cape Town, often assumed the role of territorial capital and main focal point for external cultural, political and economic influence. In most of these countries ports assumed a principal role in the development process because as much as 95 percent of all African trade is conducted with overseas countries (*Montjoy & Hilliy, 1988:80*). This is also evident in South Africa, where three of the main industrial hubs, namely Cape Town, Durban and Port Elizabeth, are port cities. Gauteng developed purely as a result of rich mineral (mainly gold) deposits far away from the coast

(*Montjoy & Hilliy, 1988:343*). Together these four centres produce 86 percent of the manufacturing output of South Africa.

In terms of its operational aspects the Port of Cape Town fulfils both a break bulk and consolidation function. Break bulk refers to goods being received in bulk and broken up into smaller units for distribution. Consolidation refers to small quantities of goods being received and packed into larger consignments for export. The activities during these processes include the warehousing and sorting of goods, which can be considered as the passive role, as well as the packaging and manufacturing of goods, which is a more active role. More recently, particularly since the early 1990s, the port has increasingly fulfilled a service function. This includes the maintenance/repairs of foreign vessels, supplying vessels for trips, as well as being used as a base for offshore expeditions and explorations.

Figure 3.7 provides a breakdown of the imports and exports via the Port of Cape Town. It will be evident from the diagrams that about 50 percent of all exports are agricultural produce. The main import item, which is listed as "other", consists mainly of consumer goods.

Figure 3.7(a): Relative breakdown of imports via the Port of Cape Town in terms of tonnage in 2000

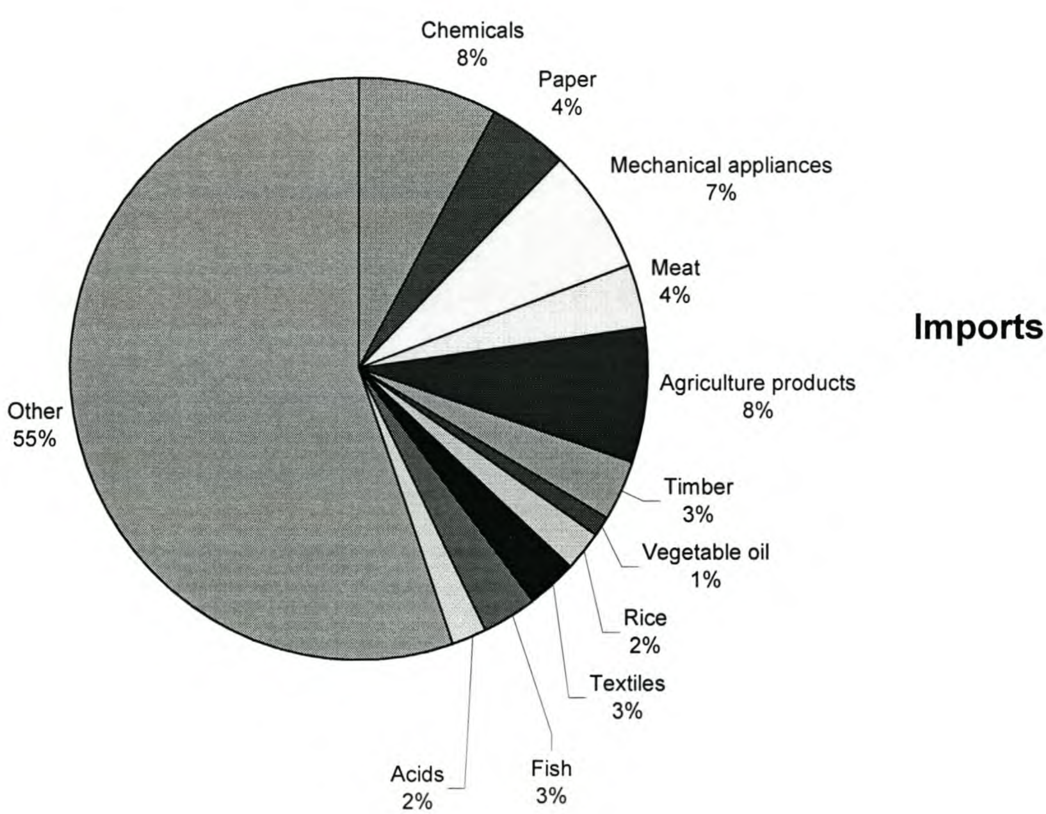
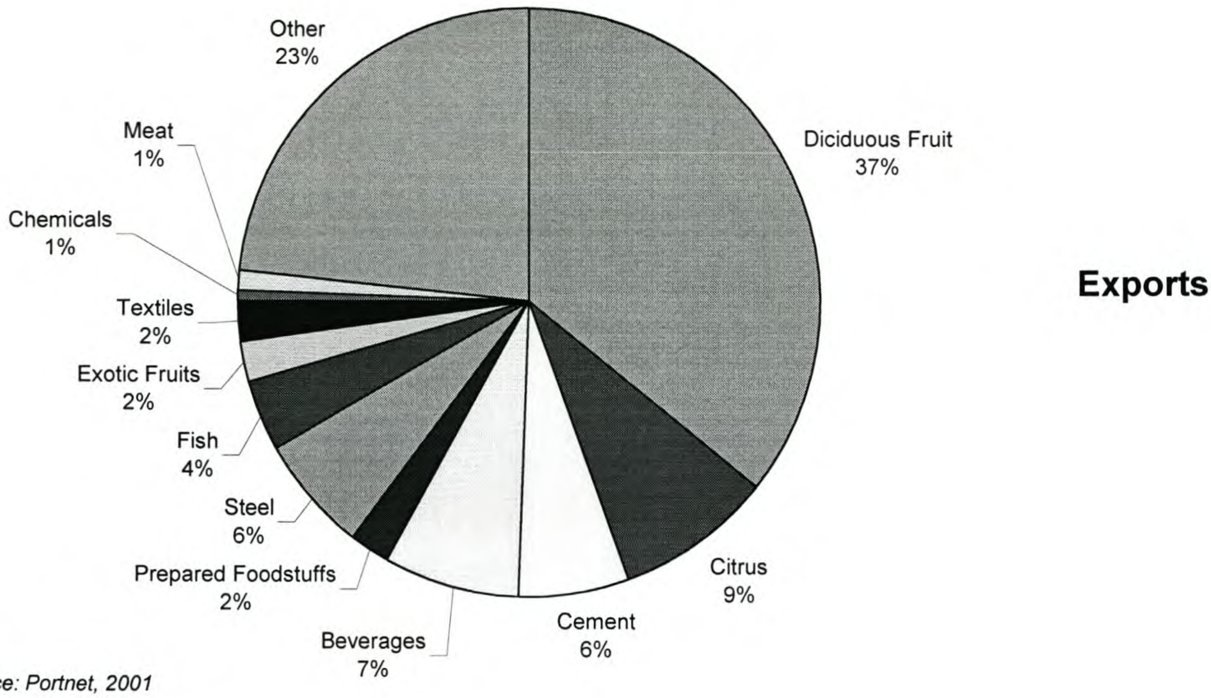


Figure 3.7(b): Relative breakdown of exports via the Port of Cape Town in terms of tonnage in 2000



Source: Portnet, 2001

The main deduction that can be drawn from the bulk freight movements to and from the Port of Cape Town is that movements from the port consist of a large variety of mainly consumer goods. Relatively few high-volume, low-cost raw materials would therefore require transportation from the port. These consumer products would be mainly transported by road due to their higher value to bulk ratio, as well as the fact that they are fragile.

In the case of exports, fruit accounts for 48 percent of goods transported to the port. This has major implications for the provision of transportation to the port:

a) Transportation of fruit is highly seasonal and its transportation occurs mainly during the summer picking season (in the case of deciduous fruit). In this respect it should be mentioned that the establishment of large inland cold-storage facilities brought about by the deregulation of the agricultural industry has dispersed the period during which the transportation of fruit takes place. However, it is expected that the majority of exports will occur in summer.

b) Fruit is perishable and subject to damage in transit. To minimise damage to fruit it is transported by road and a good road surface is thus required to optimise the agricultural export potential of the Western Cape.

3.4.5.2 Cape Town International Airport

Since 1994, Cape Town International Airport has seen strong and consistent growth in both passenger volumes and aircraft movements, resulting in an increasing demand for the constant upgrading of services and facilities. Aircraft movements now exceed 60 000 per annum and passenger numbers over the past year were approximately 4,6 million. Projections see the number of passengers at Cape Town International increasing to 6,5 million by the year 2004, and to 14 million by 2015. With the Western Cape being one of South Africa's primary tourist destinations, Cape Town International Airport plays an important role as the gateway to the region, very often being the arriving visitor's first encounter with South Africa (*ACSA, 2001*).

As part of the Airport Masterplan for developments at Cape Town International Airport, the Airports Company South Africa (ACSA) will commit R1 500 million to the upgrading and development of Cape Town International Airport. This includes extensions to existing terminal buildings, the construction of parkades, two new satellite terminals and an expanded runway system.

With the ever-increasing volumes of international and domestic passengers passing through the airport, developments within the airport continue on an ongoing basis and the airport is constantly evolving and improving. The new International Arrivals Terminal that was opened in 2001 is capable of handling 950 arriving international passengers per hour and is the first phase in the complete re-development of the international section of Cape Town International.

Another major project is the construction of a second runway. This project, subject to potential passenger growth being realized, is due to commence in 2015 and scheduled for completion in 2017.

To cope with the increased vehicular traffic volumes that increase along with the projected growth in passengers volumes, there will be a corresponding increase in the number of vehicles requiring parking at Cape Town International Airport.

Cargo throughput at the airport has also increased substantially and shows continued growth. ACSA therefore plans to develop a Freight City in order to accommodate the needs of the large numbers of freight agents situated at Cape Town International Airport. Although these agents have offices at the airport, there are no warehouses in which to store goods. ACSA will also build a perishable-goods warehouse with facilities to store fish, fruit and vegetables.

The growth in volumes and traffic has also seen an increased demand for top-grade office space at the airport. One of these is the Airport Oval office complex opened during 2000, providing prime office accommodation, with substantial expansions and developments still in the pipeline. The

Southern Office Block, situated to the south side of the Domestic Arrivals Terminal, opened in March 2001 and houses the offices of Airports Company of South Africa as well as other role players at the Airport. Plans for a hotel at Cape Town International Airport are also far advanced (*ACSA, 2001*).

3.5 Development scenarios for Cape Town

3.5.1 Introduction

According to Roux (*2002:7-4*), the economic development future of Cape Town over the next two decades will be informed by, among other things, the following considerations:

- Real economic growth in developed countries will average between 2,6 and three percent;
- Real per capita income in developing countries will grow faster than in higher-income countries;
- The inflation outlook for all countries is fairly optimistic;
- Oil prices will remain fairly volatile, but probably not exceed current levels in real terms;
- Most commodity prices (including agricultural produce) could recover from their low late-1990s levels.

Three scenario outlines are presented, based on the above and other considerations. The three outlines revolve around the relationship between economic growth, governance and entrepreneurship. Governance refers to the ability (capacity) and willingness of political leaders and policy-makers to translate opportunities for economic growth into socio-economic development, job creation and redistribution of income. Entrepreneurship refers to the ability of business leaders to utilise the opportunities presented by technological innovation and international economic integration for growth in the various economic sectors. Generally speaking, there is a positive relationship between growth, governance and entrepreneurship. Conversely, a state of societal, political and socio-economic turmoil, and a lack of leadership commitment and consistency, are certainly not conducive to meaningful economic growth. Unsatisfactory economic growth, in turn, creates further economic hardship and is hardly likely to bring about any material change in general living conditions.

In the World Report on the Urban Future (*World Commission*, *2000:21*), it is postulated that the urban world of the next decade or two will be driven by the following interrelated fundamental driving forces, i.e. socio-demographic, economic and environmental. These driving forces are taking cities in certain directions. The report forecast three types of cities that represent typical constellations of demographic-socio-economic evolution.

3.5.2 Urban socio-demographic scenarios

3.5.2.1 Informal hypergrowth

This is represented by many cities in sub-Saharan Africa and on the Indian sub-continent, by the Moslem Middle East, and by some of the poorer cities of Latin America and the Caribbean. These cities are characterised by rapid population growth, both through migration and natural increase; an economy heavily dependent on the informal sector; widespread poverty, with widespread informal housing areas; basic environmental and public health problems; and difficult issues of governance.

3.5.2.2 Dynamic growth

This city is characteristic of the middle-income rapidly developing world, represented by much of East Asia, Latin America, the Caribbean and the Middle East. Although there is still a growth in population, the population growth rate is declining. Some of these cities face the prospect of an ageing population. Economic growth continues rapidly, but with new challenges from other countries. Prosperity brings environmental problems.

3.5.2.3 The weakening mature city coping with ageing

This city is characteristic of the advanced world of North America, Europe, Japan and parts of East Asia, and Australasia. It is characterised by a stable or declining population, the challenge of ageing and of household fissioning, slow economic growth and adaptation, and social polarisation. But it does have resources to tackle environmental problems, if it chooses. These cities are characterised by widespread dispersion and reconcentration, leading to the growth of smaller cities and a challenge to the viability of the older central cities.

3.5.2.4 Discussion

Cape Town displays characteristics of both the first and second categories, i.e. somewhere between a city coping with hypergrowh and a city coping with dynamic growth. Two urban scenarios that focus on transport have therefore been developed for these two city types, namely a 'Trend' scenario and the 'Bending the Trend' scenario. The 'Trend' or 'Business as Usual' scenario assumes that there is no major intervention by government, either at national or city level, to change the underlying trends. The 'Bending the Trend' scenario represents the outcome of positive policies, i.e. when governments act positively but sensitively to influence the driving forces and thus to deflect the trends.

THE CITY COPING WITH INFORMAL HYPERGROWTH	
Trend scenario	**Bending the trend scenario**
Poor city dwellers become increasingly dependent on walking, as the commuter rail service is too unsafe and unreliable, and road-based public transport becomes unaffordable and is strangled by congestion. As the city grows, this drastically reduces their capacity to participate in urban labour markets and to access services.	Upgrading of the rail network as a cheap social service, supplemented by the use of bicycles as a major means of mobility and access for the urban poor; cities contract with private contractors to develop low-cost bus services on major urban corridors and the construction of public transport priority lanes on roads.
THE CITY COPING WITH DYNAMISM	
Trend scenario	**Bending the trend scenario**
Rapid income growth feeds rapid growth of demand for cars in most cities; high-density inner-city areas limit street widening or new construction, even for cities growing in wealth and tax revenue; thus, a transportation crisis: public transportation is only a partial solution, as the exodus of jobs and people into low-density areas makes increasing numbers of households car-dependent; infrastructure investment falls behind: particularly, rail and subway systems are poor; high dependence on bus service, often poor quality; high car dependence with crisis as fuel prices escalate.	Cities develop a sophisticated urban competence to solve ever-growing transportation problems and related tasks of managing urban growth, as international contacts grow and best-practice knowledge spreads rapidly; best-practice cities package their sophisticated solutions for export to other cities, producing a worldwide export service which revolutionises urban traffic.

Source: Jeffares & Green, 2002:66

3.5.3 Economic growth scenarios

The following economic growth scenarios need to be combined with the socio-demographic scenarios (*Jeffares & Green, 2002:65*).

3.5.3.1 Poverty trap

In this scenario a growth rate of two percent per annum is assumed, i.e. a rate that barely keeps up with the population growth rate and that is far below the rate required to bring about a meaningful difference in the purchasing power and living standards of the majority of South Africans. Under these circumstances the scope for meaningful redistribution is limited and, in essence, only those deliberately advantaged benefit to some extent, by virtue of policies such as black empowerment and affirmative action. The constraint imposed by insufficient resources and opportunities creates an air of resentment among the 'have-nots' and the resultant stresses in society become destructive rather than creative. This deters significant inflows of foreign investment and economic growth remains tepid.

3.5.3.2 Stable underachievement

This scenario assumes that the economic growth rate averages four percent per annum, as the local economy benefits from increased globalisation and restructuring. Although obviously preferable to a two percent growth path, this brings about only a moderate improvement in overall living standards.

3.5.3.3 Meaningful development

A growth rate of five percent (or higher) in Scenario 3 results in a meaningful improvement in living standards and wealth, as well as a decline in unemployment and income inequalities. A thriving economy benefits the fiscus in a non-inflationary manner and government tax revenue increases without raising the overall tax burden of the economy. The fiscal deficit remains low, education and training levels and standards improve, more and more foreign direct investment is attracted, technology and knowledge become firmly entrenched, and societal stresses dissipate.

3.5.3.4 Discussion

Cape Town will in all likelihood continue to grow at a faster rate than the rest of South Africa, but is unlikely to sustain a growth rate of five percent per annum, mainly because it would not be able to train and attract highly skilled workers in sufficient numbers to capitalise on its strengths and global competitive advantages. It will therefore fall into the "stable underachievement" category.

3.6 Summary of findings

a) Historically the economic development of Cape Town cannot be isolated from that of the Western Cape and large parts of the Northern Cape. Although Cape Town currently contributes 73 percent to the GGP of the Western Cape, the City will remain dependent on its immediate hinterland for its own development. This is illustrated by the fact that 37 percent of export tonnage is deciduous fruit. In addition, agriculture has a major multiplier effect on the industrial sector, as many industries supply the agricultural sector or store, handle and process agricultural produce.

b) All the elements for sustained stable industrial growth are present in the Cape Town economy. This includes a well developed financial sector, a diverse manufacturing base and natural resources that would encourage sustained growth of the tourism sector (where currently the largest employment growth is experienced). It is thus unlikely that there would be a complete economic collapse in the Western Cape, but it is unlikely to achieve a growth rate of more than five percent per annum due to the lack in skills to take advantage of its global competitive advantages.

c) Future accessibility for industrial development purposes within Cape Town will be road based rather than rail based. In the past the main function of the transport network was to connect opportunities. This will change in the urban areas, where one of the main constraints will be congestion of particularly the road network. The main challenge will therefore be to provide sufficient mobility for the movement of freight. The increase in congestion will also mean that the labour force within the city becomes increasingly immobile. This may impact on the future location patterns of industry within the city.

d) Although information technology is sometimes seen as a solution to transport problems by reducing the need to travel, the opposite is true. Information technology will not only change travel patterns but, more importantly, it will place additional demands on effective transport infrastructure. Tourism (moving tourists to places of interest), agriculture (transportation of high-value perishable produce), manufacturing (just-in-time logistics practices) and trade (transporting goods to the final consumer) sectors all require good transport accessibility for sustained growth. It is unlikely that rail will be able to provide the required level of service to these sectors, partly as a result of a lack of appropriate infrastructure and partly as a result of a lack in operational and managerial capacity to respond to modern transport requirements. Demand for road usage will therefore increase due to an increase in both road-based freight and passenger transport. There would thus be an increase in the number and size of heavy vehicles due to increased economic activity. Usage of private vehicles would also continue to increase, both as a result of an increase in per capita income and increased tourist activity.

CHAPTER 4

LAND PRICE AS AN INDICATOR OF ECONOMIC DEVELOPMENT POTENTIAL

4.1 Introduction

Land price, as is the case with the price of other goods and services, is determined by the interaction between the supply and demand in the free market. Firms, individuals and government institutions determine land price by the various decisions they make. Firms and individuals determine the demand for land in their decisions on where to locate. Government authorities, on the other hand, influence the supply of land through various institutional controls and restrictions they place on what the land may be used for and the intensity at which it may be used.

The objectives of this chapter are to:

a) Provide a historical overview on the economic thought surrounding land price theory;
b) Consider the interventions in the free market which affects the supply of land;
c) Identify the factors which influence the demand for land;
d) Demonstrate the relationship between land value and the economic development potential of land.

4.2 Historical overview of land price theory

4.2.1 Introduction

It should be recognised that land price theory developed systematically within the main stream of economic thought. It falls outside the scope of this study to provide an exhaustive account or inventory of all noteworthy contributions on the subject. However, it is necessary to provide an account of a number of the milestones in the development of land price theory in order to provide a solid theoretical basis for the calculation of economic land value, as well as to understand the relationship between economic land value and economic development.

4.2.2 Mercantilist theory and Physiocratic thought

Between the fifteenth and eighteenth centuries economic activity in Western Europe was associated with overseas exploration, colonisation and commerce. Mercantilism focused on wealth as a means of enhancing a nation's power. National wealth was equated with an influx of gold bullion into the national treasury. Mercantilists sought to maintain a favourable balance of trade by selling goods to accumulate gold, the chief medium of exchange. Mercantilist doctrine therefore promoted strong, central economic controls to maintain monopolies in foreign trade and ensure the economic dependency of colonies. In this period land was freely available and the only constraint in satisfying the demand was the rate at which it could be colonised.

Physiocratic thinkers of the mid-eighteenth century objected to the commercial and national emphasis of mercantilism. They formulated their theory of value around agricultural productivity. Agricultural produce rather than gold was identified as the source of wealth and land was cited as the fundamental productive agent in increasing agricultural output. One of the most important contributions by the Physiocrats was the identification of the importance of utility and scarcity in determining value. In other words, a production factor such as land could have a scarcity value due to the fact that it can increase agricultural productivity.

4.2.3 The Classical School

Based on the contributions of the Physiocrats, economic thinkers of the classical school in the eighteenth and nineteenth centuries expanded and refined Physiocratic thought and development of modern value theory, which attributes value to the cost of production. For this purpose four factors of production, i.e. labour, capital, entrepreneurship and land, were identified. They examined the relationships between these factors of production and concluded that it is the supply and demand for the basic factors of production that create value.

Adam Smith (1721-1790), the Scottish economic thinker who is the best known of the classical school thinkers, suggested that capital, land and labour are the primary agents of production. Although Smith acknowledged the role of co-ordination in production, he did not consider it as a primary agent. In *The Wealth of Nations* (1776), which is considered to be the first systematic treatment of economics, Smith considered value to be an objective phenomenon that was created when the agents of production were brought together to produce a useful item. An item was therefore assumed to possess utility merely by virtue of its existence. Although scarcity gave exchange value to goods, the "natural price" of an object generally reflected the production cost of the item. The price paid for the use of land, that is the land rent, is a monopoly price, as it is not related to what the landlord may have laid out upon the improvement of the land, nor what he can afford to charge for the rent of the land. It is determined solely by what the farmer can afford to give him (*Evans, 1991:2*). It is obvious that the farmer can afford only the amount which he earns from the cultivation of the land and is therefore determined by the yield of the land. From this it follows that an increase in the yield of the land will increase the land rent. In contemporary appraisal practice, the classical cost of production theory of value has influenced the cost approach. Being one of the factors of production, the productivity of land was from a very early stage considered to be an important component of production cost (*Barber, 1967:28*).

It is, however, the lesser-known **Henry Homes** (later Lord Homes) who discovered the link between land yield and opportunity cost (*Hartwick, 1998:410*). Homes outlines the notion of the opportunity cost of input in his book *The Gentleman Farmer* in 1776, the same year in which *The Wealth of Nations* was first published, claiming to explain rent on land in corn cultivation. He considers rent as the residual after other inputs are paid in accord with their opportunity cost. The level of rent on marginal land in corn cultivation is therefore determined by rent on the land in its next best use (*Hartwick, 1989:412*).

Later economic classical school thinkers all accepted the basic premise of Smith's thinking and offered theoretical refinements on the cost of production theory of value. From a land economics perspective **David Ricardo** (1772-1823) made the most important contribution in this regard by explaining the impact of land productivity on production cost, concentrating on the effects of the corn laws. During this period corn prices increased as a result of the Napoleonic Wars and bad harvests in Britain. Although Britain had to import corn during this period, landlords increased prices as much as tenfold between 1776 and 1816. Ricardo observed that not all of this price increase could be regarded as "economic rent" and that a component of it must be the return on the investment in improving the productivity of the soil.

In order to explain this phenomenon Ricardo argued as follows (*Barber, 1967:77*). The produce of the earth is derived by united application of labour, machinery and capital. This is divided into the three classes of the community, namely the proprietor of land, owner of capital necessary for cultivation and labourers. In different stages of society the proportions of produce allotted to each of these classes will be different, depending on the fertility of the soil, the accumulation of capital and the skills of the labourers. The yield of the land could be improved if the productivity of any one or a combination of all improved.

He developed a theory of land residual returns, which he referred to as rent, based on the concept of marginal land and the law of diminishing returns. Ricardo's theory has contributed significantly to the concept of highest and best use and the land residual technique used in the income capitalisation approach to value. However, land yield was still regarded as the only determinant of land value (productivity) and no attention was paid to the impact of the geographic location attributes of the land on the productivity of land.

Thomas Malthus (1776-1834) elaborated on Ricardo's theory of rent by proposing that these laws should only be applied to the production process itself but still did not address the location attributes of land in productivity (*Terreblanche, 1980:143*). However, he did identify three types of value, namely value in use, value in exchange (price) and intrinsic value. Although this represents a departure from the definition of value in the cost of production theory, it did not significantly alter the prevailing economic thought.

John Stuart Mill (1806-1872) reviewed Adam Smith's ideas in *The Principles of Political Economy* (1848). In addition to identifying the inequities of "unearned increments" accruing to land, Mill's other contributions centred on the definition of the relationship between interest and value in use, which he referred to as, "capital value" and the role of risk in determining interest (*Evans, 1991:3*).

4.2.4 Marxist doctrine

The most serious challenge to the classical value theory came in the second half of the nineteenth century from what later became known as the Marxist doctrine and the marginal utility or Austrian School in the second half of the nineteenth century. **Karl Marx** (1818-1883) focused on labour as the source of value. Whereas Adam Smith was of the opinion that an increase in production will improve income distribution, i.e. that economic growth will solve the production problem, Marx's approach was equally one sided by focusing on the conflict that will be created by the unequal distribution of income (*Terreblanche, 1980:142*). He stated that all value is the direct result of labour and that increased wages for labour would lower capitalist profits. Marx envisioned an inevitable struggle between the social classes that would eventually lead to violent political upheaval. Marx's contribution to land value theory was therefore insignificant.

4.2.5 The Neo-Classical School

The marginal utility, or Austrian, school, which was known later as the neo-classical school, was critical of both the classical and Marxist theories. The theoretical basis for the concept of contribution links value to the utility of and demand for an additional, unit of an item. The demand for an additional, or marginal, unit determines utility. This means that if one more unit than is needed or demanded is offered in a given market, the market becomes over–saturated, with the result that the cost of production becomes irrelevant. Value is regarded as a function of demand prices, with utility as its fundamental guideline. Eugen von **Boehm-Bawerk** (1835-1882), for example, defined value as "that significance a good acquires in the contribution of utility toward the well-being of an individual" (*Barber, 1967:207*).

It is **Alfred Marshall** (1842-1924) who is credited with the synthesis of successfully merging the supply-cost considerations of the classicists with the demand-price theory of marginal utility, which underlies contemporary value theory. Marshall compared supply and demand to the blades of a pair of scissors, neither of which could ever be separated from the determination of value. However, he stressed the critical importance of time in working out an adjustment between the two principles. Marshall maintained that market forces tend toward equilibrium where prices and production costs meet. Utility-demand considerations operate in the limited span of a given market. In the short term supply is relatively fixed and value is a function of demand. Cost-supply considerations, however, extend over a broader period, during which production flows and patterns are subject to change. Marshall believed that a perfect economic market would eventually result and that price, cost and value would all be equal. (*Barber, 1967:168*)

Marshall identified the following five aspects of land that relate directly to the industrial production process (*Thrall, 1991:956*):

a) Land is a factor of production;

b) Land has area and density and is a complement to capital and labour. There is a certain application of capital and labour per land area which gives the highest return;

c) The " situation value" and "site value" of land are measures of the importance of relative spatial location;

d) Concentrations of service industries arise from savings in transportation cost and time;

e) Land value and intensity of land use are the result of spatial equilibrium process.

Marshall also made specific reference to the utility value of land. He stated that rent income from land is in direct relation to the income that can be generated on the land. The reason for this is that the landlord will always attempt to maximise the rent income from land. Rent income is therefore determined by the yield of the land for the land tenant. Marshall was the first major economist to provide practical guidance on the valuation of assets, specifically the valuation of land. In this regard, his writings and the writings of those who built upon his work are important sources for understanding the distinction between value theory and valuation theory, or "the method of estimating, measuring, or predicting a defined value."

4.3 The nature of land supply

4.3.1 Introduction

In order to assess the likely future land use pattern in Cape Town the following key questions need to be answered:

a) What level of institutional land use control will be exercised? This includes the intensity of land usage, as well as the institutional and physical factors that will guide and influence the supply of industrial land for development in the long term. Changes in the supply of industrial land are the main determinant of the absolute level of land price that could either encourage industry to locate in Cape Town or discourage it from doing so. Land supply would therefore impact on the continued sustainable growth of Cape Town as a whole, whilst the improvement of relative accessibility to particular sites would improve their specific value due to their increased attractiveness.

b) Will the Cape Town CBD diminish in importance as the main activity centre in Cape Town?

c) Will Cape Town move from being an essentially monocentric city with one distinctive economic hub to becoming a multicentric city with economic activity spread between four hubs and a number of activity corridors as suggested by the Metropolitan Spatial Development Framework (MSDF) (*CMC, 1998b*)?

d) What will become of existing industrial townships and where would new industrial townships be developed?

Traditionally economists such as Ricardo and Marshall based their theories on the price of land on certain assumptions about the physical attributes of land (see <u>Section 4.2</u>). Four of the most important assumptions are that (a) land is homogeneous, (b) that land is traded on the free market and that a higher land use can at any time be substituted for a higher land use with a higher rent bid function, (c) that land and capital can be substituted, and (d) productivity of land remains constant. In traditional economic theory all four factors of production, namely labour, capital, coordination and land are assumed to be homogeneous. Although Marshall (*Thrall, 1991:956*) realised that land rent depends on both the features of the site as well as its location, subsequent traditional land-price theory as presented by Alonso (*1964:2*) and others also assumes land to be a homogeneous production factor for which the price is only determined by location, and more specifically the transport accessibility of that location. The same production function therefore applies to all units of land.

Needham challenges this assumption and put forward a strong argument that, because land is not homogeneous, the existing theories do not explain certain political issues to the extent that a more general theory of land price should. These issues, which are all relevant to the supply of land, he (*Needham*, *1980:90*) summarised as follows:

- The relationship between land price and product price;
- The effect on price of land for one use, if there is competition from other uses to occupy that same land;
- The effect of tax on land.

As an alternative Needham (*1980:93*) offers a supply-based approach which assumes that land is not a homogeneous factor of production. However, he made it clear that the physical suitability between two plots of land for one use (say industry) may not be the same as the difference between the same two plots of land for another use (e.g. offices). The physical suitability of plots of land for production can be compared only within one industry or land use type.

On the first question on the relationship between product price and land price, Needham confirms Ricardo's notion that the price of a product is determined by the price of production on the least suitable land. However, he showed that the rent for the better land is less than what Ricardo would have deduced because capital can be substituted for land (*Needham, 1980:97*). If land is substituted for capital, it raises the productivity of that land. This is the reason why developers will tend to maximise the density of development on a particular piece of land – the more expensive the land the more profitable it is to increase the density by investing more capital in the form of multi-story office blocks.

The practical significance of this on the supply of land if accessibility changes is significant and can be illustrated by the following example. In a quiet residential area with a good ambience and therefore high residential property prices, a prospective developer considering the location of a small office block will have to pay at least the price that the land receives for residential purposes. Because the site has poor accessibility relative to that of other office developments, office rent (price of the product) will be lower than the average. Minimum office rent will therefore be determined by the land price. If accessibility is improved by the construction of a new highway near the location, office rent will rise to at least the same level of that of other office developments. This will increase land price to beyond that for residential purposes. The residential land price can therefore be considered as the transfer earnings, whilst the difference between the residential land price and office land price is the "economic rent".

The above discussion illustrates a number of factors which have a direct impact on the supply and thus the price of industrial land:

a) The supply of land is limited by the fact that locations are concentrated within a confined space. Individual firms compete with each other for space through the market mechanism. Given the fixed supply of land in the short term, the factors which determine the demand for land are the main determinant of land price.

b) Land is not homogeneous because only land that is zoned "industrial" can be used for that purpose.

c) The land use zoning rights are controlled at an institutional level, which means that government through its officials and politicians intervene directly into the market for industrial land.

d) In practice land substitution from industrial to office and retail has been allowed, but not from office and retail to industrial. This could have the effect of inflating industrial land price in areas with good accessibility beyond what can be regarded as a fair price on the open market.

e) If industry is pushed out of the areas with good accessibility, it could have a detrimental effect on industrial development in Cape Town.

The major influence on land supply outside the market mechanism is that of government intervention in the land market through the control which it exercises on land use. However noble the reasons for an intervention in the land market, the manipulation of land supply impacts greatly on the rent which land owners can charge. Government therefore has a major influence on the price of land to the extent that they can control its supply. It is thus important that the study takes full cognisance of current land use policies and reasons put forward for following these policies in order to fully appreciate the extent to which government influences current land prices.

4.3.2 Institutional land use control

Institutional control over land can take many forms, but the most popular restrictions are as follows:

- The type of land use that it allows on specific tracts of land;
- The amount of land available for development;
- The intensity of use it allows on land;
- Environmental restrictions;
- Taxes and levies.

Sections 4.3.2.1 through 4.3.2.5 outline the impact of each of these aspects on industrial land price in more detail.

4.3.2.1 Land use control mechanisms

One of the main reasons why land is not a homogeneous factor of production is due to the restrictions which are placed on the purpose for which the land is used. These restrictions are imposed in terms of a land use classification scheme, which has the following broad land zoning categories:

- Residential
- Community facilities such as churches
- Education
- Institutional
- Retail
- Office

- Recreation
- Industrial
- Agriculture
- Extensive use, e.g. cemeteries
- Transport, e.g. road reserves and rail corridors.

The zoning classification of a property, which includes its land use classification, intensity with which it can be used (referred to as bulk) and other zoning rights and restrictions, is described in its title deeds and is legally enforced through the Land Use Planning Ordinance (*Province of the Western Cape, 1985*). Changes to the zoning are often lengthy processes over which the premier of the province has the final say. However, in most instances this authority is delegated to officials at local authority level, although an appeal can still be made to the premier to allow a rezoning when the local authority turns down an application.

It is, however, not only with the exact zoning application procedure where institutional factors impact on the supply of industrial land, but also in the enforcement of the zoning rights. This has become a more critical issue as the distinction between office, retail and certain industrial uses becomes more integrated in the era of e-commerce and just-in-time logistics practices. As a result of this more and more office and retail activities have located in industrial townships. Although the existence of factory shops is not a new phenomenon, these shops have traditionally been located at the factory. In other words, the factory location decision has determined the location of the shop. Nowadays, however, more prestigious retail outlets that often even do not have a local manufacturing base are locating in industrial areas. The Oakdale industrial township in Bellville, for example, has been completely taken over by retail developments. This may impact on the assessment as the measure of accessibility for retail and office is different to that of industrial.

In the case of industrial land the zoning controls are often applied more strictly than is the case with other land uses due to the pollution effect caused by the movement of heavy vehicles, noise from machinery, visual intrusion of factory buildings, as well as air pollution and hazardous materials. In addition, industry often requires special infrastructure and services, which is not the case with say office and retail activities. Special infrastructure requirements include high-capacity electrical power supply, internal road systems which have the geometry and pavement strength to accommodate continuous use by heavy vehicles, as well as the water and waste outfall connections.

Therefore, whereas it is easy for office and retail activities to locate in residential and industrial areas, industrial activities are restricted to well-established and purposefully developed industrial townships. However, industrial land use does frequently change from heavy industrial to light industrial. Recent examples of this are the conversion of the Everite asbestos plant in Brackenfell into light industrial hives. A similar development occurred some time ago at the Leyland motor assembly plant in Blackheath Industrial. Currently a high-security light-industrial park is being developed on the site of the Kynoch fertiliser factory in Milnerton.

4.3.2.2 Spatial planning

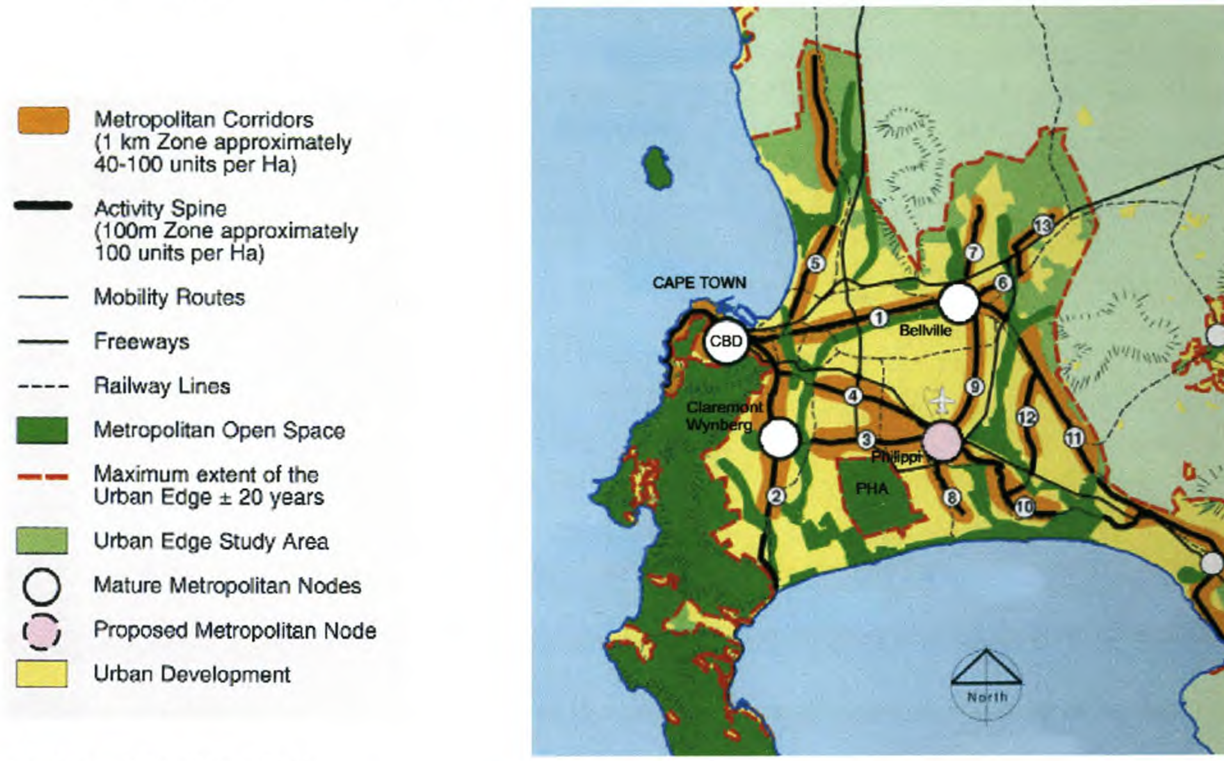
Planning and development in Cape Town does not happen in isolation, but takes place within both a broader regional and sub-regional spatial planning framework. It is important to understand and consider the broader planning approaches which guide authorities to understand the likely future supply of land.

The preferred future land use pattern for Cape Town is broadly outlined in the Metropolitan Spatial Development Framework (MSDF) (*CMC, 1998b*). The aim of the planning policies and principles that are outlined in the MSDF is to guide the form and location of physical development at a metropolitan level. It provides a 20-year spatial framework vision of a well-managed and integrated metropolitan area for the development of Cape Town.

The MSDF supports intensified urban development within the existing urban areas, mainly along the proposed framework of metropolitan activity corridors and urban nodes. It addresses the imbalances of the past and provides for future growth, while protecting the spatial character of the region. The MSDF also proposes a denser urban structure to accommodate future population growth and urban development. To achieve these and other objectives, four spatial elements have been identified (*CMC, 1998b:13*).

These elements, namely the urban edge, metropolitan nodes, activity corridors and the metropolitan open space system (MOSS) that are relevant to the study context, are briefly discussed in the following subsections. Figure 4.1 illustrates the spatial proposals graphically.

Figure 4.1: Metropolitan Spatial Development Framework land use proposals



4.3.2.2.1 The Urban Edge

The urban edge demarcates the outer limit of urban development for the next 20 years. It protects valuable natural resources such as the Durbanville farmlands, Tygerberg Hills and the Philippi Horticultural Area against urban sprawl (*CMC, 1998b:17*).

4.3.2.2.2 Metropolitan nodes

Metropolitan nodes are places of high accessibility and economic advantage where mutually reinforcing higher-order activities and land uses tend to locate. The following three nodes are well established and need to be strengthened further:

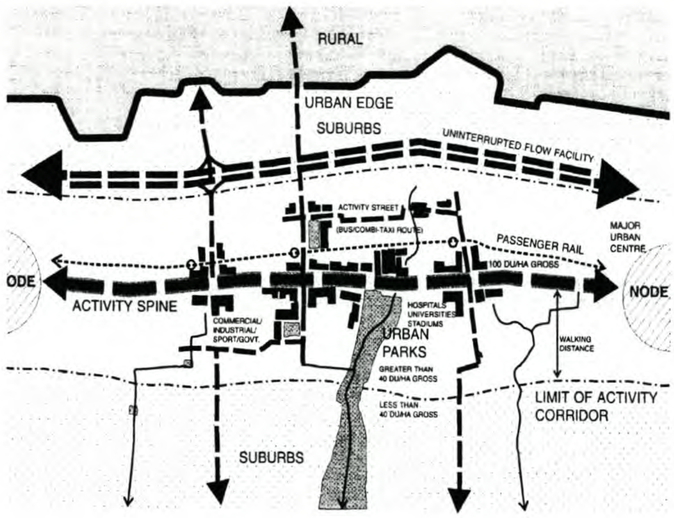
- Cape Town CBD
- Bellville CBD
- Wynberg CBD.

The Philippi East node has been identified as a node to be promoted and developed further (*CMC, 1998b:13*).

4.3.2.2.3 Activity corridors

An activity corridor is a metropolitan or urban linear zone of intense mixed land use development. The corridor may contain major transport routes such as passenger railway lines and freeways or major arterials in various forms including 'one-way super streets' such as the Durban Road/Willie van Schoor Avenue one-way couplets in Bellville's Golden Mile. It is preferable that, if railways are to be developed, they should be central to the corridor. Where there are no rail services, the activity spine should preferably permit free-flowing movement for public transport (such as in transit lanes). This is to ensure that the corridor helps to bridge the current divides between core and peripheral areas thereby helping to provide rapid access to metropolitan jobs and business opportunities (See Figure 4.2).

Figure 4.2: The Metropolitan Spatial Development Framework view of accessibility



Activity corridors are linear axes of higher-density, mixed-use development that link activity nodes. Activity nodes are centres of intense activity (commercial, residential and service industries). A linear corridor should link various centres together by means of transport infrastructure, which should ideally pass through high–density, mixed land use areas. Activity nodes are places with the highest accessibility where both public and private investment tends to concentrate. They should be magnets which stimulate movement through the corridor. Nodes offer opportunities for a range of small-scale activities, interspersed with larger concerns. For example, hawkers and informal markets may be integrated with regional shopping centres, given the appropriate stimulation (*CMC, 1998b:14*).

4.3.2.2.4 Metropolitan Open Space System (MOSS)

The MOSS is a linked system of open spaces, which forms the green framework of the metropolitan area. It provides for recreational, resource conservation and other purposes in close proximity to the urban areas (*CMC, 1998b:15*).

4.3.2.2.5 Transportation and access in the Metropolitan Spatial Development Framework model

Freeways should generally be peripheral to the corridor, facilitating long distance through movement, but permitting penetration of the corridor at freeway interchanges. The interchanges should link the through routes via activity streets (shopping 'high streets') to core activities at nodes within the corridor. The activity streets offer economic opportunities for car-based or feeder movement into the corridor and will most often converge on nodes within the corridor.

Within the corridors the development of other 'high streets' (main roads) on which trade and activity are focused is to be encouraged. For years notions of traffic safety and efficiency discouraged this form of urban development because of its interference with through moving vehicles. It continued to occur, however, because of the blighting effects of traffic volumes and noise on residential environments. The corridor/node development model, including activity spines on 'high streets', acknowledges the relationship between traffic and trade and seeks to divert through traffic and capture passing traffic in the interests of economic activity. Some possible components of an activity corridor are illustrated in Figure 4.2 (*CMC, 1998b:11*)

4.3.2.2.6 Practical Perspective on the Metropolitan Spatial Development Framework

There are a number of reasons why the MSDF would have little effect on future industrial land use patterns in Cape Town. Firstly, in many respects the MSDF is an idealistic planning model which pays little attention to market forces. Although it can to some extent be "fitted" onto the existing land use patterns in Cape Town, it fails to explain the current industrial land uses and the forces which brought them about. For example, development along activity corridors are hardly uniform and even mature corridors such as Voortrekker Road and Main Road are characterised by nodal developments rather than ribbon-type developments.

Secondly, it appears as if the MSDF has little control over land use developments, for example:

a) The corridor principle ignores industrial developments, which are invariably situated in industrial townships or nodes. In addition, some industrial nodes such as Oakdale in Bellville are allowed to convert to commercial land uses within a previous industrial node.

b) Recently major projects went ahead despite being contrary to MSDF proposals, e.g. the Century City development, where the City of Cape Town purchased land for future office development.

c) It fails to explain successful and fast-growing smaller nodal developments such as that found around the Panorama Medi Clinic in Parow.

d) There is a high growth in low-density residential development near the urban edge in the northern areas of Tygerberg and Oostenberg which is contrary to MSDF principles of densification along existing corridors. Once available land has been developed, the urban edge will come under threat.

e) The policy of the Department of Housing to provide low-cost housing in the form of (relatively) low-density single residential units are in conflict with the MSDF principles on densification along established corridors near to places of work. Many of the latest low-cost housing projects do not even have basic amenities such as schools.

f) Despite large-scale urban development close to the urban edge, the main threat on the urban edge is not from the Cape Town side, but from the adjacent rural side. It is already said that the Winelands spatial plan is in many instances in conflict with the MSDF. In addition, there is very little co-ordination from provincial authorities in the form of a regional plan. If authorities in Cape Town succeed in restricting the supply of land by protecting the urban edge, it is very likely that development will jump the edge with development taking place in the Winelands District Council Area. It should be borne in mind that many areas on the fringes of Cape Town are more accessible from adjacent towns such as Stellenbosch and Paarl than from within Cape Town.

From the above evidence it is deduced that the MSDF:

- does not explain current industrial spatial patterns adequately;
- is unlikely to have a significant impact on the future supply of industrial land in Cape Town.

4.3.2.3 Limits on the intensity of land use

The intensity with which the available land can be utilised is restricted by a number of factors as follows:

- Extent to which capital can be substituted for land; in other words, is it less costly to construct structures on available land or to add to the volume of land;
- Institutional restrictions such as building lines, height restrictions and the overall coverage of the plot;
- Physical restrictions due to the type of operation allowed on the land.

In the case of industrial land the intensity with which land can be put to use is constrained mostly by the physical restrictions. The majority of industrial activities take place at ground level, which excludes the option of multi-story buildings. Secondly, sufficient land on a plot needs to be set aside for parking and loading facilities, as well as for the manoeuvring of heavy vehicles.

4.3.2.4 Environmental restrictions

South Africans have a constitutional right to have the environment protected for present and future generations. This means that there must be reasonable legal and other measures to prevent ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources, while promoting justifiable economic and social development.

Since September 1997 a range of activities that may have a substantial detrimental affect on the environment has been identified by the National Minister of Environmental Affairs and Tourism.

These scheduled activities can only proceed if given official approval under regulations published in terms of sections 21, 22 and 26 of the National Environment Conservation Act (*Republic of South Africa, 1989*). Environmental rights may be defended in court. The law also guarantees the right of access to information on environmental risks.

Environmental legislation gives effect to two different aspects of planning and development namely Integrated Environmental Management (IEM) and Environmental Impact Assessment (EIA). IEM is a process that aims to achieve a desirable balance between conservation and development by ensuring that those environmental considerations are fully integrated into the planning and development process. The aim of IEM is to resolve or mitigate negative impacts and to enhance the positive aspects of development proposals.

The IEM process, which considers development alternatives, is based on:

a) A broad understanding of the term environment (one that includes physical, biological, social, economic, cultural, historical and political components);

b) Informed decision-making;

c) Accountability for decisions and for the information on which they are based;

d) An open, participatory approach in the planning of proposals;

e) Proactive and positive planning.

Environmental Impact Assessment (EIA) is a tool for decision-making that entails a process of identifying, analysing and evaluating the positive and negative environmental affects of a proposed development and its alternatives. The EIA regulations spell out procedures that must be followed before a decision-making authority at a provincial level can consider approving scheduled activities that may have a detrimental affect on the environment. A development may, in terms of the environmental legislation, be denied approval to proceed if it is shown to have an unacceptable detrimental effect on the environment.

4.3.2.5 Levies, taxes and service cost

Uniform rates apply in the study area for the cost of services such as electricity, water and refuse removal. The same applies to property taxes and levies, except in certain isolated instances where "tax holidays" are provided as an incentive to attract industries to a specific area. An example of this is the tax holiday that is offered to firms locating at the Capricorn Science and Manufacturing Park and the Philippi industrial township (*Wesgro, 2001*).

4.4 Factors which influence the demand for land

4.4.1 Introduction

The demand for land is determined by the amount of utility/profit which an individual or firm can extract from that land. It is therefore important to fully comprehend the location choice of firms, in other words, to understand the factors that firms regard as important land attributes which would improve their productivity or the utility which they receive from occupying a specific location.

4.4.2 Theory of location choice

Due to the fact that service provision has become such an important part of the industrial economy, much of the research on location decision that has been undertaken for residential, office and retail markets can also have an application in the light industrial sector. It is therefore necessary to consider case studies across all the land use sectors in order to arrive at a set of key location determinants which have an impact on the demand for industrial land.

Sasaki (*1991:140*) grouped the factors which determine location of firms within a CBD into two categories, namely location attributes and physical attributes. Location attributes are the characteristics of where the site is situated and include accessibility, visibility and image. Physical attributes have to do with the size, age and height of the building, in other words, improvements to the land.

A third category, namely service attributes, can be identified. Service attributes refer to the extent to which the land is provided with municipal services such as sewerage, water supply, electricity, roads, parking and storm water.

4.4.3 Location choice attributes in non-industrial sectors

4.4.3.1 Office location attributes

Sasaki (*1991:145*) applied an empirical model to a Japanese city and found that land rent would decrease by approximately 40 percent if the distance from the railway station were doubled, rail being the most important passenger transport mode in Japan. Despite the fact that his definition of accessibility is an over-simplification (he merely defined accessibility as the distance to the nearest railway station), he concluded that accessibility might affect the position of the demand curve at a specific location. The reason for this is that the demand price is higher at a location with better access to many establishments, to transport facilities and to public offices (*Sasaki, 1991:141*).

According to Sasaki (*1991:141*), an alternative variable representing the extent of demand for land is the density of employment, because the space for an office proportionally depends on the number of people working there. However, he ignored the type of work that the individuals do, which may differ between locations. Two locations may have a similar number of workers per area, but their level of skill as reflected in their earnings may differ substantially to the extent that the collective production value of one group can afford much higher land value than that of another group. In addition, certain "office" work may require more interaction with clients and/or fellow workers.

One of the most extensive cross-sectional analysis of office location patterns and linkages yet was undertaken in London based on the application of Berry's model (*Goddard, 1975: 31*). Berry (*Goddard, 1975: 24*) proposed that city centre linkages may be arranged in the following three matrices based on work that he did on the relationship between commodity flows between sectors and regions and the spatial structure of the UK economy:

- An inter-sector input-output matrix of information flows;
- A spatial structure matrix describing the geographical distribution of office employment in different sectors between different locations;
- A matrix of physical movement between these locations.

Goddard postulated that location theory was in many respects still in the age of the first industrial revolution and has not adjusted itself to the realities of the information age. However, through empirical studies he found that many firms providing associated services are still grouped in a geographical area within London, as they have been for literally hundreds of years. Examples are the civil engineering-related services which are clustered in Westminster and Bloomsbury, whilst banking and finance are found in the City of London. He also pointed out as far back as 1975 that many firms are bound together by a series of very routine tasks that can be performed at any distance through modern (1975 vintage) communications. It was perhaps the anticipation of the major advances in information technology that prompted Goddard to conclude (*1975: 34*) that, despite strong evidence of functional linkages, most routine tasks cannot be performed without personal contact. He believed that spatial location is therefore not a necessary condition for functional linkage.

In order to understand this phenomenon Goddard explained the geographical location of organisations by means of three levels at which organisations interact:

- Interaction with other branches or functions within the same organisation;
- Interaction during the act of service delivery to clients. This can either be the delivery of finished physical products (a new dining suite at home, or the purchase of groceries at a local supermarket) or the conveyance of information (obtaining information from an investment broker);

- Suppliers, which could be suppliers of information, raw materials or other inputs to the manufacturing process.

Goddard gave specific attention in spatial location theory to explain the location of specifically office functions. He identifies both functional and physical concepts to explain the job functions that are performed on office premises (*Goddard, 1975:3*). Under physical functions he groups the following:

- Individual jobs are referred to as office activity;
- Office occupations refer to a group of similar office activities;
- Office organisations are the formal groupings of different office occupations, such as a government department, corporate head office or university.

The pattern of formal and informal links between the office activities defines the structure of the organisation.

Under physical concepts he defines the following:

- Office buildings which are used to undertake the office activities;
- Office establishments which are physically separate locations where office activities are conducted.

According to Goddard (*1975:11*), the social and technical environment in which firms operate can have two meanings:

- The environment as the climate of operation; and
- The environment as the geographical area where the firm operates.

The Swedish geographer Gunner Törnquist linked the location of organisational function to the structure and volume of flows between two organisations (*Goddard, 1975:14*). His model produces an index of accessibility from each urban region to potential contact sources in the remaining regions in Sweden, given that Stockholm has an accessibility index value of 100.

Another Swede, the economist Bertil Thorngren, went further to discuss the different types of information flows in organisations (*Goddard, 1974:17*). Thorngren identified three types of information inputs in the decision making process, namely orientation processes, planning processes and routine matters. With minor adaptations to suit local circumstances and to allow for improvement in communication and transport means, these processes are defined as follows:

a) Orientation processes are long–term, direction-giving exercises that are conducted usually by means of comparatively lengthy pre-arranged meetings by individuals who seldom meet. The people involved are often high-powered individuals who are located in major urban centres.

Location of an organisation within the metropolitan area is of little importance, provided that the location is well connected to international airports. In many instances the meeting place could even be moved to a mutually convenient place far removed from the organisation. National and multinational firms often deliberately chose exotic locations for this purpose.

b) Planning processes occur more often than orientation processes. The nature of meetings is more focused on specific projects and issues, without discussing individual detailed tasks. In the case of companies that provide services to corporate clients, such meetings could include clients to discuss the brief of a certain study, or to present the findings of an investigation.

c) Routine matters are specific discussions between familiar individuals to resolve specific detail issues. Contact is therefore regular, but are much shorter in duration than that of planning processes. These tasks can often be performed through telecommunications, but personal contact is in many instances still very important. Examples include delegation by a superior, the conversation between a shop attendant and a prospective client, or between a financial advisor and an investor.

4.4.3.2 Retail/shopping location attributes

Terblanche (*1989:91*) identifies two methods for determining the location of a retail development, namely the empirical method and retail gravity flow models. In the empirical method the sphere of influence of a retail centre is referred to as the market area. The market area forms an approximately fixed geographical area around the location point from which the potential clients of such a development will originate.

Terblanche (*1989:115-116*) noted the following factors that determine the size and shape of the market area:

- Travel time and travel distance from the retail centre. The market area therefore usually extends further from the retail centre along major transport corridors;
- The size distance/time which customers are prepared to travel depends on the selection and type of products that is offered. In this respect an establishment that competes with the retail development in offering similar product, selection and convenience have a major impact on the market area of both establishments;
- Accessibility to and availability of convenient parking. In this respect accessibility is defined as the convenience with which the parking area can be accessed from the adjacent side street or major arterial. This definition of accessibility differs substantially from the definition of accessibility provided in Chapter 6;
- Residential density;
- The provision of public transport facilities is important, particularly where the target market is low-income groups;

- Topographical characteristics, such as mountain passes, could have an influence on the travel time and cost, with the result that the topographical features of the land can form a barrier in the market area.

Gravity models are commonly used tools to determine a retail development's market area. Although the input variables and formulae for the gravity models differ, they are all based on the function of population size inverse to travel distance. Reilly (*1931*) was the first to apply these principles in the following gravity model.

$$MA = \frac{D_{ij}}{1+\sqrt{\frac{P_i}{P_j}}} \qquad (4.1)$$

where:

MA	is the market area in distance from city j;
D_{ij}	is the distance between cities i and j;
P_i	is the population of city i (the larger city);
P_j	is the population of city j (the smaller city).

Based on an empirical study of development nodes in the Gauteng, Van der Merwe (*1999:195*) found that nodes where regional and sub-regional shopping centres are situated are much favoured for office developments. The presence of such shopping complexes is found to be a major catalyst for model development. This certainly holds true for the two major decentralised nodes in Cape Town. In the case of the Claremont node office development was preceded by the construction of the prestigious Cavindish Square centre, and development in the Durban Road Corridor (Golden Mile) was preceded by the construction of Tygervalley Centre. Although close the Cape Town CBD, the same applies to the V&A Waterfront, where office relocation followed an already established entertainment tourist/retail attraction. In the case of Century City the development includes a mixture of entertainment and retail in the form of a major regional shopping complex, undertaken by a single large developer who could dictate the timing.

However, Van der Merwe did not answer the question whether these office developments are attracted to retail centres or whether they are attracted to the labour supply surrounding the retail centers. It is well known that retail location is market related. Major retail markets are high-income areas, which also happens to be the areas where the highly skilled technical and professional labour force resides.

4.4.3.3 Residential location attributes

Other attempts have focused on the identification of the variables that impact on location decision and to quantify the impact of any one or combination of these variables on the location decision. A study of the determinants of property value identified the following determinants of residential location in the Greater Toronto Area (*Haider & Miller, 2000:6*):

- Accessibility variables;
- Structural attributing variable;
- Site attribute variables;
- Local service provision and cost;
- Environmental impact variables.

According to an accredited property valuer (*Dorfling-Terblanche, 2000*), when families decide on location, aspects such as view, ambience, neighbours and "address" play a much larger role in the selection choice of a property. However, access to transport facilities is rather considered by the developer in his decision to develop or not. In other words, when a developer buys land for development, he will consider the timeframe and holding cost in the purchase price. The timeframe for development depends a lot on when the necessary road infrastructure will be in place to provide proper access to the property. When considering accessibility of residential properties, one should look at the accessibility to developable pockets of land rather than at individual erven.

Another aspect is whether the market populations can verbalise that they want a certain degree of accessibility, or do they look unknowingly for features in a property that reflect the degree of accessibility.

In order to illustrate the impact of ambience on a property value, Rode (*1994:10*) compares the Cape Town CBD with the Victoria and Alfred Waterfront (V&A). He estimated a premium for ambience of about ten rand per square metre rental in 1994. However, such a comparison may not be quite relevant, because there are also factors apart from ambience that have an impact on the higher property prices. One such factor is the availability of parking. There may also be a scarcity of office space supply in the V&A due to the fact that the V&A still offers a small amount of office space compared to the CBD. The fact that it is currently a "fashionable" area therefore could result in a short-term supply shortage that will be satisfied in the longer term.

4.4.4 The demand for urban industrial land

The factors which impact on the demand for land is best described through the factors which influence the location choice of industrial firms. The demand analysis will therefore give us an indication of the factors which influence the relative land values of particular locations within the study area.

Literature on industrial location has been concerned mostly with the inter-urban location of industrial functions. Few attempts have been made to explain industrial locations within the spatial framework of a city or metropolis. Furthermore, decisions regarding the location of industries are often based on a number of subjective criteria with little or no empirical studies on the effect of office location on the way that the organisation operates. There is thus a need to explain the intra-urban location patterns of key land uses through the interaction between organisations within the social and technical environment. This section provides the necessary insight into the factors which firms objectively and subjectively take into account in their location decision.

Harvey (*1996: 203*) makes the statement that location choice of an industrial firm in the past focused more on the town or city that offers the greatest overall location advantage, rather than the selection of a site within a particular city. He continues that the actual location of a firm within the urban area will depend on the stage of development of the firm, and states further that start-up firms which serve a small localised market typically locate in or close to the CBD, whereas large established firms with national or international markets locate on the periphery of the urban centre to take advantage of freeways and cheap land.

These statements need to be put into perspective. The first part of the statement certainly holds true for some types of industries, most notably the traditional heavy manufacturing plants such as steel mills or chemical factories. The actual location choice of these industries is determined overwhelmingly by the location of the low–cost, high-volume input materials, or they are forced to locate away from existing urban areas due to environmental constraints. In many instances these large industries even created their own towns, Sasolburg being the prime example in South Africa. Many of these towns have subsequently grown to support other industries and developments as well. In this respect Gauteng is a good example. As little as 50 to 60 years ago industries in this area focused almost exclusively on supplying the mining industry. The location of industry was entirely due to the fact that there happened to be gold in the ground. Subsequently, however, the area has created its own industrial momentum with a very broad industrial base.

The question is how this has affected industrial location in Cape Town. Cape Town was established long before the industrial revolution even took place. Industrial location criteria therefore played no role in its formation or spatial location. Industries that have located there have to a certain extent done so naturally and not because of mineral deposits; in fact the city is far removed from large mineral deposits. Furthermore, it is far removed from the major local markets in Gauteng. This relative isolation from markets as well as raw materials makes Cape Town an ideal study area.

The second part of the statement which explains the location of industries within an urban area on the size of the industry and the market they serve also needs some further explanation. Within large metropolitan areas the manufacturing focus has shifted from heavy manufacturing (such as steel mills, steel foundries and vehicle manufacturing) to light industry and high technology during the past three decades (*CMC, 1998b:33*). These light industries have different requirements to the traditional industries; for example they need cleaner, smaller sites in a pleasant work environment with a greater component of office space. Concepts such as industrial parks and science parks developed. This means that what was previously termed industrial land uses is by no means uniform any more. The analysis of the access requirements of these entities therefore needs to be considered separately as well as together. For example, there is a vast difference between the location choice of an oil refinery or hazardous chemical plant, on the one hand, and a plant that manufactures computer hardware or CDs. A clear distinction therefore has to be made between the different types of industrial land uses under investigation in order to assess the impact that accessibility has on each type jointly or separately.

Van der Merwe (*1999:54*) also found that at a local level industrial developments are almost always agglomerated into specific townships. The reason for this could be both agglomeration benefits or the fact that such developments are established in terms of town planning schemes on land earmarked for that purpose.

In a stated preference study which was undertaken in the United Kingdom, established local firms rated freeway links the highest of all location determinants (*Leitham, Mc Quaid & Nelson, 2000:532*). This illustrates the dominance of road links for the distribution of goods and services. Firms outside the United Kingdom considered workforce and premises as the prime reasons for locating or not locating in the United Kingdom. Road links are therefore a crucial factor in determining the actual location of an industry at a fine geographical level, whereas centres of population, input resources and market sectors are the main regional location determinants (*Leitham, Mc Quaid & Nelson, 2000:532*).

The first consideration in site selection is the location of a firm's various resources and markets as the main objective is to lower transport costs from the location of raw materials or primary producers through the logistics chain to the consumer (*Vogt, Pienaar & De Wit, 2002:26*). Coyle, Bardi & Langley (*1996: 449-453*) identified the following additional region-specific, as opposed to site-specific, determinants of location:

- Labour climate;

- Availability of transportation services and their cost;
- Proximity to markets and customers;
- Quality of life;
- Taxes and industrial development incentives;
- Supplier networks;
- Land cost and utilities;
- Company preference.

The availability and cost of transport services, the proximity to markets and customers, and access to supplier networks will all have to be included in the definition of transport accessibility (see Chapter 6). The quantification of transport accessibility will be the independent variable in the analysis.

Cost of land, services and utilities are the main input variables for the calculation of the economic value of land (see Chapter 5), which is the dependent variable in the relationship between transport accessibility and the value of industrial land.

Due to the fact that within an urban environment labour is considered to be a completely mobile production factor, the labour climate and quality of life are not expected to impact on the location choice of industries within an urban area. Further proof of this is provided by the findings of the regression analysis in Section 6.5 (Step 1).

With the exception of the Philippi industrial township, taxes in Cape Town are uniform (see Section 4.3.2.5). Due to the fact that Philippi was excluded from the sample of dependent variables used for the regression analysis, it would have no bearing on the results of the analysis.

Factors such as company preference can obviously not be quantified within the scope of this study and would remain an unknown. Other qualitative aspects identified by Pienaar (*Vogt, Pienaar & De Wit, 2002:26*) include security and safety, legal concerns and local factors such as the attitude of the community towards new development. With the exception of safety, these factors are not major determinants of location within an urban area. Townships that were regarded as being a major security risk were excluded from the survey sample (see Table 5.1)

Following is a list of trends in the logistics environment that will impact on the demand of light industry for land within an urban area (*Coyle et al 1996:453*):

a) Direct plant-to-customer shipments which could reduce the need for field warehouses and distribution centres;

b) "Drop" shipments which arrive directly from suppliers and not via third parties;

c) Cross-docking operations which involve the consolidation of freight from a number of sources into a single load to a specific end user. This could eliminate the need for inbound consolidation facilities;

d) Strategic use of centralised, region-based distribution facilities;

e) Particular companies will make use of third parties to assume logistics tasks, including warehousing and distribution.

4.5 Change in land price as an indicator of economic development

4.5.1 Introduction

Due to the fact that the concept of value is central to this analysis, a clear distinction must be drawn among related terms such as price, cost and value. Price represents the amount a particular purchaser agrees to pay and a particular seller agrees to accept under the circumstances surrounding a specific transaction, whereas cost applies to the production process rather than exchange. It can be divided into direct, or hard, costs and indirect, or soft, costs, as well as construction and development costs. Value represents the monetary worth of land to buyers and sellers.

Although market value is a simple concept, different beliefs and assumptions about the marketplace and the nature of value render any ultimate definition controversial. Market value definitions fall into five categories. The following definition incorporates the concepts that are most widely accepted: the most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress.

The Appraisal Institute's Standards of Professional Practice (*Ellenberger, 1992:10)* requires that an estimate of market value include a statement that specifies whether the financing terms are at, below, or above market interest rates and whether unusual conditions or incentives are present, and also quantify contribution to, or negative influence on, value. Other types of value are also considered in real estate: use value, investment value, going-concern value, insurable value and assessed value. Use value focuses on the real estate's contributory value to the enterprise of which it is a part, without regard to the property's highest and best use. Investment value is the value of an investment to a particular investor, based on his or her investment requirements. Going-concern value is the value created by a proven property operation in which the physical real estate assets are an integral part of an ongoing business. Insurable value is the portion of value that is covered by casualty insurance. Assessed value refers to the property's value according to the tax rolls. Four interdependent factors create land value, namely utility, scarcity, desire and effective purchasing power. The interaction of these four factors affects the balance of supply and demand. Various schools of economic thought have contributed to the development of modern value theory. As seen in Section 4.2 above, the classical school represented by Adam Smith departed from mercantilist theory by attributing value to the cost of production. The labour theory of value, set forth by Karl Marx, and the opposing concept of marginal utility, which linked value to demand, both challenged the classical theory of value. The neoclassical economies of Alfred Marshall combined classical supply-cost considerations with the demand-price theory of the marginal utility school.

The purpose of this section is to review the work that has been done to establish the theoretical relationship between land price; the yield of land and competition between firms to occupy land as well as the factors that determine the demand for land. The central theme of the review will be the impact of accessibility on land prices.

4.5.2 The economic value of land

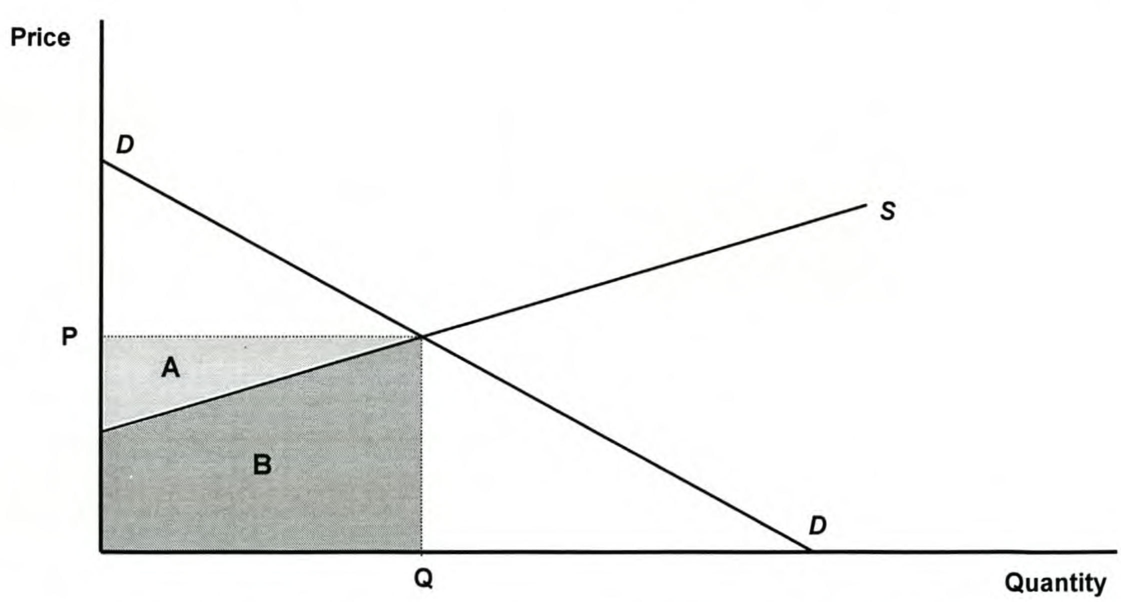
From Section 4.3 it can be concluded that (a) the supply of industrial land is fixed in the short term, (b) that land is an immobile factor of production in the short term from both a physical and economic perspective and (c) that the supply of industrial land is therefore completely inelastic in the short term. These three aspects have important consequences for determining the price of land.

Given then that the supply of land is fixed in the short term, its price would be determined by the demand therefore only. In this instance the factors that influence the demand for land would have a direct influence on the price of land. The demand for land stems from the fact that one or more firms wish to locate at a particular site, which in turn depends on the net revenue that a firm expects to obtain from locating at a particular site.

Assuming a fixed supply, the long-run equilibrium price for a particular site will be at the point where land is used most profitably by an individual firm within the institutional framework, physical restrictions of the land and subject to the imperfections of the real property market (*Harvey 1996: 197*). However, it is not only the price of land that is important, because if we wish to prove that land price is indicative of economic development, it is critical that only the economic (or resource) value of land is included in its price. On the impact of prices by competing industries Needham (*1980:102*) proved theoretically that one industry might occupy land the price of which is determined by another, in which case the price of the land may not in all instances be a reflection of its true economic value. This means that the price of land may not be a function of the goods produced on it, in which case its price would not reflect its true resource value. Lipsey (*1980:355*) also recognised this in his classic question whether cinema tickets in central London are expensive because the price of land is high, or whether the land price is high because the price of cinema tickets is high.

Lipsey (*1980: 365*) identifies two types of land prices, namely "transfer earnings" and "economic rent". Transfer earnings are payments necessary to prevent the supplier of land transferring the land to its next most profitable use. Under these circumstances land prices determine the price of the product produced on that land. If land prices are higher than transfer earnings, the supplier of land receives an economic rent, which is equal to the difference between the actual rent and the transfer earnings. In this instance land prices are determined by the price of the product produced on it. The relationship between transfer earnings and economic rent is explained graphically in Figure 4.3.

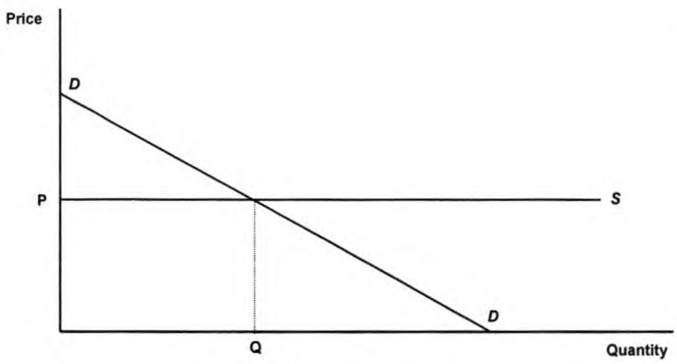
Figure 4.3: Transfer earnings and economic rent components of land price



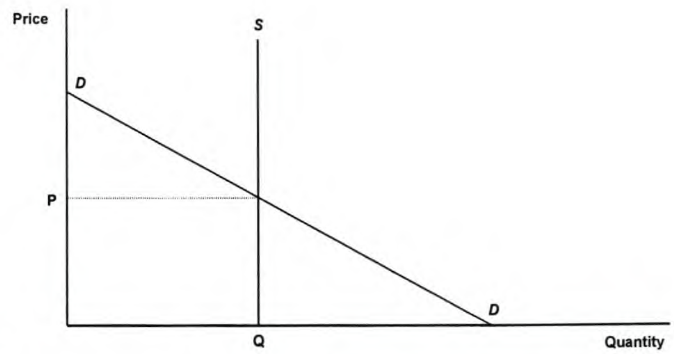
In Figure 4.3 lines **D** and **S** represent the demand and supply curves respectively. The shaded area **A** above the supply curve represents the economic price of land, whilst the shaded area **B** below the supply curve represents the transfer earnings. The ratio of economic price to transfer earnings therefore depends entirely on the elasticity of the supply of land. If the supply of land were perfectly elastic, i.e. there is an unlimited supply and one can obtain as much land as one wishes at a fixed price, land price would consist entirely of transfer earnings (see Figure 4.4 (a)).

Land price therefore consists entirely of the amount that a particular firm has to pay to prevent the site from being used by another firm. If, however, the supply for land were entirely inelastic, the entire price would consist of economic rent. In other words, the price of the land would reflect the value of the products that can be produced on it, and even if a lower price were offered, the land would not be transferred to an alternative use (see Figure 4.4 (b)).

Figure 4.4: Elasticity of land supply



(a) Completely elastic supply of land



(b) Completely inelastic supply of land

The examples used by both Needham and Lipsey need to be investigated further. To use Lipsey's example: the price of cinema tickets is high because the price of land is high, i.e. the cinema industry has to outbid the (say) retail store for a prime tract of land. Surely the same would not apply if the land were strictly reserved for the cinema industry. Then the price of land would be determined by the price of cinema tickets. Even if cinema company A outbid cinema company B to occupy the land, it would mean that cinema company A has a lower total running cost than B in order for it to be able to pay more for the land and make a bigger profit, given that it will not be able to sell cinema tickets at a higher price than B. Surely then the fact that firms within the same economic sector outbid another for land means that one firm is more efficient than another and greater efficiency (productivity) is one of the primary sources of economic growth. The fact that land price increases due to an increase in efficiency is therefore an indication of the level of economic growth. It can therefore be **concluded** that when firms within the same sector, say manufacturing, bid for land, the value of that land reflects the value of goods and services produced in the most efficient manner and therefore reflects the economic value of the land. But when bidding for land occurs across sectors, let's say retailers are bidding for industrial land, then the land price would also include transfer earnings.

The following factors should therefore be taken into account in the calculation of the economic price of land by means of the shadow price method:

a) Only land that is zoned for industrial use should be included in the analysis;

b) The value of the improvements and amenities on the land should be excluded (*Kanemoto, 1988:981*);

c) Divide industrial land into categories of industrial usage (small, medium, large) in order to account for different types of industry;

d) Only consider industrial land that is used only for industrial purposes; in other words, industrial areas that has been infiltrated by other land uses should be excluded from the survey in order to exclude transfer payments.

e) Assume that there is perfect mobility of industry in order to exclude any possible monopolistic rent.

It was mentioned above that land price consist of two components, namely transfer earnings and economic rent. The economic rent component is determined by the value of the goods and services produced on that land *(Lipsey, 1980:365-366)*. The sum of the value of goods and services is the GGP. If land price consists of only economic rent as determined by the value of products produced on it, and if GGP is an indicator of economic development, then a change in land value would reflect a change in economic development potential. The only reason why a firm would wish to outbid another for occupation of a certain piece of land is because it can improve its productivity by doing so. If therefore changes are made which influence the price of the land, it is in effect the fact that the changes improve the value of the products that are produced on the land which changes the price of the land.

4.6 Summary of issues

a) The value of land can be regarded as its utility. Utility of land is reflected in its opportunity cost, which in a free market environment is represented by its market price, i.e. the price that someone is willing to pay for the land.

b) Market price is determined by the supply and demand for land, i.e. the willingness to pay a certain price for the land. However, given that the supply for land in the short term is fixed, i.e. supply is inelastic, the price of land is determined by demand.

c) The need exist to merge theories on land demand, supply and location choice and to properly define accessibility if we are to fully comprehend the impact of transport on development.

d) The trend of decentralisation in the Cape Metropolitan Area, however, is less of a factor than in the rest of South Africa for a number of reasons, including:

- Lower security risk, mainly due to the fact that there is little low-cost housing in and around the CBD;
- Scenic beauty of the location between the mountain and sea;
- Major points of attraction such as the V&A Waterfront.

e) In all the models that Goddard listed there is a very close link between accessibility and office location. Location at a regional – in the case of this study metropolitan – level is very closely linked to the degree of accessibility between functions within an organisation, between an organisation and its clients, and between an organisation and its suppliers.

f) Demand for land depends on the yield of the land, which is the land rent;

g) Land rent is a direct input to the cost of production, which includes transport cost;

h) Location theory regards transport accessibility/cost as one of the most important factors which determines the location of industries;

i) Profit is directly related to land rent and transport cost. A decrease in transport cost will increase the demand for land because production cost will reduce. The lower the transport cost, the higher the land rent that can be charged by the landowner to achieve the same level of profit.

j) There are a number of key differences between the importance of transport for different land uses types:

- Modern communications are likely to decrease the importance of transport accessibility in the office location decision;

- Accessibility will become more important for the retail sector. Together with the increase in congestion, it will mean that retail outlets which sell basic consumer goods will locate closer to their customers. This would mean a reduction in the growth of large regional retail centres, whose function will be taken over partly by the smaller community-based retail stores and partly by e-commerce;
- Transport accessibility will become more important for the industrial sector as the demand for transporting high-value goods increases.

CHAPTER 5

DETERMINING THE ECONOMIC VALUE OF INDUSTRIAL LAND IN CAPE TOWN

5.1 Introduction

One of the hypotheses of the dissertation is that a change in the accessibility to land would bring about a change in the economic yield of the land. However, there is not a market mechanism to measure the exact value of the economic yield of a given area of land. In the absence of the measurable output of land, a change in the economic yield of the land would be reflected in the economic value of the land (see Chapter 4). It was also found in Chapter 3 that growth in industrial output would be one of the main driving forces behind economic development in Cape Town. The aim of this chapter is to determine the economic value of industrial land in Cape Town. Changes in the economic value of industrial land would therefore reflect the changes in the industrial yield of the land, and therefore also the change in the potential for economic growth.

5.1.1 Process for determining land value

5.1.1.1 Introduction

The main body of literature on the subject of property value comes from the property valuation profession. Although property valuation has been undertaken literally for centuries, it is only recently (during the past 20 years) that a professional registration process was instituted in South Africa and that universities and technicians started to offer academic qualifications in the field (*Dorfling-Terblanche, 2000*). Despite the registration of valuers and the formalisation of valuation procedures, however, property valuations are still often successfully challenged in court. Valuation procedures therefore appear to be focussed on what will stand up in court based on previous court rulings, rather than what is correct in terms of sound economic land theory. It is thus not surprising that a legal expert named Jonker authored the most authoritative work in South Africa on the underlying theory of property valuation. Although the procedures for valuing property in terms of its true economic value are not always based on sound land economic principles, they do provide a practical base for developing a procedure to determine the economic value of industrial land by means of the shadow price method.

5.1.1.2 Description of property valuation methods

Jonker (*1984:20*) defines three methods to determine the value of a property:

a) **Direct comparison** of the price of a similar property sold recently on the open market after being available for sale for a reasonable period. This excludes properties sold on auction as an auction price does not reflect market price due to the fact that (a) there is too much emotion involved in the selling process and (b) the property has often not been exposed to a sufficiently large number of prospective buyers. This method is the most widely used by property valuers, because it is the easiest to defend in court.

In order to allow a statistically valid relationship between economic land value and transport accessibility, properties with exactly the same physical attributes, but with different levels of accessibility need to be compared.

b) The **cash flow method** enables one to determine the highest possible development potential of a property over an evaluation period over which the capital invested in the property has been recovered through the income from rent. The capitalised value of a property at a particular time is therefore the "reasonably calculated expected net income flow of an investment property discounted to its present value" (*Ellenberger, 1992:6-3*). All expenditure (purchase price, maintenance, rates, taxes and levies) and income (rent and the expected selling price at the end of the evaluation period) is calculated and forms the cash flow stream for the calculation of the net present value (NPV). The projected discount rate, which takes account of inflation, the prevailing interest rate and a risk premium for investing in the property market, is used as the discount rate. The discount rate which should be used for this purpose is the prevailing rate of return sought by prudent investors, which is commonly referred to as the capitalisation rate and is expressed as a percentage; it consists of (a) an interest component for a completely risk-free investment and (b) a risk factor that represents the return over and above the bank interest for accepting the risk in property investment. The NPV reflects the current value of the property.

Property value can be calculated by means of the following Equation using the cash flow method:

$$PV = \left(\frac{FI}{(1+i)^n}\right) + \left(\frac{SP}{(1+i)^n}\right) - \left(\frac{FC}{(1+i)^n}\right) \quad \text{.......(5.1)}$$

where:

PV is the present property value;

FC is the future maintenance cost of keeping the property in a sufficiently good condition to achieve the highest possible economic occupation rent;

FI is the future occupation rent income;

SP is the future selling price of the property;

n is the discount period in years;

i is the discount rate expressed as a decimal fraction.

c) As is the case with the cash flow method the **development method** calculates land value based on the fact that the land has a certain yield. However, whereas the cash flow method takes a long view, the development method calculates the value of land based on current occupation rent levels and the current standard property capitalisation rate. The standard capitalisation rate is the expected first year's net occupation rent income before income tax and interest and assuming that the building is fully let at the current market occupation rent divided by the transaction price excluding transfer cost and value-added tax times 100 (*Rode, 2000:Annexure 1*). In order to do so the highest possible market-related occupation rent is used within the framework of the external physical attributes of the property. If there is no building on the land, then an imaginary building is placed on it and the rent income that the building will yield is then calculated and the cost of development, including services and building cost is subtracted. If the building that is currently on the sight is not achieving the full income potential of the land, then it is replaced with one that would yield the highest possible income. Both the demolition and redevelopment costs are subtracted in this instance.

Property value can be calculated by means of the following Equation using the development method:

$$PV(n) = \frac{RI(n)}{PCR} * 100 \qquad \text{....................(5.2)}$$

where:

PCR is the Standard Property Capitalisation Rate (%);

RI(n) is the total Rent Income during year n;

PV(n) is the Property's Value in year n.

5.1.1.3 Evaluation of property valuation methods

Although generally accepted by the courts, the direct comparison method suffers from a number of constraints if applied to scientific research. Firstly, unserviced virgin land can be zoned for anything, from residential, retail and office to industrial. The price of land would therefore include transfer payments, as industrial land uses would have to pay a premium over and above the economic value of industrial land to outbid other land uses. Secondly, industrially zoned land that is sold usually has been provided with engineering services such as internal access roads, stormwater, electricity, water and sewerage. The selling price therefore includes the cost of providing these services, the cost of the approvals process, as well as the profit to the developer. Thirdly, an insufficient number of industrial properties are sold on the open market during a short-term period from which to build up a statistically representative sample. The direct comparison method is therefore considered to be inappropriate for determining the economic land value for properties for the purposes of this study.

Although the cash flow and development methods are useful when making a property investment decision, they suffer from a number of constraints. Firstly, a number of assumptions have to be made about future interest rates, selling prices, maintenance cost, etc. Secondly, the method does not allow for the calculation of the economic value of virgin land as it assumes a selling price for the entire property including the improvements. Thirdly, as indicated previously, although it is of little concern to this study, it is still interesting to note that this method is not accepted in court as a reflection of the property's value.

The cash flow and development methods would bring us the closest to what the real value of land is in terms of the definition of economic value as defined in the land rent theory (see Section 5.1.1.2 (b) and (c)).

5.1.1.4 Procedure for calculating the economic land value

Ellenberger (*1992:6-14*) recommends a procedure for the calculation of a property's value. This procedure was adapted for the purpose of this study to calculate the economic land value per square metre, rather than the absolute value of a specific pocket of land with a specific size.

Step 1: Determine the land use.

The economic land value is based on the land use that will ensure the highest and best use of the land. For the purposes of this study the land use is based on the current industrial zoning rights of the properties and is similar for all properties. Any transfer payments to outbid other land uses are therefore eliminated.

Step 2: Estimate the economic income (yield) of the land.

The economic yield of industrial land is reflected in the economic occupation rent for industrial floorspace. As was explained in Chapter 4, the price of land is determined by the yield of the land. However, land price would only reflect the true economic value of the land if an economic rent were charged. Given the land use zoning mechanism, it is therefore assumed that no transfer payments take place to prevent other land uses from occupying industrial land. Industrial townships, where there is evidence of a significant invasion of industrial land by other land uses, were excluded from the analysis. The collection, enhancement, validation and occupation rent values are presented in Section 5.2.

Step 3: Determine the property value.

The property's value is calculated by capitalising the economic occupation rent by applying either Equation 5.1 (cash flow method) or Equation 5.2 (development method).

The calculation of the value of industrial properties for each industrial township in Cape Town using the cash flow method is presented in Section 5.3.

Step 4: Determine the development cost of the land.

Development cost includes the cost of establishing the infrastructure (approvals, plans, cost of engineering services such as internal roads, stormwater and sewage) that will allow such development potential to be fulfilled, as well as the improvements (buildings and structures) which are made to the land in order to fulfil its intended function.

$$DC = EC + PI \qquad (5.3)$$

where:

- DC is the development cost of the property;
- EC is the establishment cost;
- PI is the improvements to the property in order to maximise economic occupation rent.

Step 5: Calculate the economic value of industrial land in Cape Town.

The development cost per square metre is subtracted from the capitalised rent income. Therefore, if the required capitalisation rate is known, land yield for a specific level of accessibility is known from the regression analysis function (see Chapter 7), and all development costs are known except for the value of land, then the value of land can be derived from the capitalisation Equation.

$$LV_e = PV - DC \qquad (5.4)$$

where:

- LV_e is the economic land value.

5.1.2 Influence of the intensity of land usage on economic land value

The intensity with which the land can be used is designated by the bulk factor of land. Bulk restrictions are, together with the land usage and other conditions, laid down in the title deeds of the property. A bulk factor of one means that the amount of floorspace that may be provided in the buildings on the land is equivalent to the total land area. Therefore, if 50% of an erf with a bulk of one is used for parking and loading, the building that is erected on the other half may be a double story. However, it should be borne in mind that the parking and loading may be needed to optimise occupation rent of the building and that multi-story buildings are not suitable for industrial purposes.

For the purpose of this study we are interested in the potential economic value of land per square metre in a particular industrial township, rather than in the actual total value of any specific property in that township. The occupation rent per square metre should therefore indicate the yield of the land per square metre, irrespective of the intensity with which the land in the industrial township is developed. Neither the potential bulk factor of the land, nor the actual area which is developed therefore has any impact on the economic land value per square metre, provided that the following conditions are met:

a) Sufficient parking and loading space are provided on the site to optimise the occupation rent of the floorspace;

b) Only ground-level floorspace is taken into account. Floorspace that is above ground level is not classified as "prime" (see Section 5.2.4) and is therefore excluded from the database. It can also be observed that all modern industrial buildings are single story, except perhaps where offices are provided on the upper story in order to optimise ground level floorspace for industrial purposes.

5.2 Determining the economic occupation rent for industrial floorspace

5.2.1 Definition of economic occupation rent

Economic occupation rent is the actual rent of office space measured in rand per square metre and is determined where the demand for and the supply of office space at that location are at equilibrium (see Section 4.5.2). In the short term the supply of space is usually fixed if all buildings are fully occupied. In the long term supply can respond to demand by constructing new premises (if there is a shortage of supply), or demolishing premises and replacing them with another use (if there is an over-supply). Additional supply of space can therefore either occur by increasing the amount of space on a specific land area within an already developed node, or by expanding the size of the node.

5.2.2 Data requirements

In order for the results of the study to be statistically valid, occupation rent data should conform to the following requirements:

a) The source data should be reliable;

b) Collection and analysis should conform to generally accepted statistical practice;

c) Internal physical attributes should be uniform;

d) It should reflect the **economic** occupation rent;

e) The sample should include as many of the industrial townships in Cape Town as possible. It should therefore be representative of the transport accessibility within the study area;

f) The size of the floorspace is important as the type of industry that requires smaller properties differs from those that require larger properties, and the rent per square metre decreases with the amount that is rented. A sufficient sample size in each floorspace category therefore needs to be obtained;

g) In order to be of any use a sufficient number of transactions within a relatively short time window would have to be obtained to negate shifts in accessibility or in business confidence, which may have an external effect on occupation rent.

5.2.3 Identification of industrial townships in Cape Town

The location of all the major industrial townships in the study area is depicted on the map in Figure 1.3. All the noted industrial townships were included in the analysis. However, certain number of the townships were excluded from the further detailed analysis due to the fact that they did not conform to the criteria for determining the economic value of industrial land. Table 5.1 provides a list of the industrial townships and the reasons for the exclusions, where applicable. Full details of the reasons for the exclusions are provided in the following sections.

Table 5.1: Industrial townships considered in the analysis

No	Industrial Township	Reason for exclusion
1	Viking Place	
2	Glosderry (Kenilworth Park)	
3	Paarden Eiland	
4	Montague Gardens	
5	Marconi Gardens	
6	Killarney Gardens	new, no accurate data
7	City Fringe	
8	Woodstock/Salt River/Observatory	
9	Athlone 1&2	considered to be major safety risk
10	Lansdowne Nerissa	
11	Ottery Hillstar	
12	Ottery Sunset	
13	Diep River (Elfindale)	
14	Monwood/Philippi	considered to be major safety risk
15	Retreat/Steenberg	
16	Capricorn Park	technology park - outside definition of industrial township
17	Observatory	old - no modern buildings
18	Maitland/Ndabeni	
19, 20	Airport	
21, 22	Epping	
23	Elsies River	considered to be major safety risk
24	Parow Beaconvale	
25	Parow Industria	
26	Parow East	
27	Bellville Oakdale	almost all development are of a commercial nature
28, 29	Bellville Stikland	
30	Bellville Triangle	
31	Bellville South/Sacks Circle	
32	Kraaifontein	
33	Brackenfell Industria	
34	Everite Brackenfell	
35	Kuils River	
36	Blackheath	
37	Saxonberg Industial Park	
38	Okovango	

5.2.4 Data-collection method

The following data-collection methods were considered:

- Obtain data from a central transaction register;
- Conduct a sample survey of the occupation rent that businesses are currently paying and the floorspace area that they are renting;
- Establish the average market rent rates by means of the Delphi technique.

Based on an exploratory investigation, which included discussions with various experts in the property market, the following factors were identified which would inform the selection of the most appropriate data-collection approach:

a) Unlike residential property transactions that can be obtained from the deeds office, rent rates are not available from a central registry. They consist of a confidential contract between two individuals. Individuals are reluctant to divulge rent information. Because there is not a central register, it would also be extremely costly to obtain the contract details. Larger property brokers such as Broll and Nick Geldenhuys properties, however, do keep their own records of property transactions (*Broll Property Brokers, 2000*).

b) Although a large number of properties are rented, the number of transactions within each industrial township is relatively small. It is therefore impossible to obtain a sufficient number of transactions that took place within a specific property size category in each industrial township within a relatively short time window. This is all but impossible, considering the difficulties in obtaining actual data as explained under point (a) above.

c) It should also be taken into account that rent agreements for industrial properties are for medium- to long-term periods, usually three to five years or even longer. The value of the lease is usually determined at the beginning of the lease agreement, which would constitute the market price at that time. Once a rental rate is agreed upon, the rate is adjusted by a prescribed inflation rate, which often does not have a direct bearing on the market rental rate at that time. This rate is a guesstimate of what may happen to rent rates over the term of the lease agreement. For this reason the adjustment factor does not reflect the actual current market conditions. Current rent paid by a firm does not represent the actual market rental once it has been adjusted by the adjustment factor and a survey of actual current rent rates paid by firms would therefore be inaccurate.

   One often experiences a phenomenon that vacancy rates increase simultaneously with an increase in rentals, or *vice verse*. The reason for this is that either one or both of the parties are not prepared to enter into a long-term agreement in anticipation of changes in the demand for office space.

d) The level of industrial output is directly linked to the economic cycle of a country. This is observed in the fact that the production price index usually precedes changes in the consumer price index. It is therefore important that data-collection spans a short space of time as a sudden decrease in industrial output may adversely affect the rentals.

e) Some industrial plots are used for purposes other than the manufacture or distribution of goods. The shift to retail is evident in areas such as Bellville Oakdale and Kenilworth Park that can be attributed to the proximity of these areas to other major retail and office developments.

Such uses distort the rental rates and relate more to those of retail developments than to industrial areas.

Based on the above, it was concluded that the Delphi technique would be the most appropriate for this study.

5.2.5 Data-collection procedure

The primary source for industrial rent data was the database of property economists Rode and Associates CC. This is the most comprehensive database of its type in South Africa and contains the market rentals for industrial properties in all the industrial townships in South Africa. The database is updated on a quarterly basis and has been maintained for more than a decade.

Rode uses the following Delphi technique to gather the data. A questionnaire is distributed to a panel of property brokers who are active in the property market in a specific industrial township. A list of the panel of property brokers, the firm that they represent, as well as their contact details are provided in Table 5.2. Panel members vary from township to township, depending on how active they are in a specific area and therefore their experience in rental rates in a specific area. The brokers who supplied the data are therefore listed separately for each township.

Table 5.2: Panel of property brokers

Company	First Name	Surname	Telephone Number	Fax Number	Cell Phone Number
Annenberg Real Estate	Dudley	Annenberg	0214657780	0214657798	
Atlas Property Services	Ian	Raubenheimer	0214472010	0214471559	0829003436
Birch Organization	Steven	Birch	021924035	0219306452	
Broll Property Group	William	Wakefield	0214197373	0214194688	0828070666
Brouwer & Associates	Menno	Brouwer	0214487489	0214487618	
Capricorn Business &	Steven	Kruger	0217090044	0217090054	0825726715
David Newham Property	Tony	Freedman	0219480934	0219498838	
De la Porte Property Group	Guy	de la Porte	0215519777	0215519683	
Delta Real Estates	Neels	De Bod	0219302343	0213936575	
Devmark	Peter	Loots	0214222085	0214232515	
Diamond Properties	Errol	Diamond	0214194499	0214346006	0832752526
Entrepreneur Finance Co.	Ian	Manship	0219131806	0219131692	0825535312
Excel Pro Investements	Billy	Knox	0219482411	0219482412	0837355219
Expo Property	Grant	Williams	0215525005	0215525006	0825511335
Foresite Real Estate	Mike	Dicky	0215576210	0215576280	
Gary Luyt Property Brokers	Gary	Luyt	0219191414	0219823335	0828802238
Golding Commercial Properties	Mark	Kenyon-Slade	0219190991	0219199017	
Gona Pillay Properties	Gona	Pillay	0216857710	0216857711	
JHI Property Services	Kurt	Gouwsventer	0219144300	0219144314	0836551144
Manprop Realtors Cape	David	Price	0214489760	0214489764	
Master Estate Agency	Gerald	Richman	0215915231	0215921996	0829754181
Nick Geldenhuys Eiendomme	Phillip	Olivier	0219817200	0219817215	0832516402
Property Finders	Avron	Chernotsky	0215510099	0215511000	
Regal Commercial & Ind.	Pieter	du Toit	0214254400	0214250050	
Remax Elite	Deon	van Rensburg	0217620222	0217620244	0832615259
RMB Properties	Francois	Koch	0214182233	0214182249	
Selprop	Paul	Rutzen	0214658888	0214611804	0825705997
Tobie Mynhardt Properties	Tobie	Mynhardt	0218543404	0218543407	0825535757
Trafalgar Properties Services	Chris	Farley	0214196540	0214252059	
Zonix Properties	Jonathan	Manion	0215518361	0215518362	0827707667

Property brokers are asked to express their opinion of the present market occupation rent rate for prime industrial floorspace in the particular industrial township. The rental rates represent the gross leases, which in a free-standing building includes refuse removal, water, electricity, internal maintenance, as well as rates and taxes. However, security is not included as the tenant is responsible for his own security. In the case of an industrial park the tenant pays in addition to the above also a pro rata share of security costs, security lighting and landscaping. Data from the questionnaires are captured into a database in order to calculate the accounting average market occupation rent rates for prime industrial floorspace for each industrial township.

In order to achieve consistency amongst the panel of property brokers, the following criteria are laid down for industrial floorspace to be considered "prime":

- The buildings and environment are generally in a good condition;
- It has satisfactory macro- and micro-accessibility, in other words it is not completely inaccessible;
- There are proper loading facilities;
- Eaves are greater than four metres (excluding micro/mini units);
- Units are at ground level;
- Sites are equipped with adequate three-phase electrical power;
- It has clear spans.

The above criteria should be seen as an entry level norm and do not imply that the industrial areas are uniform in all these respects. The fact that a particular industrial park has a good appearance will necessarily mean that a higher rental would be achieved than another site *ceteris paribus* which is situated in a poor environment. It is for this reason that the study could not focus only on accessibility as a determinant of rent rates. Other factors were therefore also quantified to provide as complete a picture as possible of the factors which influence rent rates. Examples of enhancements which would influence rental rates are sufficient office accommodation, adequate parking, fire-protection measures such as sprinkler systems, masonry up to sill height, adequate floor loading, roof insulation, sufficient yardspace and good location (as opposed to access).

In addition, industrial rentals are also analysed in terms of five floorspace size categories, namely $250m^2$, $500m^2$, $1000m^2$, $2500m^2$ and $5000m^2$. The reason for this is twofold. Firstly, rent per square metre is influenced by the size of the space required and, as with many types of goods, a premium is placed on the price per unit if smaller quantities are purchased. Secondly, the types of industries that locate on larger sites differ from those that require smaller sites. This means that the accessibility requirements related to different sizes of property could differ from one another as the accessibility needs of industries may differ, which means that the relationship between accessibility and rent needs to be undertaken separately for each property size category.

Secondary industrial space is specifically excluded from the survey as it has any one of a number of defects, including extremely poor physical access to (for example) heavy vehicles, too little yardspace or office accommodation, inadequate goods lifts and obsolete electrical power supply. These features are typically found in highly urbanised areas in old buildings which have been haphazardly renovated (*Rode, 2000:107*).

An office portion of not larger than 10% is included in any particular site. As an average for all industrial sites rental rates are 150% higher, if the office portion is larger than the stated limit.

5.2.6 Occupation rent values and statistical validation data

The space rent for each of the industrial areas and the statistical validation data are presented in the following tables:

a) Table 5.3 (a) through (e) contains the quarterly occupation rent data between 1998 and 2000 for each of the five occupation rent categories (250 m^2, 500 m^2, 1000 m^2, 2500 m^2 and 5000 m^2). This allowed an analysis of occupation rent to assess whether there are any anomalies in the time-series data.

b) Table 5.4 contains the standard deviation and number of observations recorded for each of the industrial township occupation rent categories for each quarter in 2000. The standard deviations confirmed the statistical validity of the data. Some of the industrial townships, such as Oakdale in Bellville, however, were excluded on the grounds that the data did not meet the requirements of statistical validity.

c) Table 5.5 is a summary of the occupation rent data according to space rent category and represent the accounting average of rent data for 2000.

Table 5.3 (a): Quarterly occupation rent data for the 250m² rent category

Industrial Township	1998:1	1998:2	1998:3	1998:4	1999:1	1999:2	1999:3	1999:4	2000:1	2000:2	2000:3	2000:4
Viking Place	0	23	20	20	24	23	20.38	23.58	20.4	24	23.42	24
Glosderry (Kenilworth Park)	18	17	18.33	17.58	19.33	19	21.33	17.5	25	22.17	17.25	20
Paarden Eiland	16.6	17.33	18	17.83	18.85	18.89	19.5	20.17	21.4	22.2	22.17	21.6
Montague Gardens	16.4	15.33	15.3	15.86	17.95	18.89	19.67	20.39	19.29	21.5	21.25	21.67
Marconi Gardens	0	16	16.67	16.25	19.75	20.5	20.88	23.2	22.6	23.5	25.17	24.6
Killarney Gardens	13.25	13.63	14.67	14.25	14.94	16.38	16.14	16.57	16.5	16.7	17.79	16.36
City Fringe	18	0	0	0	19	21.5	21.5	0	20	20	22	0
Woodstock/Salt River/Observatory	18.67	16	14.17	18.5	18.4	17.5	17.25	17.5	18	18.75	19.5	19
Athlone 1&2	0	0	0	12.25	12	14.5	17.5	16	18	17.75	15	16
Lansdowne Nerissa	18	18	15.75	16.17	16.17	16.25	18	17	17.5	17.5	16	18
Ottery Hillstar	18	0	16.25	16.25	16.67	17	18	18	21.5	19	19	22
Ottery Sunset	18	0	16.25	17.5	17.75	17.5	19.5	18.67	20	19.75	20	22
Diep River (Ellindale)	17.25	18.5	18.75	18.33	20.57	22	22	21.6	20.75	23.5	23.5	24.33
Monwood/Philippi	0	0	8.5	9	11.5	14	15	0	0	16.5	14	16
Retreat/Steenberg	18	18	16.17	15.25	18.58	0	19.67	20.75	19	22	18	22.67
Capricorn Park	0	0	0	0	0	0	0	0	0	0	23.5	25
Observatory	0	0	0	0	0	19.5	22.5	0	0	0	0	0
Maitland/Ndabeni	17	18.5	18.33	17.38	18.38	17	17.94	19.14	20.8	21	21.71	20.4
Airport 1	15.2	15.25	15.57	15.5	17.4	17.83	17.57	18.86	18.75	19.08	20.14	18.38
Airport 2	15.2	15.25	15.57	15.5	17.4	17.83	17.57	18.86	18.75	19.08	20.14	18.38
Epping 1	14	15.75	15.25	15.63	16.64	16.43	15.92	16.67	17.25	16.38	18.63	17.25
Epping 2	14	15.75	15.25	15.63	16.64	16.43	0	0	0	16.38	0	0
Elsies River	10	12.75	11.92	11.83	14.25	14	12.75	13	12.5	13	12.5	13
Parow Beaconvale	15.63	15.25	16.06	15.33	16.92	16.08	18.25	16	16.75	16.63	14.08	17.42
Parow Industria/Tygerberg Busi Park	14	14.69	14.68	13.5	15.2	15	15.83	16	16	16.75	17	16.5
Parow East	16.4	15.33	16.86	15.78	17.31	17.29	18.25	18	18	17.75	18.42	18.8
Bellville Oakdale	19	21	21.2	20.36	20.8	21.5	19.5	20	23	21.67	32.8	29.67
Bellville Stikland	15.4	15.25	15	16	15.69	16.25	17.25	17.33	17.5	16.9	19.17	18.6
Bellville Stikland	15.4	15.25	15	16	15.69	16.25	17.25	17.33	17.5	16.9	19.17	18.6
Bellville Triangle	13	12.5	13.75	13.85	14.17	14.56	15	14.33	14	14.45	16.08	15.5
Bellville South/Sacks Circle	11.5	12.75	12.75	12.28	12.43	13.25	12.75	14.25	13.83	14.25	14.8	14.5
Kraaifontein	12	12	11	12.9	13	13.3	15.5	13	14.38	13.5	0	16.5
Brackenfell Industria	14.58	14.75	15	15.5	16.14	16.25	16.83	17	15.2	15.17	17	16
Everite Brackenfell	0	0	0	0	0	0	0	0	0	17.13	18.5	17.4
Kuils River	12.5	13	13.75	13.5	14.14	14.94	14.75	14.6	14	15	17	15.67
Blackheath	11.17	11.75	13	12.86	12.7	14	13.75	14	13.75	13.5	15	14.67
Saxonberg Industial Park	0	0	0	0	0	0	0	0	0	15	0	16
Okovango	0	0	0	0	0	0	18.5	17	18	18.63	20.75	20

Table 5.3 (b): Quarterly occupation rent data for the 500m² rent category

Industrial Township	Zone	1998:1	1998:2	1998:3	1998:4	1999:1	1999:2	1999:3	1999:4	2000:1	2000:2	2000:3	2000:4
Viking Place	**1108**	0	20	18.88	18.5	21	18	19.63	20	20.5	22.67	19.7	21.13
Glosderry (Kenilworth Park)	**1505**	16.75	16	16.92	16.63	16.33	15	18.67	16.5	19	17.67	16.5	18.67
Paarden Eiland	**201**	14.6	14.25	15.75	15.33	16.32	15.67	16.25	16.72	16	16.06	15.57	17
Montague Gardens	**506**	14.8	14.88	13.6	14.29	15.75	15.61	15.8	16.5	15.75	16.34	16.38	18
Marconi Gardens	**517**	0	15.5	15.33	16	16.19	16.25	17.2	17.7	16.92	17.58	17.75	19.9
Killarney Gardens	**912**	12.38	12.25	14.33	13.25	14.33	14.06	14	14.17	14.4	14.8	14.31	15.07
City Fringe	**106**	16	0	0	0	17.5	18	18.5	0	15.75	18	21	0
Woodstock/Salt River/Observatory	**207**	15.67	13.75	13.67	15.5	14.6	13.83	14.5	14.25	15.25	15.7	14.63	16
Athlone 1&2	**2203**	0	0	8	11	11	12.5	16	14	16	15.75	14	14
Lansdowne Nerissa	**1410**	16	18	14.75	14.83	14.83	15	16.75	0	16	16	14.5	14.25
Ottery Hillstar	**2402**	16.75	0	15.5	15	15.17	15.75	16.5	17	16	17.17	18	18.5
Ottery Sunset	**2404**	16.75	0	15.5	15.5	15.83	16	17.5	17	16.5	18	19	19.25
Diep River (Ellindale)	**2603**	16.5	18.5	17.5	16.33	17.5	18.25	18.75	18	18	18.75	20.67	21.5
Monwood/Philippi	**3605**	8	0	8.5	8	10.5	11	14	0	0	14	13	14
Retreat/Steenberg	**2605**	16	16	15.5	14.25	15.38	0	15.25	16.25	0	17	17	19.5
Capricorn Park	**2506**	0	0	0	0	0	0	0	0	0	25	23	24
Observatory	**701**	0	0	0	0	0	17	17	0	0	0	0	0
Maitland/Ndabeni	**607**	13	14.92	15.75	15.25	13.89	14.5	15.43	15.67	14.8	14.33	15.31	15.8
Airport 1	**2902**	13.88	13.75	14.21	13.83	15.25	14.71	15.57	15.29	15	15.29	15.71	15.38
Airport 2	**2903**	13.88	13.75	14.21	13.83	15.25	14.71	15.57	15.29	15	15.29	15.71	15.38
Epping 1	**1202**	14	14.75	14.25	14.25	14.89	13.86	13.58	15.25	14.67	14.25	15	15.1
Epping 2	**1201**	14	14.75	14.25	14.25	14.89	13.86	0	0	0	14.25	0	0
Elsies River	**1106**	0	12.38	11.42	10.83	12.33	12.17	11	10.5	9.67	11.25	10	10
Parow Beaconvale	**1105**	13.9	12.7	14.25	13.5	14.31	13.57	13.75	13.5	13.43	13.3	11.92	13.83
Parow Industria/Tygerberg Busi Park	**2101**	12.25	12.88	13.14	12.28	13.5	12.19	12.83	13.25	13.17	14.92	12.75	13.63
Parow East	**1102**	14.6	14	15.21	14.25	14.86	14.11	14.5	14.5	14.75	14.67	14.58	14.6
Bellville Oakdale	**1905**	18.5	19	20	18.57	19.2	19.67	17	17.67	19	19.5	27	25.67
Bellville Stikland	**2013**	13.2	13	14.14	13.95	13.88	13.78	14.36	14.13	14.4	14.75	15.25	15.33
Bellville Stikland	**2713**	13.2	13	14.14	13.95	13.88	13.78	14.36	14.13	14.4	14.75	15.25	15.33
Bellville Triangle	**2014**	10.79	10.9	12.67	11.9	12	12.28	12.29	12.17	11.6	12.38	12.81	13.33
Bellville South/Sacks Circle	**2019**	9.75	11.67	11	11	10.81	10.63	12.07	12.07	10.7	11.8	11.38	12
Kraaifontein	**2706**	10.5	11.5	10.67	11.58	11.8	11.75	12.42	11.25	12.13	11.83	11.75	13
Brackenfell Industria	**2712**	12.42	12.5	13.17	13.44	13.79	13.81	14.5	14	13.75	13.7	14.36	14
Everite Brackenfell	**2738**	0	0	0	0	0	0	0	0	0	14.3	15.08	14.1
Kuils River	**2813**	10.75	11	12.63	11.93	11.67	12.93	13.2	13	12.5	12.88	12.8	11.75
Blackheath	**3201**	10	10.25	12	11.5	11.4	12.14	12.08	11.6	12.25	11.63	12	12
Saxonberg Industial Park	**3216**	0	0	0	0	0	0	0	0	0	13.5	14.5	13.5
Okovango	**2718**	0	0	0	0	0	0	15	14.67	14.5	16.25	16.25	15.75

Table 5.3 (c): Quarterly occupation rent data for the 1000m² rent category

Industrial Township	Zone	1998:1	1998:2	1998:3	1998:4	1999:1	1999:2	1999:3	1999:4	2000:1	2000:2	2000:3	2000:4
Viking Place	**1108**	0	16	0	17.5	21	18.5	19.33	20.5	20.33	21.88	18.6	20
Glosderry (Kenilworth Park)	**1505**	16	16	16.88	15.75	15	14	17	16	17	16	15.5	18.25
Paarden Eiland	**201**	13.1	12.33	14.67	13.9	14.38	14.36	15.08	14.83	17	14.57	13.93	15.3
Montague Gardens	**506**	14.3	14.17	12.8	14.43	14.59	14.15	14.83	15.22	16.34	16.33	15.31	17.42
Marconi Gardens	**517**	0	14.75	14.17	15.67	14.92	15.7	15.63	16.88	15.67	16.8	17.17	18.7
Killarney Gardens	**912**	12.5	12.25	12.5	12.63	13.6	13.25	13.25	13.63	14.25	13.75	13.64	13.58
City Fringe	**106**	15	0	0	0	15.5	17	17.67	14.5	15.25	15.5	17.5	12.5
Woodstock/Salt River/Observatory	**207**	14.25	13.5	13	14.5	13.25	12.4	13.33	13.71	13	14.38	13.5	15
Athlone 1&2	**2203**	0	0	8	10	10	12	13.5	13.5	13	14.5	13	12
Lansdowne Nerissa	**1410**	13.75	16	12.67	13.17	13.33	13.75	14.5	0	14	14.5	14	14
Ottery Hillstar	**2402**	16	0	14.17	13.75	14.33	14.5	13.75	15.5	14	16.17	17.5	17.5
Ottery Sunset	**2404**	16	0	14.17	14.5	14.5	14.25	14.5	15.25	14.5	16.83	18	17.75
Diep River (Ellindale)	**2603**	15.5	18.5	15.67	14.25	15.25	15.67	16.5	16.75	16	18.5	16.5	18.75
Monwood/Philippi	**3605**	8	0	0	8	12	10.5	12	0	0	13	12	12
Retreat/Steenberg	**2605**	14	16	14.67	13.5	13.13	0	13	14.5	0	16	16	17.25
Capricorn Park	**2506**	0	0	0	0	0	0	0	0	0	0	18.5	18
Observatory	**701**	0	0	0	0	0	14.75	14.5	0	0	0	0	0
Maitland/Ndabeni	**607**	13.5	13.67	14.75	14.13	13.63	12.92	14.14	13.5	15.33	12.86	13.63	14.3
Airport 1	**2902**	12.75	13	12.92	12	13.58	13.5	14.25	13.93	14.44	14.86	14.14	14.79
Airport 2	**2903**	12.75	13	12.92	12	13.58	13.5	14.25	13.93	14.44	14.86	14.14	14.79
Epping 1	**1202**	12.67	14	13.5	13	13.75	13.07	13.33	13.08	14.25	13.14	12.86	13.75
Epping 2	**1201**	12.67	14	13.5	13	13.75	13.07	0	0	0	13.14	0	0
Elsies River	**1106**	0	11.25	9.5	10.25	10.5	10.25	10	9	8	8.67	8.5	8
Parow Beaconvale	**1105**	11.75	11.5	12.93	11.78	13.36	12	11.8	11	12.36	12	11.3	12.7
Parow Industria/Tygerberg Busi Park	**2101**	11.88	10.69	11	10.67	12.14	11.64	10.75	11.56	12.21	12	11.08	11.7
Parow East	**1102**	14.5	12.1	14.38	13	13.5	13.43	13.38	13	13	13.8	12.92	13.25
Bellville Oakdale	**1905**	18	10	17.33	15.17	14	16.5	15	15.75	16	17.13	18.75	20.67
Bellville Stikland	**2013**	12	12.38	13.14	12.72	12.44	12.5	12.43	12.5	12.5	12.88	13.57	13.4
Bellville Stikland	**2713**	12	12.38	13.14	12.72	12.44	12.5	12.43	12.5	12.5	12.88	13.57	13.4
Bellville Triangle	**2014**	9.75	10.2	11.17	10.56	11	10.94	10.86	10.67	10.2	10.64	11.43	11.33
Bellville South/Sacks Circle	**2019**	9.25	8.25	9.9	9	9.56	9.86	9.83	10.5	9.4	10.4	8.5	10.3
Kraaifontein	**2706**	8.83	10	9.33	9.83	10.3	10.42	11.2	10.75	10.5	10.67	9.5	11.63
Brackenfell Industria	**2712**	11.3	10.33	11.8	11.25	12.14	12.41	12.8	12	11.7	12.38	13.17	13
Everite Brackenfell	**2738**	0	0	0	0	0	0	0	0	0	12.88	13.13	13.67
Kuils River	**2813**	9	10.13	10.33	10.5	10.6	11.42	11.5	11.25	11.5	11.5	11.13	10.67
Blackheath	**3201**	9.1	9.94	9.75	9.43	10.3	10.75	10	9.8	9.45	10.5	10.2	10
Saxonberg Industial Park	**3216**	0	0	0	0	0	0	0	0	0	13	13	12
Okovango	**2718**	0	0	0	0	0	0	13.5	13.75	12.5	15	14.13	13.67

Table 5.3 (d): Quarterly occupation rent data for the 2500m² rent category

Industrial Township	Zone	1998:1	1998:2	1998:3	1998:4	1999:1	1999:2	1999:3	1999:4	2000:1	2000:2	2000:3	2000:4
Viking Place	**1108**	0	0	0	0	21	16.25	18	20	20	21.67	16.67	18.17
Glosderry (Kenilworth Park)	**1505**	14.5	0	0	14.5	0	0	15	15.5	14	14.5	14	17
Paarden Eiland	**201**	12	10.83	12	11.88	12.5	12.31	13.08	13	12.46	13.7	13.67	13.9
Montague Gardens	**506**	14	13.5	12	14.43	13.55	13.5	14.36	13.92	15.38	15.17	14.57	16.42
Marconi Gardens	**517**	0	14	14.5	15.5	15	15	14.88	16	15	16.5	16	18
Killarney Gardens	**912**	0	12	12	12	13.13	12.8	12.25	13.17	12.5	13.5	12.8	13.08
City Fringe	**106**	0	0	0	0	15	15	14	0	12.5	0	0	0
Woodstock/Salt River/Observatory	**207**	12	0	9	13.25	11.38	11.33	11.25	12.5	11.5	13.67	12.25	14.25
Athlone 1&2	**2203**	0	0	0	10	11	11	12.25	12.5	12	13.5	12	11
Lansdowne Nerissa	**1410**	14	0	12.75	12.5	12.5	13	13	0	13	13	13.5	13
Ottery Hillstar	**2402**	14.5	0	13.75	12.5	13.17	13	11.5	14.5	12	15.75	17	16
Ottery Sunset	**2404**	14.5	0	13.75	13.5	14	14	14	14	13.5	16.5	17.5	17.25
Diep River (Ellindale)	**2603**	0	0	0	12.5	14.5	14.5	16	15.25	15	16.5	16	17.25
Monwood/Philippi	**3605**	0	0	0	0	11	11	11	0	10.5	12.8	12	11
Retreat/Steenberg	**2605**	0	0	14	0	14	0	12	13	0	14.5	15	17
Capricorn Park	**2506**	0	0	0	0	0	0	0	0	0	0	18	17
Observatory	**701**	0	0	0	0	0	0	12.5	0	0	0	0	0
Maitland/Ndabeni	**607**	0	0	14.25	13.5	12.3	12.5	11.63	13	15.2	12.63	13.36	13.6
Airport 1	**2902**	13	0	11.67	12	13.13	13	14	13.6	14	12.88	14	14.3
Airport 2	**2903**	13	0	11.67	12	13.13	13	14	13.6	14	12.88	14	14.3
Epping 1	**1202**	12.75	13.25	12.17	12	12.5	11.86	12.6	12.38	13.13	12.58	11.86	12.25
Epping 2	**1201**	12.75	13.25	12.17	12	12.5	11.86	0	0	0	12.58	0	0
Elsies River	**1106**	0	0	8	10.5	9.75	9.13	9	8	7	8.33	7.25	7
Parow Beaconvale	**1105**	10.83	8.5	12.5	10.5	12.75	11.58	11.3	11	10.6	11	9.8	11.3
Parow Industria/Tygerberg Busi Park	**2101**	9.63	9	10.1	9.25	10.92	10.5	10.33	10	9.6	10.7	9.42	10
Parow East	**1102**	16	12	14.67	12.6	13.5	12.9	12.75	`111````	12.5	12.6	11.9	12
Bellville Oakdale	**1905**	0	0	16	14.75	15.33	15	13	15	15	15.33	18.33	22.5
Bellville Stikland	**2013**	11.5	12	12	11.71	11.5	11.5	11.25	11.75	11.5	12	12.08	11.63
Bellville Stikland	**2713**	11.5	12	12	11.71	11.5	11.5	11.25	11.75	11.5	12	12.08	11.63
Bellville Triangle	**2014**	9.67	9.83	10.17	9.33	11.33	10	9.67	9.25	9.1	9.56	10.36	10
Bellville South/Sacks Circle	**2019**	8.88	7.95	8.23	8.33	9	8.75	8.29	9	8	9.1	8.36	8.8
Kraaifontein	**2706**	7.5	9.25	8.67	9	9.75	9.5	10.3	9.67	9	9.5	7.88	9.38
Brackenfell Industria	**2712**	11.17	10	11	10	10.5	11.33	10.6	11	10.83	11.17	10.8	10.33
Everite Brackenfell	**2738**	0	0	0	0	0	0	0	0	0	12.9	11	10.5
Kuils River	**2813**	8.75	10	9.5	9.4	9.7	10	10	9.75	9.5	9.93	9	8.33
Blackheath	**3201**	8.83	10	9.5	8.25	9.25	9.3	9.13	9	8.67	9.5	8.38	8
Saxonberg Industial Park	**3216**	0	0	0	0	0	0	0	0	0	12	11	8
Okovango	**2718**	0	0	0	0	0	0	11	0	10	11.75	10	12

Table 5.3 (e): Quarterly occupation rent data for the 5000m^2 rent category

Industrial Township	Zone	1998:1	1998:2	1998:3	1998:4	1999:1	1999:2	1999:3	1999:4	2000:1	2000:2	2000:3	2000:4
Viking Place	**1108**	0	0	0	0	20.5	11	14	19.75	0	20.75	16.5	17
Glosderry (Kenilworth Park)	**1505**	0	0	0	0	0	0	13	14	13	13.5	13.5	16.5
Paarden Eiland	**201**	10.83	10.25	9.5	11.13	11.13	11.29	11.58	11.92	11.5	12.5	12.25	12.55
Montague Gardens	**506**	13	13	11.88	13.5	13	13	12.83	13.42	13	14.46	13.21	15.33
Marconi Gardens	**517**	0	14	13	13	14.5	14.2	14.25	15.63	14.5	15.75	15.1	17
Killarney Gardens	**912**	0	11	0	11	13	12.25	12	12.75	12	12.5	12.33	12.33
City Fringe	**106**	0	0	0	0	14	14	14	0	9	0	0	0
Woodstock/Salt River/Observatory	**207**	0	0	0	11.5	11.33	11.5	11	12	11	14.25	11.75	15
Athlone 1&2	**2203**	0	0	0	0	10	10	11	11	11	12	11.5	11
Lansdowne Nerissa	**1410**	0	0	13	0	12	12	11.5	0	12	0	13	7.5
Ottery Hillstar	**2402**	0	0	0	0	12	12	11.5	13	11	13.8	16.5	15
Ottery Sunset	**2404**	0	0	0	0	11	13	14	12	13	13	17	16.5
Diep River (Ellindale)	**2603**	0	0	0	0	14	14	15	14	14	15	17	16
Monwood/Philippi	**3605**	0	0	0	0	10	10	10	0	0	12	11.5	10
Retreat/Steenberg	**2605**	0	0	0	0	13	0	10	11.75	0	12.5	14	16
Capricorn Park	**2506**	0	0	0	0	0	0	0	0	0	0	17	17
Observatory	**701**	0	0	0	0	0	0	12	0	0	0	0	0
Maitland/Ndabeni	**607**	0	0	13	12.5	12.25	11.75	9.83	12.67	10.75	11.67	12.4	12.63
Airport 1	**2902**	12.5	0	11.5	11.33	12.7	11.67	12.38	12.88	12.5	12.5	13	12.83
Airport 2	**2903**	12.5	0	11.5	11.33	12.7	11.67	12.38	12.88	12.5	12.5	13	12.83
Epping 1	**1202**	12.3	12	10.25	10.75	11.25	10.92	11.13	11.25	12.25	10.8	11.6	11.25
Epping 2	**1201**	12.3	12	10.25	10.75	11.25	10.92	0	0	0	10.8	0	0
Elsies River	**1106**	0	0	8	10	10.5	9	7.5	0	6	8.25	0	0
Parow Beaconvale	**1105**	11	0	12.33	11	12.83	11.13	10.67	11	11	10.25	9	0
Parow Industria/Tygerberg Busi Park	**2101**	9	9	10	7.7	10.6	9.4	10.25	10	10	10.17	8.75	8.67
Parow East	**1102**	15	0	14.5	12.5	13	12	11	11	12	10.72	10.5	10
Bellville Oakdale	**1905**	0	0	0	13	14.5	13.25	11	13	13	13	13	13
Bellville Stikland	**2013**	12	10	11.75	10.33	11	10.5	10	10.88	10.5	11.5	10.88	8.75
Bellville Stikland	**2713**	12	10	11.75	10.33	11	10.5	10	10.88	10.5	11.5	10.88	8.75
Bellville Triangle	**2014**	8.75	9.75	10	8	10.5	8.86	9.13	8	8.5	9.5	9.38	9.17
Bellville South/Sacks Circle	**2019**	7.75	7.75	7	7.42	8.17	7.6	7.5	8.4	7.5	8.63	7.42	8.17
Kraaifontein	**2706**	7	8.5	7	7.63	9	8.4	9	8.67	8	9.5	7.33	9.33
Brackenfell Industria	**2712**	9.5	10	9.75	9.5	10	10.55	9.75	9.75	8.75	9.83	10.38	9.5
Everite Brackenfell	**2738**	0	0	0	0	0	0	0	0	0	11.75	10.5	9.5
Kuils River	**2813**	7.5	10	8.5	9.2	9.5	8.17	9	8.33	7.75	9.75	8.83	7.5
Blackheath	**3201**	7.33	10	9.5	7.25	9.33	7.4	8	7.67	7.5	8	7.67	7
Saxonberg Industial Park	**3216**	0	0	0	0	0	0	0	0	0	10	9	7
Okovango	**2718**	0	0	0	0	0	0	8	0	8	11	9.25	10

Table 5.4: Standard deviation and number of observations

Industrial Township	2000:1 250 m²	2000:1 500 m²	2000:1 1000 m²	2000:1 2500 m²	2000:1 5000 m²	2000:1 n	2000:2 250 m²	2000:2 500 m²	2000:2 1000 m²	2000:2 2500 m²	2000:2 5000 m²	2000:2 n
Viking Place	9.2087	2.5166	0.5774			5	1.4142	0.5774	1.0308	1.0408	1.0607	6
Glosderry (Kenilworth Park)						1	3.3292	1.1547	1.3229	2.1213	2.1213	3
Paarden Eiland	2.7019	0.8944	4.1932	0.6189	0.7071	8	1.9235	1.5684	1.484	0.6708	0.7071	8
Montague Gardens	3.4017	0.6124	3.2539	3.2043	0.6325	8	4.8403	3.9346	2.4221	2.1134	2.3044	8
Marconi Gardens	3.7148	0.9174	0.2887		0.7071	6	1	1.8005	1.8235	0.5774	0.866	6
Killarney Gardens	1.291	1.084	1.5411	0.7071		7	1.4832	1.0954	0.866	0.5774	0.7071	5
City Fringe	2.8284	3.8891	3.182	2.1213	7.0711	3			0.7071			3
Woodstock/Salt River/Observatory		0.3536				2	1.5	2.1679	1.8875	3.0551	2.4749	5
Athlone 1&2						1	1.7678	1.7678	0.7071	4.2426		2
Lansdowne Nerissa						1	0.7071	1.4142	2.8284	4.2426		2
Ottery Hillstar	4.9497					3		1.0408	0.2887	1.0607		4
Ottery Sunset						1	0.3536		1.0408	2.1213		3
Diep River (Ellindale)	1.0897					3	1.3229	1.0607	3.0414			4
Monwood/Philippi						1						1
Retreat/Steenberg	2.8284					2	1.4142		0.7071			3
Capricorn Park												1
Observatory												
Maitland/Ndabeni	2.7749	1.5248	4.0208	4.3818	1.0607	7	1.4142	1.472	2.8389	0.75	1.5275	7
Airport 1	1.7248	0.6325	2.8715	0.8165	0.866	8	1.4289	0.9063	2.4275	0.6292	0.866	8
Epping 1	0.3536	0.5774	1.2583	1.652	1.7078	5	3.038	1.8097	2.3223	2.3752	1.3038	7
Elsies River		0.5774				3	2.582	3.4034	1.5275	0.5774	0.3536	4
Parow Beaconvale	0.9574	1.7182	2.5935	1.5166		8	1.25	1.9875	0.8165	1	0.3536	5
Parow Industria/Tygerberg Busi Park		1.7224	2.2704	1.8166		8	0.9574	2.5771	0.7906	1.2042	0.2887	6
Parow East	3.2863	1.084	1	0.5		6	0.9874	1.472	0.7583	0.8944	1.0607	6
Bellville Oakdale	1.4142	1.4142				2	2.0817	1.9149	1.9311	0.5774		4
Bellville Stikland	1	0.5477	0.5	0.7071	0.7071	6	1.245	0.4183	0.4916	0.8165	0.866	6
Bellville Triangle	1	0.8944	1.0954	0.5477	0.7071	6	0.9713	0.8786	0.9209	0.8173	7071	5
Bellville South/Sacks Circle	1.0408	0.9747	0.5477	1.0954	0.7071	6	0.9574	1.3509	0.5477	0.8944	1.25	5
Kraaifontein	0.75	0.25	1	1.4142	1.4142	5	0.7071	0.7638	0.5774	1.3229		3
Brackenfell Industria	2.1679	0.9574	0.9747	1.6073	1.7678	7	2.2286	1.3038	0.75	1.2583	0.7638	6
Everite Brackenfell							0.8539	2.5884	2.3229	1.2728	0.3536	5
Kuils River	1.4142	0.5774	0.7071	2.1213	0.3536	5	1	1.1815	1.3229	0.9018	0.3536	4
Blackheath	0.9574	0.5	1.462	1.1547	0.7071	6	1.8028	0.75	1	0.5		4
Saxonberg Industial Park								1.291				4
Okovango	1.4142	0.5774	1			5	0.9465	1.5	2.1602	1.0607		4
	3.8871	**2.5178**	**3.5597**	**3.2835**	**2.5211**		**3.7153**	**2.9312**	**3.0139**	**3.0276**	**2.7799**	

Industrial Township	2000:3 250 m²	2000:3 500 m²	2000:3 1000 m²	2000:3 2500 m²	2000:3 5000 m²	2000:3 n	2000:4 250 m²	2000:4 500 m²	2000:4 1000 m²	2000:4 2500 m²	2000:4 5000 m²	2000:4 n
Viking Place	3.1689	3.1544	3.5602	2.8868	2.5981	7	1.4142	2.6575	2.7386	1.7559	0.7071	4
Glosderry (Kenilworth Park)	1.0607	0.5	0.7071			4	2.8284	2.0817	2.4749			3
Paarden Eiland	2.137	4.315	3.1941	1.472	0.6124	7	1.1402	2.2361	1.7176	1.5166	1.3739	6
Montague Gardens	2.252	1.2748	1.28	1.0177	0.7486	8	1.9664	4.8062	3.4701	3.412	3.8427	6
Marconi Gardens	3.3714	1.3628	1.1255	1.2247	1.6733	8	3.2094	2.6077	2.5884	2.4495	2.4495	5
Killarney Gardens	2.7058	1.1319	0.4756	0.4472	1.1547	8	1.7008	1.2724	0.801	0.2041	0.2887	8
City Fringe												
Woodstock/Salt River/Observatory	1.9149	1.493	1.7321	1.893	2.4749	5	1.4142	2.8284	1.4142	1.7678		3
Athlone 1&2						2						1
Lansdowne Nerissa						1		3.182	2.8284	2.8284	9.1924	2
Ottery Hillstar						1		3.5355	2.1213	2.8284	1.4142	2
Ottery Sunset						1	2.8284	3.8891	1.7678	1.0607		2
Diep River (Ellindale)	2.1213	3.0551	2.1213	1.4142		3	1.5275	0.7071	1.0607	1.0607		3
Monwood/Philippi						1						1
Retreat/Steenberg						2	2.3094	3.5355	1.0607			3
Capricorn Park	3.5355	4.2426				2		2.8284				2
Observatory												
Maitland/Ndabeni	3.9036	1.8696	2.4893	1.3138	1.7103	8	1.6733	1.8908	1.7889	1.8166	2.2867	5
Airport 1	2.5448	1.6036	1.5736	1.7678	2.1794	7	2.56	2.6693	1.3496	1.7889	1.4434	8
Epping 1	2.9262	0.7071	2.8536	2.4616	2.0736	8	1.0607	0.8944	0.6455	1.2583	1.2583	5
Elsies River	0.3536	0	0.7071	0.3536		2						1
Parow Beaconvale	5.5174	3.0069	0.8367	0.4472	1.4142	6	1.5626	1.6021	1.9875	2.1095		6
Parow Industria/Tygerberg Busi Park	1.4142	1.4748	0.6646	0.6646	0.9574	6	0.7071	1.1087	0.4472	0.7071	1.1547	5
Parow East	1.8552	0.801	0.6646	1.1402	2.1213	7	2.2804	1.6733	0.5	1		5
Bellville Oakdale	7.8549	6.7082	6.1847	5.7735		5	5.5076	5.1316	6.4291	6.364		3
Bellville Stikland	1.8348	1	1.2392	1.8552	2.5941	8	1.3416	0.8165	0.8944	1.493	4.3493	6
Bellville Triangle	1.9083	1.7308	1.9017	1.6511		8	1.6583	1.5055	1.633	1.8708	3.2532	6
Bellville South/Sacks Circle	2.1679	1.5059	0.5	0.4756	0.6646	8	1.3784	1.2649	1.3038	1.9235	2.0166	6
Kraaifontein		1.7078	1	0.25	0.5774	4	3.5355	2.708	3.25	4.1908	5.1316	4
Brackenfell Industria	2.582	1.5999	1.3663	1.7889	2.136	7	1.5811	1.5811	1	0.5774	1.3229	5
Everite Brackenfell	2.2583	1.4972	1.0308	1.4142	2.1213	5	1.5166	1.8841	1.5275	0.7071	2.1213	5
Kuils River	2.6458	1.6432	1.652	1.1547	1.2583	5	1.5275	1.2583	1.1547	0.5774	2.1213	4
Blackheath	3	1.5811	1.3038	1.1087	0.5774	5	0.5774				1.4142	3
Saxonberg Industial Park		1.291				3		1.291				4
Okovango	0.9574	1.2583	1.75		0.3536	3	1.633	0.9574	1.5275			4
	4.824	**3.7239**	**3.1256**	**3.1586**	**3.041**		**3.937**	**3.6342**	**3.3688**	**3.7097**	**3.9038**	

Table 5.5: Average monthly occupation rent in rand for industrial townships in Cape Town per square metre in 2000 for each floorspace category used to calculate economic property and land value

Industrial Township	250 m^2	500 m^2	1000 m^2	2500 m^2	5000 m^2
Viking Place	22.46	20.50	19.70	18.63	17.58
Glosderry (Kenilworth Park)	21.11	17.96	16.69	14.88	14.13
Paarden Eiland	21.84	16.16	15.20	13.43	12.20
Montague Gardens	20.93	16.62	16.35	15.39	14.00
Marconi Gardens	23.97	18.04	17.09	16.38	15.59
Killarney Gardens	16.84	14.65	13.81	12.97	12.29
City Fringe	20.67	18.25	15.19	12.50	9.00
Woodstock/Salt River/Observatory	18.81	15.40	13.97	12.92	13.00
Athlone 1&2	16.69	14.94	13.13	12.13	11.38
Lansdowne Nerissa	17.25	15.19	14.13	13.13	10.83
Ottery Hillstar	20.38	17.42	16.29	15.19	14.08
Ottery Sunset	20.44	18.19	16.77	16.19	14.88
Diep River (Elfindale)	23.02	19.73	17.44	16.19	15.50
Monwood/Philippi	15.50	13.67	12.33	11.58	11.17
Retreat/Steenberg	20.42	17.83	16.42	15.50	14.17
Capricorn Park	24.25	24.00	18.25	17.50	17.00
Maitland/Ndabeni	20.98	15.06	14.03	13.70	11.86
Airport 1	19.09	15.35	14.56	13.80	12.71
Airport 2	19.09	15.35	14.56	13.80	12.71
Epping 1	17.38	14.76	13.50	12.46	11.48
Epping 2	16.38	14.25	13.14	12.58	10.80
Elsies River	12.75	10.23	8.29	7.40	7.13
Parow Beaconvale	16.22	13.12	12.09	10.68	10.08
Parow Industria	16.56	13.62	11.75	9.93	9.40
Parow East	18.24	14.65	13.24	12.25	10.81
Bellville Oakdale	26.79	22.79	18.14	17.79	13.00
Bellville Stikland	18.04	14.93	13.09	11.80	10.41
Bellville Stikland	18.04	14.93	13.09	11.80	10.41
Bellville Triangle	15.01	12.53	10.90	9.76	9.14
Bellville South/Sacks Circle	14.35	11.47	9.65	8.57	7.93
Kraaifontein	14.79	12.18	10.58	8.94	8.54
Brackenfell Industria	15.84	13.95	12.56	10.78	9.62
Everite Brackenfell	17.68	14.49	13.23	11.47	10.58
Kuils River	15.42	12.48	11.20	9.19	8.46
Blackheath	14.23	11.97	10.04	8.64	7.54
Saxonberg Industial Park	15.50	13.83	12.67	10.33	8.67
Okovango	19.35	15.69	13.83	10.94	9.56

5.2.7 Validation and enhancement of occupation rent data

In order to overcome some of the inherent constraints of the observed data, the following further enhancements were made to the data:

a) The following industrial land use categories were defined for the purpose of this study:
   - Heavy industrial areas such as steel mills, oil refineries and chemical plants;
   - Light-industrial areas, which include industrial service industries, light manufacturing, wholesale stores, retail stores that supply primarily the industry and logistics operations such as transport companies and warehouse facilities;
   - Significant retail/office component in industrial areas;
   - Technology parks.

   Heavy industry (Category 1) is excluded on two grounds. Firstly, these industries are mostly located outside the metropolitan area near the primary input source. Secondly, the location of heavy industries is of a long-term nature and these sites are therefore not traded on the open market. In the case of Categories 3 and 4, retail/office and technology parks respectively, the location decision could be substantially different than that of industrial uses. Therefore, even though these uses may occur on land which is zoned for industrial purposes, they are regarded as non-industrial for the purpose of this study.

   The main driver of the demand for urban industrial land is therefore considered to be Category 2, light industry, which will be the main focus of the study.

b) Rode and Associates is a well-known and respected firm of property economists. Erwin Rode, who is managing director, has been involved in the property market for more than two decades. Rode's occupation rent database, which was the source of the occupation rent data, has been maintained for more than a decade and is updated regularly. Statistical validity of the collection and analysis used in obtaining the source data has been done by comparing the standard deviation of the opinions of the different panel members, as well as the number of observations in each category.

c) Due to the fact that the database has been updated quarterly for so many years, time-series date were inspected to identify anomalies in the values over time. Where anomalies existed, they were further investigated to explain significant changes in the occupation rent. Very few anomalies of this nature were observed and those that were found could all be explained.

d) Occupation rent values of industrial townships and knowledge of their physical attributes were used to compare townships with one another to assess whether they were realistic in relative terms. Three reasons were identified for observed anomalies. Firstly, the occupation rent of industrial townships with a significant percentage of commercial and office components was significantly higher than that of "pure" industrial land uses, e.g. Oakdale and Capricorn. Secondly, the occupation rent of industrial townships where crime is significantly more prevalent than elsewhere, e.g. Philippi, Athlone and Elsies River, has lower than expected occupation rent rates. Townships where these abnormal industrial occupation rent rates were observed are excluded from the analysis altogether. Thirdly, industrial areas that are specifically located away from the CBD due to their environmental impact were excluded. The only two sites that fall into this category in the CBD are the Caltex oil refinery and the Kynoch fertiliser plant.

e) In addition Rode monitors the panel after each survey. Brokers that were responsible for outliers are quizzed on the reasons for their estimate. If any particular broker frequently estimates an outlier, then he is removed from the panel.

f) Some of the new industrial township developments such as Viking Place has perimeter security which adds 45 cents to the occupation rent per square metre. Adjustments were therefore made to the rental rates of free-standing and industrial parks to ensure that they include similar cost items such as security.

g) In some cases adjustments were made where there is a significant retail component present in an industrial area. Examples include Makro in Montague Gardens, which focuses increasingly on general retail rather than wholesale.

h) The relative movement in industrial rentals in specific townships was compared over time by means of the time-series data.

i) Buildings within each industrial township were valued on the basis of a visual assessment of the general appearance of the industrial township as a whole in terms of the age, type of construction and the extent of the improvements (landscaping, security fences) within each industrial township.

Due to the fact that the type of properties included in the rent assessment have already been through a sifting process and are therefore considered to be fairly uniform (see <u>Section 5.2.4</u>), industrial townships were considered in two groups in terms of their physical attributes. Category A industrial townships have new buildings with modern designs. They also have landscaping and security fences on the outer perimeter of the township, but do not necessarily have monitored security and access control to the area. These items are costed separately.

Category B industrial townships have older buildings with older designs. They have no landscaping or perimeter security measures. Examples of each category are provided in Figure 5.1.

Figure 5.1: Classification of building types in industrial townships

Category A, smaller than 1000 m²

Category A, larger than 1000 m²

Category B, smaller than 1000 m^2

Category B, larger than 1000 m^2

A further distinction was made between the sizes of buildings. The cost per square metre to construct larger structures is usually less than the unit cost of constructing smaller buildings.

Table 5.6 provides a list of the industrial townships which falls in each category.

Table 5.6: Industrial townships categorised in terms of physical attributes

Category A	Category B
Viking Place	Paarden Eiland
Glosderry (Kenilworth Park)	City Fringe
Montague Gardens	Woodstock/Salt River/Observatory
Marconi Gardens	Lansdowne Nerissa
Ottery Hillstar	Maitland/Ndabeni
Ottery Sunset	Airport 1
Diep River (Elfindale)	Airport 2
Retreat/Steenberg	Epping 1
Bellville Stikland 1	Epping 2
Bellville Stikland 2	Parow Beaconvale
Bellville Triangle	Parow Industria
Bellville South/Sacks Circle	Parow East
	Kraaifontein
	Blackheath

j) Interviews were conducted with panel members to access fully the method which they use in formulating their impression of the rental rate in a specific industrial township.

k) Obtain selected samples of rental rates in specific industrial areas were obtained.

5.3 Calculation of the property value

The property value includes the cost of the land and buildings, municipal engineering services and landscaping. The economic industrial property value was calculated by means of the development method described in Section 5.1.1.2 (c) using Equation 5.2. A standard property capitalisation rate of 13% was used (*Rode, 2000:15*) and the economic occupation rent for 2000 was based on the average monthly rental per square metre presented in Table 5.5. The property value of each industrial township used for the final regression analysis is presented in Table 5.7.

Table 5.7: Estimated property price per square metre for industrial townships in Cape Town

	250 m^2	500 m^2	1000 m^2	2500 m^2	5000 m^2	Average (Y)
Viking Place	R 1,570	R 1,433	R 1,377	R 1,302	R 1,229	R 1,382
Glosderry (Kenilworth Park)	R 1,475	R 1,255	R 1,166	R 1,040	R 987	R 1,185
Paarden Eiland	R 1,527	R 1,129	R 1,062	R 939	R 853	R 1,102
Montague Gardens	R 1,463	R 1,162	R 1,143	R 1,075	R 979	R 1,164
Marconi Gardens	R 1,675	R 1,261	R 1,194	R 1,145	R 1,090	R 1,273
City Fringe	R 1,445	R 1,276	R 1,062	R 874	R 629	R 1,057
Woodstock/Salt River/Observatory	R 1,315	R 1,076	R 976	R 903	R 909	R 1,036
Lansdowne Nerissa	R 1,164	R 1,025	R 953	R 885	R 731	R 951
Ottery Hillstar	R 1,375	R 1,175	R 1,099	R 1,025	R 950	R 1,125
Ottery Sunset	R 1,379	R 1,227	R 1,131	R 1,092	R 1,003	R 1,166
Diep River (Elfindale)	R 1,553	R 1,331	R 1,176	R 1,092	R 1,046	R 1,240
Retreat/Steenberg	R 1,377	R 1,203	R 1,107	R 1,046	R 956	R 1,138
Maitland/Ndabeni	R 1,415	R 1,016	R 946	R 924	R 800	R 1,020
Airport	R 1,288	R 1,035	R 982	R 931	R 857	R 1,019
Epping	R 1,172	R 995	R 911	R 840	R 774	R 939
Parow Beaconvale	R 1,094	R 885	R 816	R 720	R 680	R 839
Parow Industria	R 1,117	R 919	R 792	R 670	R 634	R 826
Parow East	R 1,231	R 988	R 893	R 826	R 729	R 934
Bellville Stikland 1	R 1,217	R 1,007	R 883	R 796	R 702	R 921
Bellville Stikland 2	R 1,217	R 1,007	R 883	R 796	R 702	R 921
Bellville Triangle	R 1,012	R 845	R 735	R 658	R 616	R 774
Bellville South/Sacks Circle	R 968	R 774	R 651	R 578	R 535	R 701
Kraaifontein	R 998	R 822	R 713	R 603	R 576	R 742
Brackenfell Industria	R 1,069	R 941	R 847	R 727	R 649	R 847
Everite Brackenfell	R 1,192	R 978	R 892	R 774	R 714	R 910
Kuils River	R 1,040	R 842	R 756	R 620	R 571	R 766
Blackheath	R 960	R 808	R 677	R 583	R 509	R 707
Saxonberg Industial Park	R 1,046	R 933	R 855	R 697	R 585	R 823
Okavango	R 1,305	R 1,058	R 933	R 738	R 645	R 936

5.4 Calculation of the economic value of industrial land

The economic value of industrial land is based on the economic property value presented in Section 5.3 above, but exclude the replacement of all the improvements to the land, as well as the investment required in time and cost to obtain the necessary approvals for the zoning of the land for industrial purposes. The economic value of industrial land was computed by means of the shadow price method using a similar approach and input data as the calculation of the property value. In order to account for the fact that a certain portion of land would be required for parking and unlettable space, a bulk factor of 0,75 was used. The value of buildings and establishment cost is presented in Table 5.8. The economic value of each industrial township is presented in Table 5.9.

Table 5.8: Input parameters for the calculation of the property value and land value for industrial townships in Cape Town

Parameter	Value
Value of buildings (R/m^2)	
Category A Townships	
< 1000 m^2	1000
> 1000 m^2	800
Category B Townships	
< 1000 m^2	600
> 1000 m^2	560
Establishment cost (R/ha)	
Approvals	10000
Municipal services	180000

Source: Jeffares & Green, 2000

Table 5.9: Shadow price of the economic value of land per square metres for industrial townships in Cape Town

	250 m^2	500 m^2	1000 m^2	2500 m^2	5000 m^2	Average (Y)
Viking Place	R 801	R 664	R 608	R 533	R 460	R 613
Glosderry (Kenilworth Park)	R 706	R 486	R 547	R 421	R 368	R 506
Paarden Eiland	R 1,058	R 660	R 623	R 500	R 414	R 651
Montague Gardens	R 694	R 393	R 524	R 456	R 360	R 485
Marconi Gardens	R 906	R 492	R 575	R 526	R 471	R 594
City Fringe	R 976	R 807	R 593	R 405	R 160	R 588
Woodstock/Salt River/Observatory	R 846	R 607	R 537	R 464	R 470	R 585
Lansdowne Nerissa	R 695	R 556	R 514	R 446	R 292	R 500
Ottery Hillstar	R 606	R 406	R 480	R 406	R 331	R 446
Ottery Sunset	R 610	R 458	R 512	R 473	R 384	R 487
Diep River (Elfindale)	R 784	R 562	R 557	R 473	R 427	R 561
Retreat/Steenberg	R 608	R 434	R 488	R 427	R 337	R 459
Maitland/Ndabeni	R 946	R 547	R 507	R 485	R 361	R 569
Airport	R 819	R 566	R 543	R 492	R 418	R 568
Epping	R 703	R 526	R 472	R 401	R 335	R 488
Parow Beaconvale	R 625	R 416	R 377	R 281	R 241	R 388
Parow Industria	R 648	R 450	R 353	R 231	R 195	R 375
Parow East	R 762	R 519	R 454	R 387	R 290	R 483
Bellville Stikland 1	R 448	R 238	R 264	R 177	R 83	R 242
Bellville Stikland 2	R 448	R 238	R 264	R 177	R 83	R 242
Bellville Triangle	R 243	R 76	R 229	R 152	R 110	R 162
Bellville South/Sacks Circle	R 349	R 155	R 212	R 139	R 96	R 190
Kraaifontein	R 529	R 353	R 274	R 164	R 137	R 291
Brackenfell Industria	R 300	R 172	R 228	R 108	R 30	R 168
Everite Brackenfell	R 423	R 209	R 273	R 155	R 95	R 231
Kuils River	R 346	R 148	R 212	R 76	R 27	R 162
Blackheath	R 491	R 339	R 238	R 144	R 70	R 256
Saxonberg Industial Park	R 277	R 164	R 236	R 78	R 34	R 180
Okavango	R 536	R 289	R 314	R 119	R 26	R 257

CHAPTER 6

DEFINITION AND QUANTIFICATION OF THE ACCESSIBILITY OF INDUSTRIAL TOWNSHIPS

6.1 Introduction

It was pointed out in Chapter 1 that the definition and quantification of "accessibility" and "economic development" are key elements of the study. Chapter 2 concluded that the macro-economic approach used by Ashauer and others measures an increase in accessibility by the amount which is spent on a road infrastructure and maintenance programme in a specific region or country. This presupposes that the efficiency of that expenditure contributes maximally to an improvement in accessibility. The expenditure on transport is then compared directly to economic growth. It was therefore concluded in Chapter 2 that this approach is inherently flawed in a number of ways and is therefore not suitable for a micro-economic analysis.

The main objective of this chapter is to quantify accessibility for the industrial townships under investigation. In order to achieve this goal the concept "accessibility" will firstly be defined. Secondly, a suitable unit of measure (benchmark) for accessibility will be developed. Thirdly, the level of accessibility for each of the industrial townships under investigation will be quantified.

6.2 Defining accessibility

6.2.1 Existing definitions of accessibility

Although accessibility measures have played an important role in transport planning since the 1960s, their application is still largely confined to the use of aggregate data and travel distance to measure it (*Recker, Chen & McNally, 2001:359*). Sasaki (*1991:140*), for example, refers to accessibility merely as "location", which he describes as the access to many establishments, transportation facilities and public offices, whereas Vuchic (*1981:199*) describes accessibility as the ability to travel between different activities.

However, it is too simplistic for the purpose of this study merely to relate accessibility to the ability to travel as this does not indicate the degree of ability to travel between two points. Schoon, McDonald & Lee (*1999:29*) go a step further and define accessibility as the "...ease and convenience of reaching some destination...", whereas Grey (*1989:2*) regards accessibility as "...a measure of the relative access of an area or zone to population, employment opportunities, community services...". This view is supported by Button (*1982:232*), who sees accessibility as "...nothing more complicated than an index that reflects the ease with which people can achieve the various activities they wish...". Based on the above definitions, as well as the fact that the ease and convenience of travel can be regarded as the level of disutility experienced when travelling between an origin and a destination, the definition of accessibility should include the level of disutility experienced to travel between two locations.

Troxel (*1955:275*) introduces a further aspect to the definition by defining accessibility as "...the availability of movement means between any two end points, or set of points...". Access quality is therefore not the actual movement so much as the opportunity or prospect of movement. Accessibility can depend on a number of conditions with the result that more than one definition of accessibility is possible. He continues that there could thus not be a universally accepted definition as it can be expressed in terms of who, what, how much can move, or when movement occurs. Button's views correspond with this (*Button, 1982:231*) as he states that the demand for commuter person movements are, for example, different from that of freight movement, because person movements are circular (home to work to home) and commodity movements are unidirectional. This difference in person and commodity movements is important in the definition of accessibility of industrial areas, which generate trips of both persons and goods.

Partly in response to the lack of understanding of the relationship between accessibility and mobility, the City of Cape Town (*1998a:15*) defined accessibility as the access to opportunities in terms of a broader definition incorporating mobility, proximity and connectivity. In this definition proximity represents land use configuration, connectivity indicates transport networks and services, and mobility refers to the quality of movement. This definition differs from that of Vuchic (*1981:199*), who sees mobility as the total **amount** which is travelled in terms of total vehicle kilometres or person kilometres, whereas Owen (*1964:14*) included the amount of transport infrastructure as well as the amount of travel into his mobility index. According to Vuchic, mobility will therefore increase with an increase in accessibility. As this study will concern itself primarily with the ability to travel, i.e. accessibility, the actual amount that is travelled is not important per se, except where it impacts on the ability to travel through increased congestion between two points. The demand for transport at any given time period is a function of the need to travel between those points, the cost of travel between the points and the quality of the available transport service between the points. Therefore, given a certain need to travel between two points an increase in accessibility, i.e. an increase in the quality of the service and a decrease in the cost of travel, will increase the amount which is travelled.

Based on his definition of accessibility, Button states that changes in the ease of access can be expressed in terms of the cost of transport (*Button, 1982:232*). Considering that accessibility is the ease of movement between two points relative to the ease of movements between all other points in the study area, then "price" should be viewed as a broad concept, which includes travel cost, travel time and other qualitative factors such as comfort. Due to the fact that transport is a derived demand for other goods and services, the price of a transport trip can be regarded as the amount of disutility which is experienced by undertaking the trip. This lays the foundation for measuring accessibility in terms of the disutility cost of transport.

Button identifies a number of factors which may improve accessibility after a policy which was formulated to revitalise the CBD of the City of Leeds (*Button*, *1982:266*). These factors may or may not be a function of travel distance. They are also perceived as variables rather than actual. The factors are:

- Travel time. This includes both the free flow travel time as well as roadside impedance such as the frequency of intersecting streets and property driveways;
- Travel cost. This amounts to the vehicle running cost directly associated with the trip;
- Geographical coverage of the network;
- Travel safety;
- Travel comfort and reliability;
- Availability of service. Car ownership, etc.;
- Car parking effects such as parking charges for private vehicles;
- Travel time on property driveway;
- Roadside distractions such as neon signs and bill boards.

6.2.2 Summary

Over the years many distinguished authors on transport and economic development referred to the term accessibility without providing either a detailed definition, or a quantification unit of measurement.

In this absence of a generally accepted definition, many practising transport planners and spatial planners often wrongly assume accessibility and mobility to be the opposite poles of the same travel continuum. When referring to the classification of roads and public transport services, it is common for planners to refer to mobility routes or services as those factors that allows high-speed travel over longer distances with few interruptions such as transit stops or side-road interruptions. On the other hand, accessibility routes are viewed as those routes which have more interruptions due to friction caused by side streets, direct property accesses or transit stops. Not only is the meaning of accessibility and mobility confused, but in this sense there also appears to be a lack of understanding of the difference between accessibility and access. The perception is therefore that accessibility routes provide more opportunities to get off the road network or transit system, whereas mobility routes allow fast travel between two points. It is thus important to clearly define accessibility and to establish the relationship between access and mobility before accessibility indices can be developed. Based on the above experience, the definition of accessibility needs to include the relationship between accessibility, mobility and access.

6.2.3 Proposed definition of accessibility

From the above it can be deduced that the definition and quantification of accessibility should consider the following aspects:

a) Accessibility is expressed in terms of the disutility of travel between the subject area (see Section 1.5.4), which is also referred to in this study as the subject node, and the node or combination of nodes with which it interfaces, which are referred to as the accessibility node(s) in this study. Both the subject nodes and the accessibility nodes are specific geographical areas.

b) Accessibility is composed of the interrelationship between the following three elements:

- Proximity, which describes the physical separation between the subject node and the accessibility node and can be measured by the crow-fly distance between these two points.

- Connectivity is the distance between the subject node and the accessibility node as measured along the transport network (road or rail). It is therefore determined by the extent of the transport network, as well as the frequency of access points along the links.

- Mobility is the quality of the movement offered by the transport services that operate on the transport network between the subject node and the accessibility node. Mobility is expressed in travel time.

The factors that impact on the elements of accessibility are discussed in more detail in Section 6.3.

c) The disutility of accessibility can be expressed in terms of generalised transport cost (hereafter referred to as generalised cost) by quantifying and adding the cost of the distance travelled (connectivity) and the travel time (mobility) for a single trip. Note that proximity is merely an indication of the maximum level of accessibility which any node will ever be able to achieve in relation to another node. It is also important to consider that the amount that is actually travelled (that is the number of trips that occur) does not influence accessibility unless it affects the mobility due to an increase in congestion, in which case it is reflected in a reduced travel time for a single trip. A land use that generates many trips will merely be influenced more by accessibility of its location than a land use which produces fewer trips. It therefore follows that a land use which produces no trips, for example, undeveloped land which has a completed road network, would have the same accessibility as a similar piece of land which produces many trips, if they share the same connection to the metropolitan road network and have similar internal layouts.

Based on the above, the following definition of accessibility will apply for this study:

Accessibility is the level of resistance in terms of travel distance and travel time required to bridge the geographical gap between a location and all other locations with which it has physical interface in order to create place utility for people, goods and services.

Accessibility therefore indicates the attractiveness of a place (subject node) with respect to its main origin and destination (accessibility node). As the generalised cost of movement between the subject node and the accessibility node decreases, accessibility between these places increases. Accessibility therefore increases as generalised transport cost decreases.

6.3 Factors that impact on the elements of accessibility

6.3.1 Proximity of land uses

Proximity describes the physical separation between two nodes as measured by the crow-fly distance between them. It thus reflects the optimum level of connectivity between two points.

The question can now be asked which two locations are the origin and destination. In this study the first location is referred to as the subject node. This is the area that is regarded as the subject of the investigation and for which the level of economic development needs to be determined. In the development of the accessibility model there would be a number of subject areas that consist of all the investigated industrial townships in Cape Town. Once the model has been developed, only one subject area at a time will be considered. The subject area can be either an origin or a destination or both, depending on whether the location choice is predominantly based on proximity to the raw materials, labour supply or the market area.

The second location is the place or places with which the subject area interfaces and is referred to as the accessibility node. This is the node(s) that can be considered as the centre of economic activity in the study area and can be regarded as the node towards which all activity is attracted. An accessibility node could therefore either be a particular location, such as in a monocentric urban structure. It can also be a combination of a number of location points with which the subject area interfaces, as in the case of a multicentric urban structure, where there are a number of strong decentralised zones.

It was therefore an important aspect of the study to define the urban structure of the study area in order to determine the potential accessibility nodes for individual townships (subject nodes) in the study area.

In a multicentric urban structure where there is more than one accessibility node, the total generalised cost will have to be determined separately for each of these nodes.

6.3.2 Connectivity offered by the transport network

Efficiency of the transport network can be measured by the circuitry of the route, which is the difference in distance between the crow-fly distance (proximity) and the actual travel distance along the transport network (*Ballou, Rahardja & Sakai, 2002:844*). For all practical purposes all freight movements and business trips which are generated by industrial land uses in Cape Town take place on the road network (see Section 3.6(c)). The metropolitan road network is therefore used as a basis for determining the level of accessibility.

In practical terms this means that the level of connectivity that is offered by the transport network is determined by the following two factors:

- The extent and coverage of the transport network;
- The spacing of accesses along transport linkages.

The road hierarchy and the functional classification of roads and streets are central to the planning and management of the road network. A functionally developed road network consists of a sufficient density of roads that are arranged in an appropriate hierarchy in order to cater for a variety of travel functions (*COTO, 2001:3-1*). The relationship between connectivity and the functional hierarchy is shown in Figure 6.1. Higher classes of roads such as freeways serve larger areas and provide less connectivity due to less frequent access spacing. They are therefore able to provide higher levels of mobility (see Section 6.3.3) due to higher average travel speeds. Lower classes of roads provide greater levels of connectivity with lesser mobility.

Access is the opportunity provided by the transport system to approach a particular location. The relationship between access and mobility and the functional classification of roads is shown in Figure 6.2. For any given level of proximity and mobility, accessibility will therefore be influenced by the efficiency with which access is provided from the available transport linkages. Access spacing standards along each class of road are managed in terms of an access management guideline (*PAWC, 2001*), of which a summary is provided in Table 6.1.

Figure 6.1: Relationship between reach of connectivity and functional classification

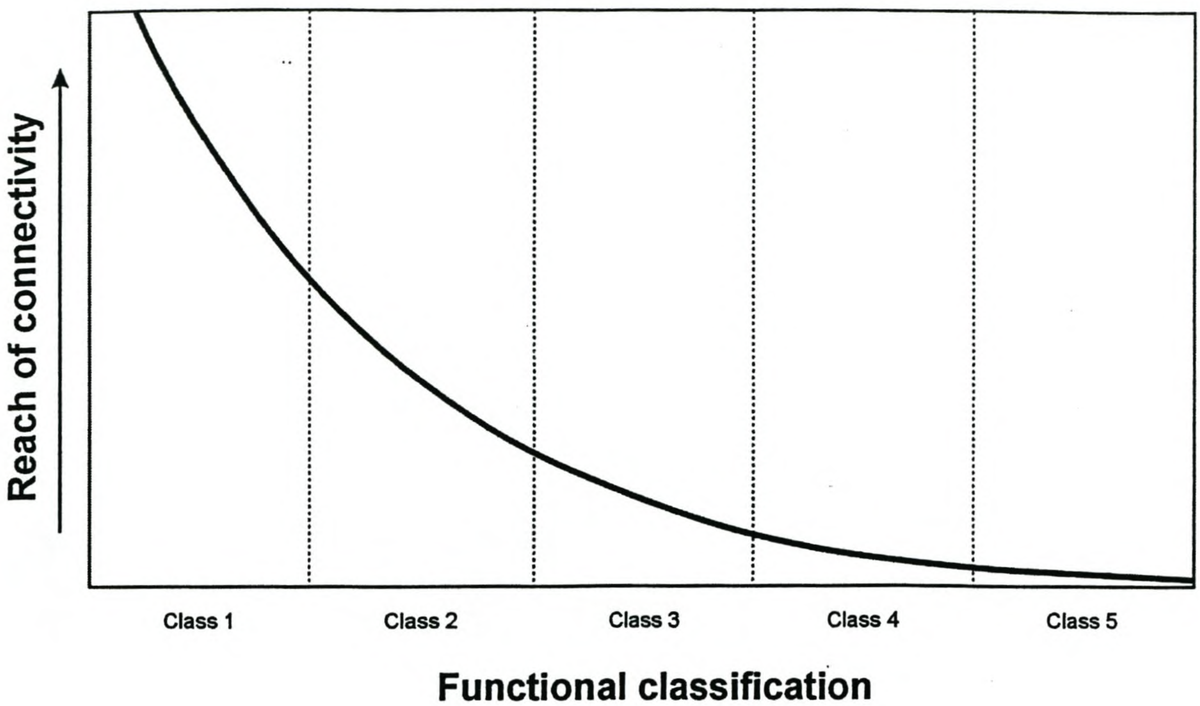


Figure 6.2: Relationship between mobility/access and functional classification

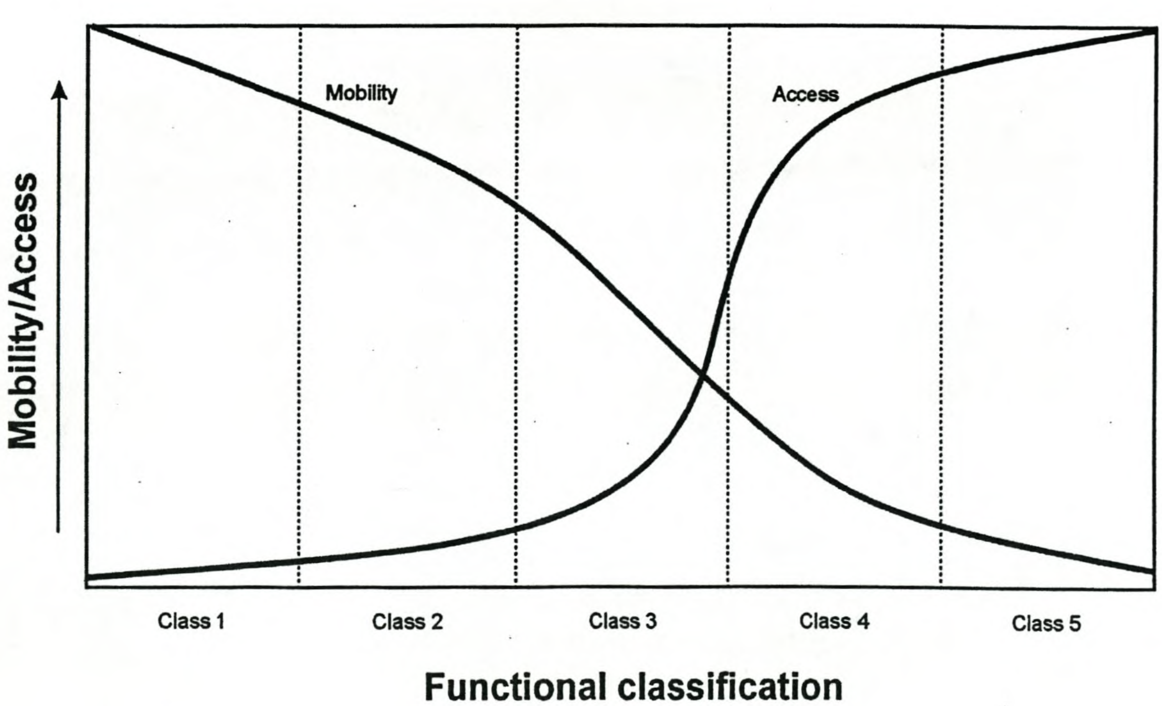


Table 6.1: PAWC Road Access Guidelines: Minimum Spacing of Accesses

Development Environment	Access Type			Road Classification						
				Class 1 Expressway	Class 2 Primary Arterial / Primary Distributor		Class 3 Secondary Arterial / District Distributor		Class 4 Minor Road / Local Distributor	
					Full access	Left only	Full access	Left only	Full access	Left only
Urban >10 000m² GFA/ha	Operating speed			60 km/h	50 km/h		40 km/h - 50 km/h		35 km/h - 40 km/h	
	Unsignalised	Low vol driveway	<50 veh/h		60	60	45	45	25	25
		High vol driveway	<250 veh/h		120	75	60	60	45	45
		Equivalent side road	<450 veh/h	540	120	90	90	75	60	60
	Signalised			540	375		275		225	
	Median Opening			540	120		90		60	
Intermediate 3 000-10 000m² GFA/ha	Operating speed			70 km/h	60 km/h		50 km/h		50 km/h	
	Unsignalised	Low vol driveway	<50 veh/h		90	90	45	45	25	25
		High vol driveway	<125 veh/h		180	100	75	75	60	60
		Equivalent side road	<375 veh/h	800	180	120	120	90	90	75
	Signalised			800	540		375		275	
	Median Opening			800	180		120		90	
Suburban 1 000-3 000m² GFA/ha	Operating speed			80 km/h	70 km/h		60 km/h		50 km/h	
	Unsignalised	Low vol driveway	<50 veh/h						45	45
		High vol driveway	<100 veh/h						60	60
		Equivalent side road	<300 veh/h	1200	270	160	180	120	120	90
	Signalised			1200	800		540		375	
	Median Opening			1200	270		180		120	
Semi-Rural <1 000m² GFA/ha	Operating speed			100 km/h	80 km/h		70 km/h		60 km/h	
	Unsignalised	Low vol driveway	<50 veh/h							
		High vol driveway	<150 veh/h							
		Equivalent side road	<150 veh/h	1600	400	200	270	155	180	120
	Signalised			1600	1200		800		540	
	Median Opening			1600	400		270		180	
Rural Natural/agricultural areas	Operating speed			120 km/h	120 km/h		110 km/h		80 km/h	
	Unsignalised	Driveway	<50 veh/day	600	500	500	450	450	300	300
		Equivalent side road	<500 veh/day	1600	600	600	450	450	450	450
	Signalised									
	Median Opening			1600	600		450		300	

Due to the fact that access has a direct impact on connectivity, access spacing should be optimised in terms of generalised transport cost. In order to optimise generalised transport cost it is necessary to consider two groups of road users as follows:

a) Through-traffic, which is defined as the road users who travel the entire distance along a defined road section. Generalised cost for this traffic will be minimised if the journey along the link section is uninterrupted.

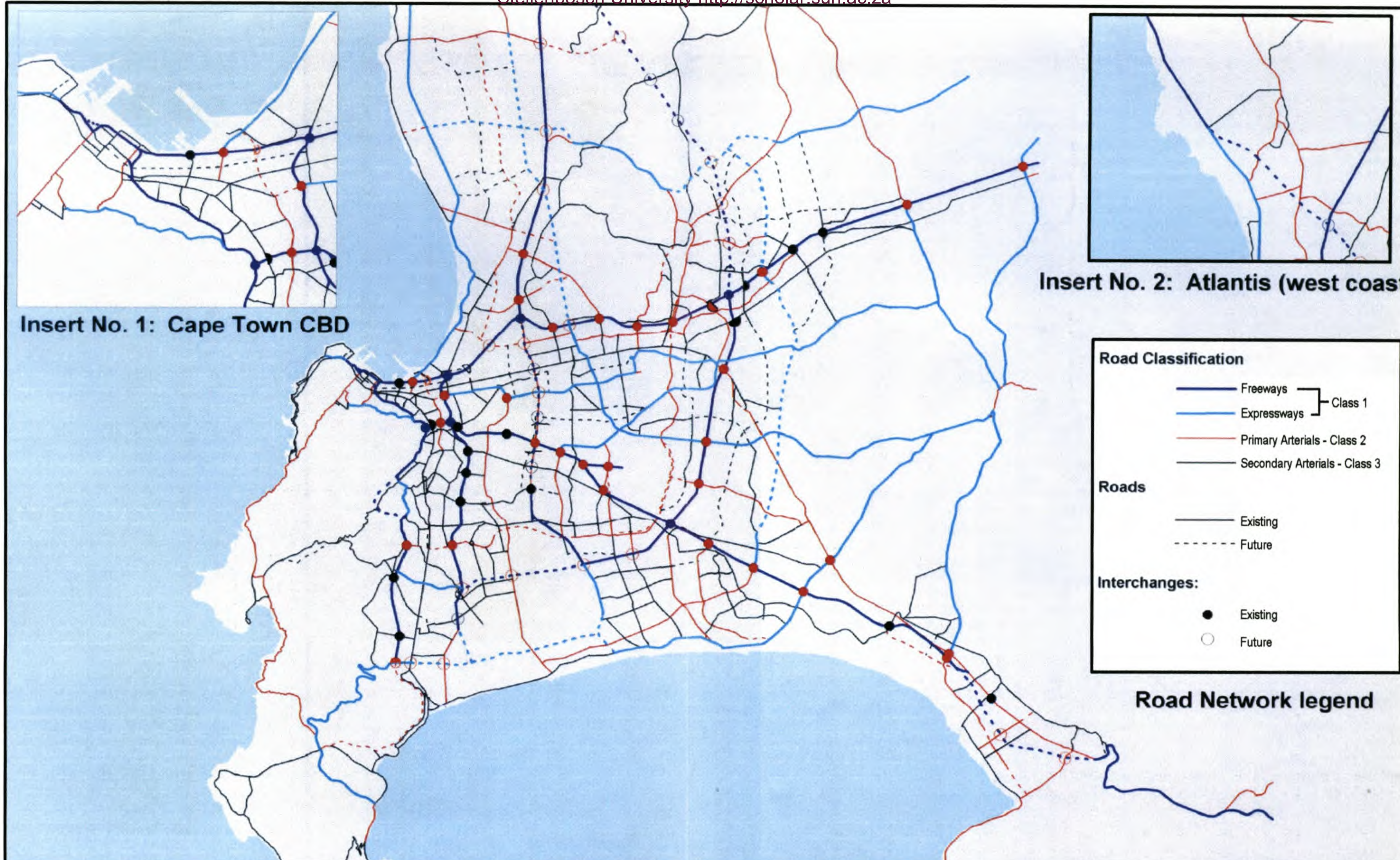
b) Local traffic refers to the road users who would enter and/or exit a defined road section, if they were given the opportunity to do so. These road users would therefore prefer access as close as possible to their destination in order to reduce their generalised transport cost. In this context the link can provide either direct access to their destination, or indirect access via the supporting higher- or lower-order roads. However, it should be borne in mind that local traffic would only benefit from an access at the point closest to their destination. Other access points along the link will impede their flow similar to that of through-traffic until they reach the access point closest to their destination.

There is a trade-off between the generalised cost of through-traffic and local traffic. The optimum access spacing is therefore at the point where generalised transport cost is minimised. This is also the point at which accessibility is maximised and the highest level of regional economic development can be achieved.

The metropolitan road network includes Class 1, 2 and 3 roads, whilst the street network consist of Classes 4 and 5. The extent of the Cape Town metropolitan road network, as well as the proposed extensions to the network, is depicted on Figure 6.3. It is clear from the presented network that the metropolitan road network provides excellent levels of connectivity to all the current industrial townships in Cape Town (compare with Figure 1.3), and that future industrial developments could be served equally well once the network is completed.

6.3.3 Mobility

The level of mobility is expressed in terms of the average travel time between the subject node and the accessibility node. This depends on (a) the travel distance between the subject node and the accessibility node (i.e. proximity of connectivity); (b) the impedance experienced by other vehicles that are commonly referred to as congestion; (c) impedance by the physical features of the network itself such as the spacing of accesses that lead to other public roads, streets or private driveways; and (d) the average free flow speed of the vehicle.



Cape Town Metropolitan Strategic Road Network

Fig. 6.3

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Due to the fact that the majority of industrial trips take place during the off-peak hours when there is no notable congestion, the impact of congestion on the accessibility of industrial townships is ignored for the purpose of this study. The only factors that will thus impact on mobility are the travel distance, physical impedance and vehicle speed.

It is therefore also important to consider intersection characteristics.

a) Signalised intersections

Table 6.1 outlines the ideal spacing of signalised intersections in terms of generalised transport cost for the defined functional scenarios.

b) Roundabouts

Due to the fact that roundabouts cause impedance to the movements of through-traffic in order to allow access opportunities to local traffic, the spacing of roundabouts would not differ substantially from that of signalised intersections. However, comparative economic evaluations of signals and roundabout control showed that roundabouts often offer considerably less overall transport cost if all traffic over a 24-hour period is taken into account. In one particular instance the vehicle operating cost and time cost of a roundabout at an intersection with an average daily traffic of about 20 000 vehicles on all approaches were 25% and 60%, respectively, lower than those of a signalised intersection. This is despite the fact that delays during the peak hour were higher than those of traffic signals. The main reason for this saving is the fact that through-traffic is not unnecessarily delayed during off-peak hours. This would suggest that the total cost curve of roundabout spacing is somewhat flatter than that of traffic signals, which would allow the spacing of roundabouts to be closer than that of traffic signals under conditions where the capacity of the roundabout is not exceeded for long periods.

c) All-way stops

From a generalised transport cost perspective all-way stops are regarded as completely inefficient and should be avoided. Apart from the many negative technical characteristics of all-way stops, economic evaluations of a number of case studies have shown that the cost involved in stopping all vehicles on all the approaches can never be justified, regardless of the traffic volume or intersection spacing.

d) Stop or yield control on minor approaches

Access spacing at intersections which have stop control on the minor approaches is determined primarily by the trade-off between generalised cost of local traffic seeking access to the higher order road network and accident cost at intersections. Purely from a vehicle operating cost and time cost point of view, stop control accesses could decrease accessibility cost without necessarily increasing cost to through-traffic. The reason for this is that access points with stop control on the minor approaches do not impede the through flow on the major link, provided that sufficient provision is made for deceleration lanes for left turning traffic and storage lanes for right turners. One of the most popular methods of achieving this is to provide slipways from and/or to the major road.

There are, however, a number of other aspects which also influence the frequency of stop/yield control accesses:

- If the stop control access is close enough to an existing signalised intersection so as to become part of an existing conflict point and not add to the occurrence of accidents;
- In some instances the provision of slipways contributes to illegal U-turns, which increases traffic accidents if the intersection where they occur is not designed for this purpose;
- Pressure is often exerted on authorities to signalise an unsignalised intersection;
- It may not be technically possible to introduce a stop control intersection without turning traffic impeding the through-traffic flow.

e) One-way street systems

Although the study brief does not specifically include the merits of one-way street systems, it is worth noting that one-way couples can greatly reduce overall transport cost. This would allow far closer access spacing without compromising transport cost. A recent study, where a one-way couplet system was simulated by means of the SATURN traffic model, showed that travel time would decrease by as much as 80% if a one-way couplet was introduced. As can be expected, there was a slight increase of about 3% in travel distance due to the fact that some traffic has to circulate in order to reach a destination fronting the opposite direction of travel.

Unfortunately no specific data were found on the frequency of accidents on one-way couplets, but considering that the number of intersection conflict points on one-way systems are considerably less (in the case of a four-leg intersection a one-way system has 5 conflict points compared to the 32 of two-way intersecting roads), it can be expected that fewer accidents will occur. This further strengthens the notion that access spacing on one-way roads can be at least half that of two-way roads.

6.4 Quantification of the measure of accessibility

6.4.1 Requirements

During the process of quantifying the generalised transport cost, it became evident that the accessibility scale has to comply with the following practical considerations:

a) It should be relatively simple to calculate, but it should allow further refinement and development that may be required for the purpose of other applications.

b) It should be able to reflect both current levels of accessibility as well as accessibility levels after hypothetical or real transportation and land use interventions.

c) It must be able to reflect door-to-door trips between any specific point and all other points in the study area.

d) It should allow for a direct comparison between modes, trip purposes and when trips occur.

e) It should exclude value judgements such as attaching weights to certain variables.

f) It should be expressed as a mathematical function which can be included in the further analysis.

g) A single value should pertain to any particular point in the network and should include both trip productions as well as attractions to that point.

h) It should include the demand for travel between a point and all other points in the study area.

6.4.2 Techniques to quantify accessibility

Previous attempts to quantify accessibility can be broadly categorised in terms of their purpose of application as follows:

- Determine land values or explain land use patterns (land economists and spatial planners);
- Strategic transport planning;
- Graph theory;
- Determine the market area of retail outlets;
- Route planning and location decisions in the logistics environment.

It appears that many researchers who investigated the relationship between transport and land use are mostly specialists on land rather than on transport. This resulted in an over-simplification of the value attached to accessibility. Early researchers such as Ricardo and Marshall (see Section 4.2) used distance to the market to describe and quantify the accessibility of a particular geographical point. When later research, led by Alonso (*1964:10*), attempted to explain land rent in urban environments, travel time was used as an index of accessibility. Even recent researchers such as Sasaki (*1991:145*) introduce distance to the railway station as a proxy of the accessibility of a specific location when analysing changes in land rent in Japanese cities.

On the other hand, more comprehensive accessibility indices are developed for **strategic transport planning** purposes and therefore the selection of origin-destination pairs is not suited for the development of a universal accessibility index that can be used to predict land values. These indices vary in complexity. The Dutch method (*Verroen & Jansen, 1992: 81-88*) uses qualitative ratings (A, B and C) to indicate the level of accessibility for urban areas, whereas the Policy and Procedures Guidelines (*Schoon, McDonald & Lee, 1999:30*) of the Department of Environment in the UK formulate accessibility indices by comparing accessibilities of specific locations to the 45-minute isochrons for public and private transport modes. Other methods such as the Local Index of Transit Accessibility (LITA), which was developed in the United States, base accessibility on service attributes related to intensity of activity such as population density, area and employment levels (*Rood, 1997*). Another example is ACCMAP (*MVA, 1997*), which is a computerised public transport accessibility model that was developed by the firm MVA, which is based in the UK. This model uses a geographical information system (GIS) to generate data to measure accessibility to specified locations by using the public transport system. The model can also be extended to include other attributes of the system and population characteristics.

Public Transport Accessibility Levels (PTAL) developed by London Transport (*Schoon et al, 1999:30*) measure the ease of reaching public transport routes from home in terms of travel time and distance. However, this index does not include trip purpose, trip destination or the cost of the trip. Schoon *et al.* (*1999:33-35*) used a similar method to developed accessibility indices for private and public transport in a pilot study in north-east Hampshire, England. These PTALs were based on door-to-door travel time and travel cost between specified origins and destinations. The main constraints of using this approach for this study, other than that it focused on commuter travel time and ignored freight movements, is the fact that it considered travel time and travel cost as separate criteria and did not combine them into a single disutility value.

Another group of researchers studied accessibility purely from a theoretical point of view. Gould (*Straffin, 1980:269-276*), for example, used graph theory to develop an accessibility index to determine the accessibility between each point and every other point on a graph. Although a few applications for this model are cited, little attention is paid to the practical application of the model. The main shortcoming of Gould's approach is that its definition of accessibility conforms to the simple definition of accessibility which regards accessibility merely as the ability to travel between two points. It therefore does not take the disutility of travel between the points into account, which is very important in a well-developed urban road network, where every point is connected to every other point. Furthermore, it assumes that the demand for travel between all points are equal, which is not the case in practice. In addition, the accessibility matrix would become unmanageably big when a detailed analysis of urban origins and destinations is made. If the transport zone system of the City of Cape Town is used, there would be a total of 90 000 accessibility indices for which the disutility and traval demand will have to be calculated. However, it would be worthwhile to develop Gould's approach further with the view of simplifying the approach.

It can therefore be **concluded** that generalised cost would be the most appropriate unit to measure accessibility. The reasons for this are as follows:

- Generalised cost is regarded as the best reflection of the disutility of travel;
- It contains elements of both travel time and travel cost combined into a single monetary unit;
- Travel time and travel cost are quantified in terms of a well-documented procedure which is commonly applied in economic evaluations.

6.4.3 Proposed method of quantifying accessibility

It was found in Section 6.4.2 above that generalised cost would be the most appropriate unit to measure accessibility. Furthermore, accessibility needs to take the functional classification of roads (road hierarchy) into account. For this reason accessibility was quantified in terms of the following three accessibility categories:

a) Regional accessibility is the inverse of the generalised cost on the Class 1 metropolitan road network.

b) Local accessibility is the inverse of the generalised cost of accessibility on the Class 2 and 3 metropolitan road network.

c) Internal accessibility is the inverse of the generalised cost of accessibility on the Class 4 and 5 street network within the industrial township.

The objective of this section is to individually quantify each of the above components of accessibility.

6.4.4 Generalised cost of accessibility

The generalised cost of accessibility (GCA) between locations i and j, where node i is the subject node point and node j is the accessibility node, can therefore be calculated by means of the following equation:

$$GCA_{ij} = CR_{ij} + CL_{ij} + CI_{ij} \qquad \text{(6.1)}$$

where:

CR_{ij}	is the generalised cost of **regional** accessibility between locations i and j;
CL_{ij}	the generalised cost of **local** accessibility between locations i and j;
CI_{ij}	the generalised cost of **internal** accessibility between locations i and j.

The generalised cost of **regional accessibility** can be calculated by means of the following equation:

$$CR_{ij} = DR_{ij} * FFC + TR_{ij} * TC / 60 \qquad (6.2)$$

where:

DR_{ij}	is the travel distance in kilometres along the Class 1 metropolitan road network (freeways) between nodes i and j;
FFC	is the free flow vehicle operating cost per kilometre for the typical goods vehicle class (see Table 6.7);
TR_{ij}	is the vehicle travel time in minutes along the primary road network (freeways) between location i and j;
TC	is the transport time cost in rand per hour (see Section 6.5, Step 4(b)).

The generalised cost of **local accessibility** can be calculated by means of the following equation:

$$CL_{ij} = DL_{ij} * FFC + SN_{ij} * SC + IT_{ij} * IC / 60 + TL_{ij} * TC / 60 \qquad (6.3)$$

where:

DL_{ij}	is the travel distance in kilometres along the Class 2 and 3 metropolitan road network between nodes i and j;
FFC	is the free flow vehicle operating cost per kilometre for the typical goods vehicle class (see Table 6.7);
SN_{ij}	is the number of stops on the Class 2 and 3 network between nodes I and j;
SC	is the cost per stop for the typical goods vehicle class (see Table 6.7);
IT_{ij}	is the total time in minutes during which the vehicle remains stationary at stops between nodes i and j;
IC	is the stationary/idling cost per hour for the typical goods vehicle class (see Table 6.7);

TL_{ij} is the vehicle travel time in minutes along the Class 2 and 3 metropolitan road network between location i and j;

TC is the transport time cost in rand per hour (see Section 6.5, Step 4(b)).

The generalised cost of **internal accessibility** can be calculated by means of the following equation:

$$CI_{ij} = DI_{ij} * FFC + TR_{ij} * TC / 60 \quad \text{.......(6.4)}$$

where:

DI_{ij} is the travel distance in kilometres along the Class 4 and 5 internal street network between nodes i and j;

FFC is the free flow vehicle operating cost per kilometre for the typical goods vehicle class (see Table 6.7);

TI_{ij} is the vehicle travel time in minutes along the internal street network (Class 4 and 5) between location i and j;

TC is the transport time cost in rand per hour (see Section 6.5, Step 4(b)).

6.5 The accessibility of industrial townships in Cape Town

The following procedure was formulated to determine the accessibility index of a particular location within a defined geographical area. The procedure for calculating the accessibility indices can be described by means of the following steps:

Step 1: Establish the location of the industrial accessibility node.

Step 2: Measure the total door-to-door travel distance of a trip between each subject node and the industrial accessibility node.

Step 3: Determine the vehicle time of a trip between each subject node and the industrial accessibility node broken down into the following components:

- Vehicle travel time along the Class 4 and 5 street network between the trip generator and the nearest Class 2 and 3 metropolitan road;
- Vehicle travel time along the Class 2 and 3 metropolitan road network to the nearest freeway;
- Vehicle travel time along the freeway network to the industrial accessibility node;

Step 4: Determine the generalised transport cost between the industrial accessibility node and all each subject node by means of Equations 6.1, 6.2, 6.3 and 6.4.

Step 1: Establish the industrial accessibility node.

The definition of accessibility implies that there is a demand to travel between two geographically remote locations. Current land use and travel pattern data do not provide sufficient information to determine the geographical accessibility location from which travel time and distance can be measured to calculate the generalised cost of each industrial township (see Section 4.3.2.2 on the land use and travel patterns in Cape Town). An alternative approach was therefore adopted whereby the correlation between accessibility and land value was calculated for a number of possible geographical accessibility location combinations as defined in Section 4.3.2.2.2. The following geographic accessibility location scenarios were identified based on the land use analysis:

a) The Cape Town CBD/Port

It should be borne in mind during the interpretation of the results that the zone system, although very detailed for modelling on a metropolitan scale, does not differentiate between locations which are very close to one another. One specific example where this placed a particular constraint on the results of the analysis is the close proximity of the Cape Town CBD, the V&A Waterfront and the Port of Cape Town. All these very important land uses fall into the same transport zone. It was thus not possible to differentiate between the importance of these land uses. It therefore has to be accepted that both the port and the waterfront are historically, geographically and functionally an integral part of the Cape Town CBD and that further attempts to separate them from the CBD would amount to a theoretical exercise with little or no practical value for the purpose of this study. If reference is made to the Cape Town CBD, it therefore includes all the land uses in that zone.

b) The Wynberg and Bellville Development Nodes

Both Wynberg and Bellville are two decentralised nodes which have experienced considerable growth over the past decade, particularly in the provision of upmarket retail and office accommodation. They are also at the centre of the high-income residential areas of the southern suburbs and northern suburbs, respectively, and can therefore be viewed as both a major supplier of skilled labour and a demand for consumer goods.

c) The Philippi Development Node

Although Philippi is still an undeveloped development node, it is identified by the MSDF as an emerging node that would ultimately become the fourth development node of Cape Town. Its inclusion as a potential attraction node is, however, warranted on the grounds that it has existed as an industrial township since the 1960s and because it is surrounded by townships such as Khyelitsha, Mitchells Plain and Crossroads and is thus located in the centre of the low-skilled workforce. It could therefore be a prime location for industry, if proximity to the labour force could be considered to be an important industrial location attribute.

d) Cape Town International Airport

e) National road connections (N1, N2 and N7), where they cross the Cape Town boundary.

The above nodes were considered one at a time by means of a simple regression analysis, and were also collectively regressed on the land values of industrial townships (a multi variant regression of nodes on land values of industrial townships was performed). The proximity of the subject nodes (sample of industrial townships) to the accessibility nodes, as well as the land value used in regression analysis, is presented in Table 6.2.

Table 6.2: Proximity of subject areas to potential industrial accessibility nodes

		Proximity (X) (km)								Land Value (Y) (R/m²)
		Potential Industrial Accessibility Nodes								
	Industrial Township	CBD/Port	Wynberg	Bellville	Philippi	Airport	N1	N2	N7	Size of rented space 500m²
Subject Areas	Viking Place	18.2	16.08	14.32	14.43	13.41	24.96	37.31	16.06	R 664
	Glosderry (Kenilworth Park)	15.91	5.13	26.3	17.11	21.45	36.94	42.64	26.52	R 486
	Paarden Eiland	6.64	14.26	18.59	20.5	22.19	29.23	43.38	18.81	R 660
	Montague Gardens	17.6	22.84	15.21	22.17	20.83	25.85	45.05	10.97	R 393
	Marconi Gardens	13.02	22.87	15.24	22.2	20.86	25.88	45.08	10.59	R 492
	City Fringe	3.89	13.64	22.2	22.17	23.86	32.84	45.05	22.42	R 807
	Woodstock/Salt River/Observatory	5.37	11.91	21.06	20.44	22.13	31.7	43.32	21.28	R 607
	Lansdowne Nerissa	17.62	4.56	28.01	13.46	22.26	37.69	37.33	28.32	R 556
	Ottery Hillstar	19.05	4.2	29.44	14.31	23.11	38.54	38.18	29.66	R 406
	Ottery Sunset	22.08	5.56	32.47	16.34	25.14	40.57	40.21	32.69	R 458
	Diep River (Elfindale)	21.12	6.13	33.04	21.06	28.19	43.68	44.93	33.26	R 562
	Retreat/Steenberg	23.91	7.39	34.3	18.87	27.67	44.94	42.94	34.52	R 434
	Maitland/Ndabeni	9.94	12.42	19.51	18.66	20.35	30.15	41.54	19.73	R 547
	Airport	21.85	19.46	12.68	7.74	8.64	25.79	30.62	25.55	R 566
	Epping	15.1	14.73	16.42	13.62	13.13	27.06	36.5	18.13	R 526
	Parow Beaconvale	20.6	19.45	9.73	13.16	9.86	20.37	36.04	18.43	R 416
	Parow Industria	26.39	23.03	8.86	13.14	9.84	19.5	36.02	21.53	R 450
	Parow East	23.18	28.42	5.65	15.17	11.87	16.29	38.05	18.32	R 519
	Bellville Stikland	28.14	30.43	5.92	17.42	8.36	14.51	35.01	23.28	R 238
	Bellville Triangle	28.47	27.2	6.25	17.74	8.68	14.83	35.33	23.61	R 76
	Bellville South/Sacks Circle	27.98	24.74	7.09	14.86	10.68	16.83	37.33	23.12	R 155
	Kraaifontein	35.21	40.45	13.04	28.67	19.61	0	46.26	30.35	R 353
	Brackenfell Industria	32.27	37.51	10.1	23.42	14.36	7.48	41.01	27.41	R 172
	Everite Brackenfell	32.87	38.11	10.7	22.72	13.66	8.08	40.31	28.01	R 209
	Kuils River	35.91	29.94	13.74	16.93	7.87	16.42	24.49	31.05	R 148
	Blackheath	35.65	28.43	19.11	15.42	6.36	21.79	24.32	36.42	R 339
	Saxonberg Industial Park	36.25	29.03	16.19	16.02	6.96	18.87	22.06	33.5	R 164
	Okavango	31.5	36.74	9.33	22.92	13.86	6.71	40.51	19.7	R 289

The results of the first-stage analysis are presented in Appendix A and are summarised in Table 6.3.

Table 6.3: Results of the first-stage analysis based on proximity to various potential industrial accessibility nodes

	Adjusted R^2	Appendix Reference
CBD/Harbour	0.68	A.1
Wynberg	0.41	A.2
Bellville	0.19	A.3
Philippi	-0.02	A.4
Airport	0.30	A.5
N1	0.36	A.6
N2	0.19	A.7
N7	0.06	A.8
All Locations	0.73	A.9

The results in Table 6.3 can be interpreted as follows:

a) The CBD/Port node shows the best correlation between proximity and industrial land value. This confirms that, despite suggestions that Cape Town is a multi-centric city, from an industrial perspective land values depend to a large extent on the distance from the CBD. Similar results were obtained in the United Kingdom for residential land uses where, provided that the location specific characteristics of housing are appropriately measured, monocentric models performed well despite the fact that the urban framework was regarded as multi-centric (*Cheshire & Sheppard, 1995:248*).

b) Neither of the developed decentralised zones, i.e. Wynberg and Bellville, shows significant correlation between proximity and industrial land value. The reason why Wynberg has a better correlation than Bellville is likely to be related more to the fact that it is situated closer to the CBD/Port than Bellville, rather than the fact that it is inherently more attractive as a potential industrial accessibility node. A direct comparison between the attractiveness of Wynberg and Bellville should therefore not be based on the presented results.

c) The Philippi node, the undeveloped decentralised node, shows no relationship between accessibility and land value. This indicates that industry does not view closeness to an abundance of low skilled labour as a factor in the location decision within the Cape Town metropolitan area.

d) None of the four external connection points other than the port, namely the airport as well as the N1, N2 and N7 freeways, shows an acceptable absolute correlation. Again, a direct comparison of the relative attractiveness of these points should not be based on the presented results.

e) A multiple regression analysis of all the potential nodes shows a marginally better R square than the CBD/Port. There are, however, a number of reasons why the CBD/Port node is favoured in this instance:

- The measurement of accessibility costs between all industrial townships and all potential industrial accessibility nodes would be significantly more costly and would require resources well beyond the potential benefit of a better quantified generalised cost of accessibility.

- Some of the other statistical tests cast doubt over the statistical robustness of using "all locations" as an industrial accessibility node. As opposed to this, the statistical parameters of the simple regression analysis of the CBD node prove to be very good considering the nature of the source data.

f) In addition to providing an indication of the geographical accessibility location, this initial analysis also provided an indication of whether the hypothesis that accessibility has a significant impact on land value holds true at a fairly early stage of the study. The refinement of the accessibility factor was therefore the result of an iterative process after a preliminary relationship between accessibility and rent had been established.

Step 2: Measure the travel distance of industrial townships to the industrial accessibility node.

Travel distances were measured along the connectivity path between the industrial accessibility node and each of the subject areas. The distances for regional, local and internal accessibility, which were scaled from available street plans (*Map Studio, 1999*), are presented in Tables 6.4, 6.5 and 6.6 respectively.

Step 3: Measure the vehicle travel time.

Resource constraints did not allow the undertaking of extensive travel time measurements between the industrial accessibility node and all subject nodes. In the absence of such travel time data, a pragmatic approach was adopted whereby vehicle travel time of goods vehicles on the road network was derived from the estimated average travel speed during typical business hours and the travel distances as measured in Step 2.

Free flow travel speeds of goods vehicles (excluding light passenger vehicles) during business hours were based on data from the Highway Capacity Study (*Cape Town Metropolitan Transport Area, 1991*) adjusted to 2002, the 80 km/h legal speed limit of heavy vehicles, the posted speed limit on the various classes of road and visual observations by the author of what could be considered a safe travel speed along the various links. These speeds were rounded to the nearest ten kilometres per hour. In addition the number of stops (it was assumed that a vehicle would stop at every signalised intersection and that the number of signalised intersections would be equal to the number of stops) along each link was recorded and an average stationary delay of ten seconds per vehicle was allowed for at each intersection. The vehicle travel time for regional, local and internal accessibility is presented in Tables 6.4, 6.5 and 6.6 respectively.

Table 6.4: Regional accessibility: travel distance, travel time and generalised cost

	freeway + connection		dist to CBD (m)	average free flow speed (km/h)	travel time (minutes)	VOC	Time Cost	Generalised Cost
Viking Place	N2	Vanguard	13600	80	10.20	R 54.67	R 7.21	R 61.89
Glosderry (Kenilworth Park)	M5	Racecourse	12800	80	9.60	R 51.46	R 6.79	R 58.25
Paarden Eiland	N1	Koeberg	5500	80	4.13	R 22.11	R 2.92	R 25.03
Montague Gardens	N7	Bosmansd	14500	80	10.88	R 58.29	R 7.69	R 65.98
Marconi Gardens	N7	Bosmansd	14500	80	10.88	R 58.29	R 7.69	R 65.98
City Fringe		cbd	0	80	0.00	R 0.00	R 0.00	R 0.00
Woodstock/Salt River/Observatory	N1	Church	2100	80	1.58	R 8.44	R 1.11	R 9.56
Lansdowne Nerissa	M5	Racecourse	12800	80	9.60	R 51.46	R 6.79	R 58.25
Ottery Hillstar	M5	Ottery	15500	80	11.63	R 62.31	R 8.22	R 70.53
Ottery Sunset	M5	Ottery	15500	80	11.63	R 62.31	R 8.22	R 70.53
Diep River (Elfindale)	M5	Ottery	15500	80	11.63	R 62.31	R 8.22	R 70.53
Retreat/Steenberg	M5	Ottery	15500	80	11.63	R 62.31	R 8.22	R 70.53
Maitland/Ndabeni	N1	Koeberg	5500	80	4.13	R 22.11	R 2.92	R 25.03
Airport	N2	Airport	18200	80	13.65	R 73.16	R 9.66	R 82.82
Epping	N2	Vanguard	13600	80	10.20	R 54.67	R 7.21	R 61.89
Parow Beaconvale	N1	MonteVista	14000	80	10.50	R 56.28	R 7.43	R 63.71
Parow Industria	N2	Modderdam	15200	80	11.40	R 61.10	R 8.06	R 69.17
Parow East	N1	KarlBremer	20500	80	15.38	R 82.41	R 10.88	R 93.29
Bellville Stikland 1	N1	OldOak	26000	80	19.50	R 104.52	R 13.79	R 118.31
Bellville Stikland 2	N1	OldOak	26000	80	19.50	R 104.52	R 13.79	R 118.31
Bellville Triangle	R 300	Strand	32000	80	24.00	R 128.64	R 16.98	R 145.62
Bellville South/Sacks Circle	R 300	Strand	32000	80	24.00	R 128.64	R 16.98	R 145.62
Kraaifontein	N1	Joostenberg	34300	80	25.73	R 137.89	R 18.20	R 156.08
Brackenfell Industria	N1	Okavango	30000	80	22.50	R 120.60	R 15.92	R 136.52
Everite Brackenfell	N1	Okavango	30000	80	22.50	R 120.60	R 15.92	R 136.52
Kuils River	R 300	Stellenbosch	30600	80	22.95	R 123.01	R 16.23	R 139.25
Blackheath	R 300	Stellenbosch	30600	80	22.95	R 123.01	R 16.23	R 139.25
Saxonberg Industial Park	R 300	Stellenbosch	30600	80	22.95	R 123.01	R 16.23	R 139.25
Okovango	N1	Okavango	30000	80	22.50	R 120.60	R 15.92	R 136.52

Table 6.5: Local accessibility: travel distance, travel time and generalised cost

	freeway + connection		dist to f'way connection (m)	average free flow speed (km/h)	free flow travel time (minutes)	number of stops at intersections	average delay per stop (s)	total stop delay (min)	total travel time to f'way (min)	VOC	Time Cost	Generalised Cost
Viking Place	N2	Vanguard	3100	60	3.10	6	20	2.00	5.10	R 17.59	R 3.61	R 21.20
Glosderry (Kenilworth Park)	M5	Racecourse	1300	40	1.95	3	20	1.00	2.95	R 7.79	R 2.09	R 9.88
Paarden Eiland	N1	Koeberg	500	60	0.50	2	20	0.67	1.17	R 3.72	R 0.83	R 4.54
Montague Gardens	N7	Bosmansd	1000	60	1.00	3	20	1.00	2.00	R 6.58	R 1.41	R 8.00
Marconi Gardens	N7	Bosmansd	2500	60	2.50	5	20	1.67	4.17	R 14.32	R 2.95	R 17.27
City Fringe		cbd	1500	30	3.00	5	20	1.67	4.67	R 10.30	R 3.30	R 13.60
Woodstock/Salt River/Observatory	N1	Church	700	30	1.40	3	20	1.00	2.40	R 5.38	R 1.70	R 7.07
Lansdowne Nerissa	M5	Racecourse	3000	60	3.00	7	20	2.33	5.33	R 18.04	R 3.77	R 21.81
Ottery Hillstar	M5	Ottery	4400	60	4.40	7	20	2.33	6.73	R 23.67	R 4.76	R 28.43
Ottery Sunset	M5	Ottery	3200	60	3.20	4	20	1.33	4.53	R 16.28	R 3.21	R 19.49
Diep River (Elfindale)	M5	Ottery	2600	60	2.60	4	20	1.33	3.93	R 13.87	R 2.78	R 16.65
Retreat/Steenberg	M5	Ottery	6000	60	6.00	4	20	1.33	7.33	R 27.54	R 5.19	R 32.72
Maitland/Ndabeni	N1	Koeberg	1700	30	3.40	4	20	1.33	4.73	R 10.25	R 3.35	R 13.60
Airport	N2	Airport	2000	80	1.50	0	20	0.00	1.50	R 8.04	R 1.06	R 9.10
Epping	N2	Vanguard	1800	60	1.80	4	20	1.33	3.13	R 10.65	R 2.22	R 12.87
Parow Beaconvale	N1	MonteVista	4000	60	4.00	12	20	4.00	8.00	R 26.33	R 5.66	R 31.99
Parow Industria	N2	Modderdam	5500	80	4.13	6	20	2.00	6.13	R 27.24	R 4.33	R 31.57
Parow East	N1	KarlBremer	1800	60	1.80	5	20	1.67	3.47	R 11.51	R 2.45	R 13.96
Bellville Stikland 1	N1	OldOak	1700	60	1.70	4	20	1.33	3.03	R 10.25	R 2.15	R 12.40
Bellville Stikland 2	N1	OldOak	2000	60	2.00	4	20	1.33	3.33	R 11.46	R 2.36	R 13.82
Bellville Triangle	R 300	Strand	2000	60	2.00	6	20	2.00	4.00	R 13.17	R 2.83	R 16.00
Bellville South/Sacks Circle	R 300	Strand	3700	60	3.70	8	20	2.67	6.37	R 21.71	R 4.50	R 26.21
Kraaifontein	N1	Joostenberg	500	60	0.50	0	20	0.00	0.50	R 2.01	R 0.35	R 2.36
Brackenfell Industria	N1	Okavango	2000	60	2.00	5	20	1.67	3.67	R 12.31	R 2.59	R 14.91
Everite Brackenfell	N1	Okavango	2700	60	2.70	5	20	1.67	4.37	R 15.13	R 3.09	R 18.21
Kuils River	R 300	Stellenbosch	4200	80	3.15	8	20	2.67	5.82	R 23.72	R 4.11	R 27.83
Blackheath	R 300	Stellenbosch	4200	80	3.15	4	20	1.33	4.48	R 20.30	R 3.17	R 23.47
Saxonberg Industial Park	R 300	Stellenbosch	4500	80	3.38	5	20	1.67	5.04	R 22.36	R 3.57	R 25.93
Okovango	N1	Okavango	700	60	0.70	3	20	1.00	1.70	R 5.38	R 1.20	R 6.58

Table 6.6: Internal accessibility: travel distance, travel time and generalised cost

	size of area (ha)	crow fly distance to entrance (m)	travel distance (m)	average speed (km/h)	travel time (minutes)	VOC	Time Cost	Generalised Cost
Viking Place	25	125	125	30	0.25	R 0.50	R 0.18	R 0.68
Glosderry (Kenilworth Park)	10	50	50	30	0.10	R 0.20	R 0.07	R 0.27
Paarden Eiland	135	675	675	30	1.35	R 2.71	R 0.95	R 3.67
Montague Gardens	210	1050	1050	60	1.05	R 4.22	R 0.74	R 4.96
Marconi Gardens	160	800	800	60	0.80	R 3.22	R 0.57	R 3.78
City Fringe	10	50	50	30	0.10	R 0.20	R 0.07	R 0.27
Woodstock/Salt River/Observatory	25	125	125	30	0.25	R 0.50	R 0.18	R 0.68
Lansdowne Nerissa	65	325	325	60	0.33	R 1.31	R 0.23	R 1.54
Ottery Hillstar	50	250	250	30	0.50	R 1.01	R 0.35	R 1.36
Ottery Sunset	15	75	75	30	0.15	R 0.30	R 0.11	R 0.41
Diep River (Elfindale)	40	200	200	30	0.40	R 0.80	R 0.28	R 1.09
Retreat/Steenberg	30	150	150	30	0.30	R 0.60	R 0.21	R 0.82
Maitland/Ndabeni	160	800	800	30	1.60	R 3.22	R 1.13	R 4.35
Airport	90	450	450	60	0.45	R 1.81	R 0.32	R 2.13
Epping	441	2205	2205	60	2.21	R 8.86	R 1.56	R 10.42
Parow Beaconvale	25	125	125	60	0.13	R 0.50	R 0.09	R 0.59
Parow Industria	160	800	800	60	0.80	R 3.22	R 0.57	R 3.78
Parow East	28	140	140	30	0.28	R 0.56	R 0.20	R 0.76
Bellville Stikland 1	100	500	500	60	0.50	R 2.01	R 0.35	R 2.36
Bellville Stikland 2	150	750	750	60	0.75	R 3.02	R 0.53	R 3.55
Bellville Triangle	230	1150	1150	60	1.15	R 4.62	R 0.81	R 5.44
Bellville South/Sacks Circle	350	1750	1750	60	1.75	R 7.04	R 1.24	R 8.27
Kraaifontein	36	180	180	60	0.18	R 0.72	R 0.13	R 0.85
Brackenfell Industria	50	250	250	30	0.50	R 1.01	R 0.35	R 1.36
Everite Brackenfell	75	375	375	30	0.75	R 1.51	R 0.53	R 2.04
Kuils River	96	480	480	30	0.96	R 1.93	R 0.68	R 2.61
Blackheath	188	940	940	60	0.94	R 3.78	R 0.66	R 4.44
Saxonberg Industial Park	25	125	125	30	0.25	R 0.50	R 0.18	R 0.68
Okovango	16	80	80	60	0.08	R 0.32	R 0.06	R 0.38

Step 4: Determine the generalised transport cost.

The intensity or level of disutility experienced with any particular trip can be measured in terms of the generalised transport cost. This allows the accessibility of any particular industrial location to be measured in terms of a single monetary value. The accessibility of industrial townships can therefore be directly compared by means of the generalised cost principle.

Based on the disutility of travel, generalised transport cost consists of three categories, namely the vehicle operating cost of travel, transport time cost and other negative qualitative aspects. The following is a brief description of the methodology that was followed to calculate each of these cost components:

a) Vehicle operating cost is influenced by such factors as the distance travelled, operating cost of specific vehicles and the conditions under which vehicles are operating. It should be appreciated that it would have been impractical to attempt a statistically valid measurement of the exact average vehicle operating cost per trip between the industrial accessibility node and all the subject areas. For this purpose certain assumptions had to be made about the vehicle operating cost of goods vehicles and the conditions under which they operate in the primary study area.

The unit vehicle operating cost was determined for what can be referred to as the "typical goods vehicle". This vehicle class' operating cost per unit (per kilometre, per stop and per hour) is representative of the accounting average of the vehicle operating cost per unit of all goods vehicles operating in the primary study area. Table 6.7 presents the vehicle operating cost per kilometre under free flow travel conditions, the cost to stop and accelerate and the idling/stationary cost per hour. These unit costs were based on the accounting average vehicle operating cost of a light commercial vehicle and a heavy goods vehicle (*City of Cape Town, 2002: Appendix F*) as originally measured by Pienaar.

Table 6.7: Vehicle operating cost in terms of financial prices of July 2001

	Goods vehicle category		
	Light	Heavy	**Typical**
Free flow vehicle operating cost per kilometre	R 1,53	R 6,51	**R 4,02**
Cost per stop (stopping and accelerating)	R 0,13	R 1,52	**R 1,53**
Cost per hour while idling	R 4,21	R 6,34	**R 5,28**

Source: Adapted from Pienaar (*City of Cape Town, 2002: Appendix F*)

It is important to note that the vehicle operating cost characteristics of the typical goods vehicle should be kept constant for all trips and should also be applied to all subsequent analyses and applications of the industrial accessibility model. If it is suspected that the characteristics of the typical goods vehicle have changed for whatever reason, the entire exercise should be repeated to establish a new relationship between transport accessibility and land value.

The vehicle operating cost per unit was applied to the distance travelled, number of stops along the link and the average delay per intersection (see Tables 6.4, 6.5 and 6.6) to arrive at the total vehicle operating cost per trip between the industrial accessibility node and all subject nodes (see Table 6.8).

b) Transport time cost is regarded as a sacrifice of time which could be spent more productively on something else. Although transport time cost consists of the time value of people and goods, only in-vehicle person travel time was taken into account for the purpose of this study. The reason for this is that no reliable data could be obtained of the value of goods in transit during a typical business hour in the primary study area. The in-vehicle travel time per hour is R 42,44 assuming an average goods vehicle occupancy of two people per vehicle (*Cape Town Metropolitan Transport Area, 1991*) and a value per person work hour of R 21,22 (*Conningarth Economists, 2001:119*).

c) Other negative qualitative aspects related to travel such as safety risks (accidents), frustration at intersections, discomfort, inconvenience, as well as the loading and off-loading of goods. Due to the difficulty in accurately quantifying the qualitative aspects it was decided not to include it in the calculation of generalised cost for the purpose of this study.

The total generalised transport cost is calculated by means of Equations 6.1, 6.2, 6.3 and 6.4 and are presented in Table 6.8.

Table 6.8: Total generalised cost

	Internal	Local	Regional	Total
Viking Place	R 0.68	R 21.20	R 61.89	R 83.08
Glosderry (Kenilworth Park)	R 0.27	R 9.88	R 58.25	R 68.12
Paarden Eiland	R 3.67	R 4.54	R 25.03	R 29.57
Montague Gardens	R 4.96	R 8.00	R 65.98	R 73.98
Marconi Gardens	R 3.78	R 17.27	R 65.98	R 83.25
City Fringe	R 0.27	R 13.60	R 0.00	R 13.60
Woodstock/Salt River/Observatory	R 0.68	R 7.07	R 9.56	R 16.63
Lansdowne Nerissa	R 1.54	R 21.81	R 58.25	R 80.06
Ottery Hillstar	R 1.36	R 28.43	R 70.53	R 98.96
Ottery Sunset	R 0.41	R 19.49	R 70.53	R 90.02
Diep River (Elfindale)	R 1.09	R 16.65	R 70.53	R 87.18
Retreat/Steenberg	R 0.82	R 32.72	R 70.53	R 103.26
Maitland/Ndabeni	R 4.35	R 13.60	R 25.03	R 38.63
Airport	R 2.13	R 9.10	R 82.82	R 91.92
Epping	R 10.42	R 12.87	R 61.89	R 74.76
Parow Beaconvale	R 0.59	R 31.99	R 63.71	R 95.70
Parow Industria	R 3.78	R 31.57	R 69.17	R 100.74
Parow East	R 0.76	R 13.96	R 93.29	R 107.24
Bellville Stikland 1	R 2.36	R 12.40	R 118.31	R 130.71
Bellville Stikland 2	R 3.55	R 13.82	R 118.31	R 132.13
Bellville Triangle	R 5.44	R 16.00	R 145.62	R 161.61
Bellville South/Sacks Circle	R 8.27	R 26.21	R 145.62	R 171.83
Kraaifontein	R 0.85	R 2.36	R 156.08	R 158.45
Brackenfell Industria	R 1.36	R 14.91	R 136.52	R 151.42
Everite Brackenfell	R 2.04	R 18.21	R 136.52	R 154.73
Kuils River	R 2.61	R 27.83	R 139.25	R 167.08
Blackheath	R 4.44	R 23.47	R 139.25	R 162.72
Saxonberg Industial Park	R 0.68	R 25.93	R 139.25	R 165.17
Okovango	R 0.38	R 6.58	R 136.52	R 143.09

CHAPTER 7

RESULTS OF THE ANALYSIS, MODEL DEVELOPMENT AND APPLICATION OF THE MODEL

7.1 Introduction

The basic procedure of the model development can be described in terms of a number of steps as follows:

- Determine the relationship between accessibility and industrial land value;
- Building the model;
- Application of the model;
- Implications for economic development.

7.2 The relationship between accessibility and industrial land value

7.2.1 Analysis procedure

Using regression analysis, the relationship between industrial property value and land value, and accessibility was found to be described reasonably well by a linear function. The following combinations of property and land price were tested by means of generally accepted statistical techniques to establish their relationship with accessibility as measured by generalised cost.

Scenario A: A price of properties rented in size categories of 250m², 500m², 1000m², 2500m², 5000m² and the accounting average of these areas rented by means of a simple regression analysis as dependent value and total generalised cost as their independent value X.

Scenario B: Similar to A but generalised cost was split up into three independent variables, namely internal accessibility (X1), local accessibility (X2) and regional accessibility (X3). The relationship between accessibility and property value was tested by means of a multiple regression analysis.

Scenario C: Similar to A, but the price for size categories reflected land values rather than property values.

Scenario D: Similar to B, but the price for size categories reflected land values rather than property values.

The results and statistical validity of these analyses are summarised in Tables 7.1 through 7.5. Figures 7.1 through 7.5 show the function of Scenario C graphically. Detailed results of each of the above scenarios are presented in Appendices B, C, D and E respectively.

Table 7.1: Scenario A: Summary of simple regression statistics for all rent size categories based on property value

	Scenario A				
	250m²	**500m²**	**1000m²**	**2500m²**	**5000m²**
Appendix reference	***B.1***	***B.2***	***B.3***	***B.4***	***B.5***
Multiple R	0.716424	0.637661	0.631715	0.632558	0.564464
R Square	0.513263	0.406612	0.399064	0.40013	0.31862
Adjusted R Square	0.495235	0.384634	0.376807	0.377912	0.293384
Standard Error	142.5555	133.6612	138.9582	148.6805	157.5168
Observations	29	29	29	29	29

Table 7.2: Scenario B: Summary of multiple regression statistics for all rent size categories based on property value

	Scenario B				
	250m²	**500m²**	**1000m²**	**2500m²**	**5000m²**
Appendix reference	***C.1***	***C.2***	***C.3***	***C.4***	***C.5***
Multiple R	0.738431	0.707548	0.688369	0.661523	0.586956
R Square	0.545281	0.500625	0.473852	0.437613	0.344517
Adjusted R Square	0.490715	0.4407	0.410714	0.370126	0.265859
Standard Error	143.1924	127.4269	135.1251	149.6081	160.5553
Observations	29	29	29	29	29

Table 7.3: Scenario C: Summary of simple regression statistics for all rent size categories based on land value

	Scenario C				
	250m²	**500m²**	**1000m²**	**2500m²**	**5000m²**
Appendix reference	***D.1***	***D.2***	***D.3***	***D.4***	***D.5***
Multiple R	0.905517	0.891438	0.893449	0.848482	0.768795
R Square	0.819962	0.794662	0.798251	0.719922	0.591046
Adjusted R Square	0.813294	0.787056	0.790779	0.709549	0.575899
Standard Error	94.60483	84.45926	65.70523	86.62901	104.1199
Observations	29	29	29	29	29

Table 7.4: Scenario D: Summary of multiple regression statistics for all rent size categories based on land value

	Scenario D				
	$250m^2$	$500m^2$	$1000m^2$	$2500m^2$	$5000m^2$
Appendix reference	*E.1*	*E.2*	*E.3*	*E.4*	*E.5*
Multiple R	0.908128	0.898168	0.898189	0.850671	0.771532
R Square	0.824697	0.806706	0.806744	0.723641	0.595261
Adjusted R Square	0.803661	0.783511	0.783554	0.690478	0.546692
Standard Error	97.01463	85.15945	66.83012	89.42779	107.6454
Observations	29	29	29	29	29

Figure 7.1: Relationship between land value and accessibility (Scenario C) for category 250 m^2

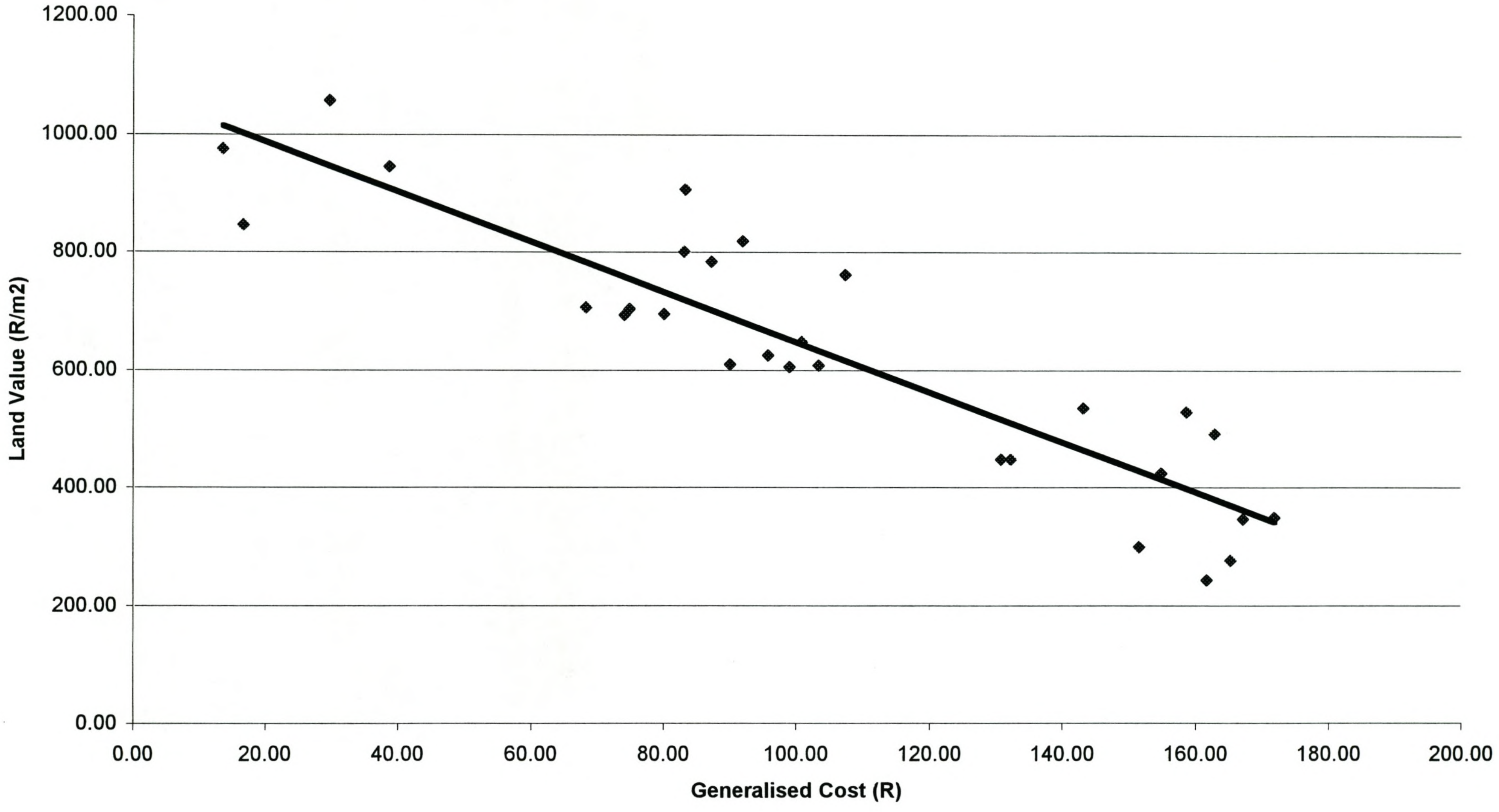


Figure 7.2: Relationship between land value and accessibility (Scenario C) for category 500 m^2

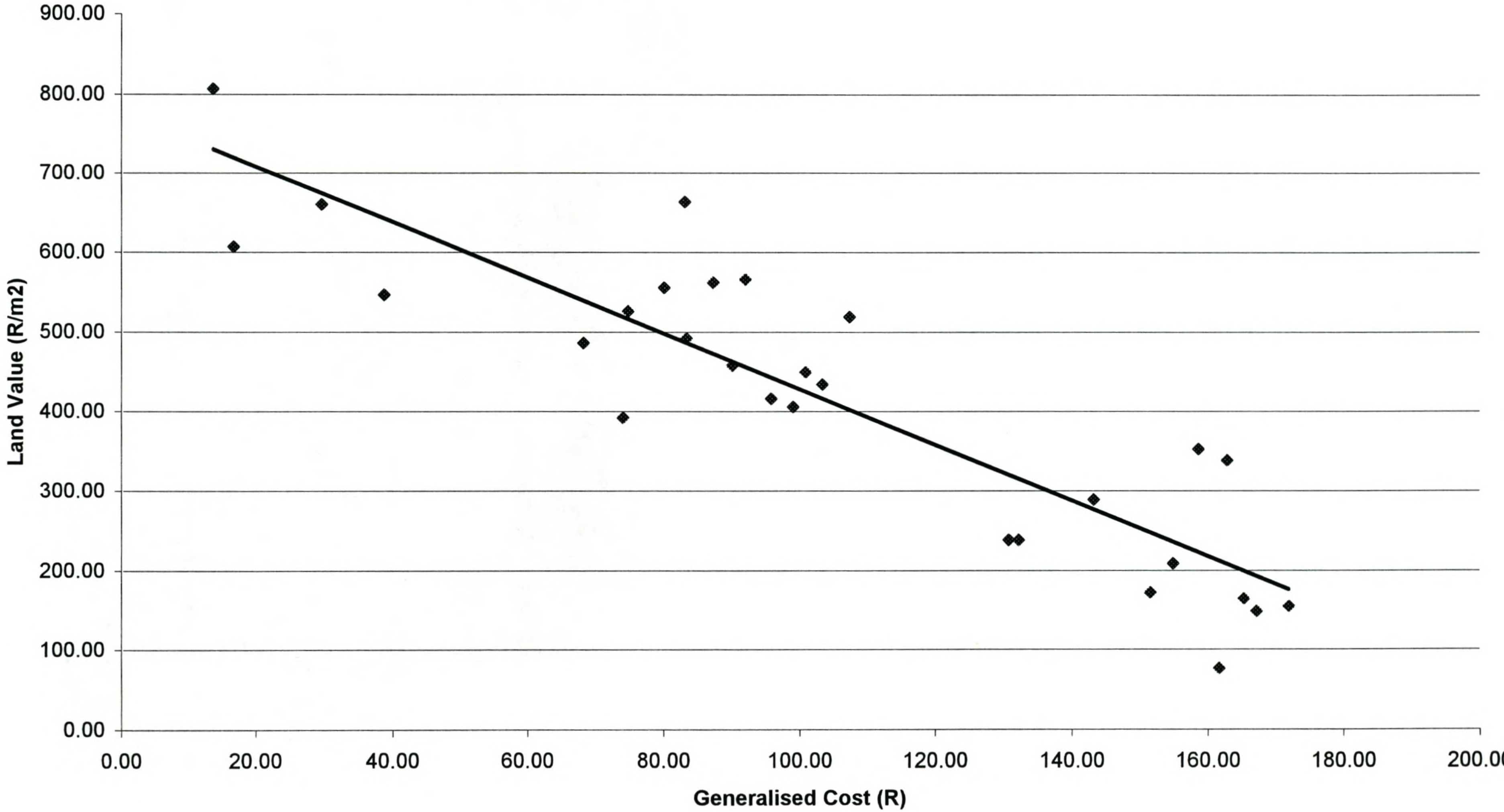


Figure 7.3: Relationship between land value and accessibility (Scenario C) for category 1000 m²

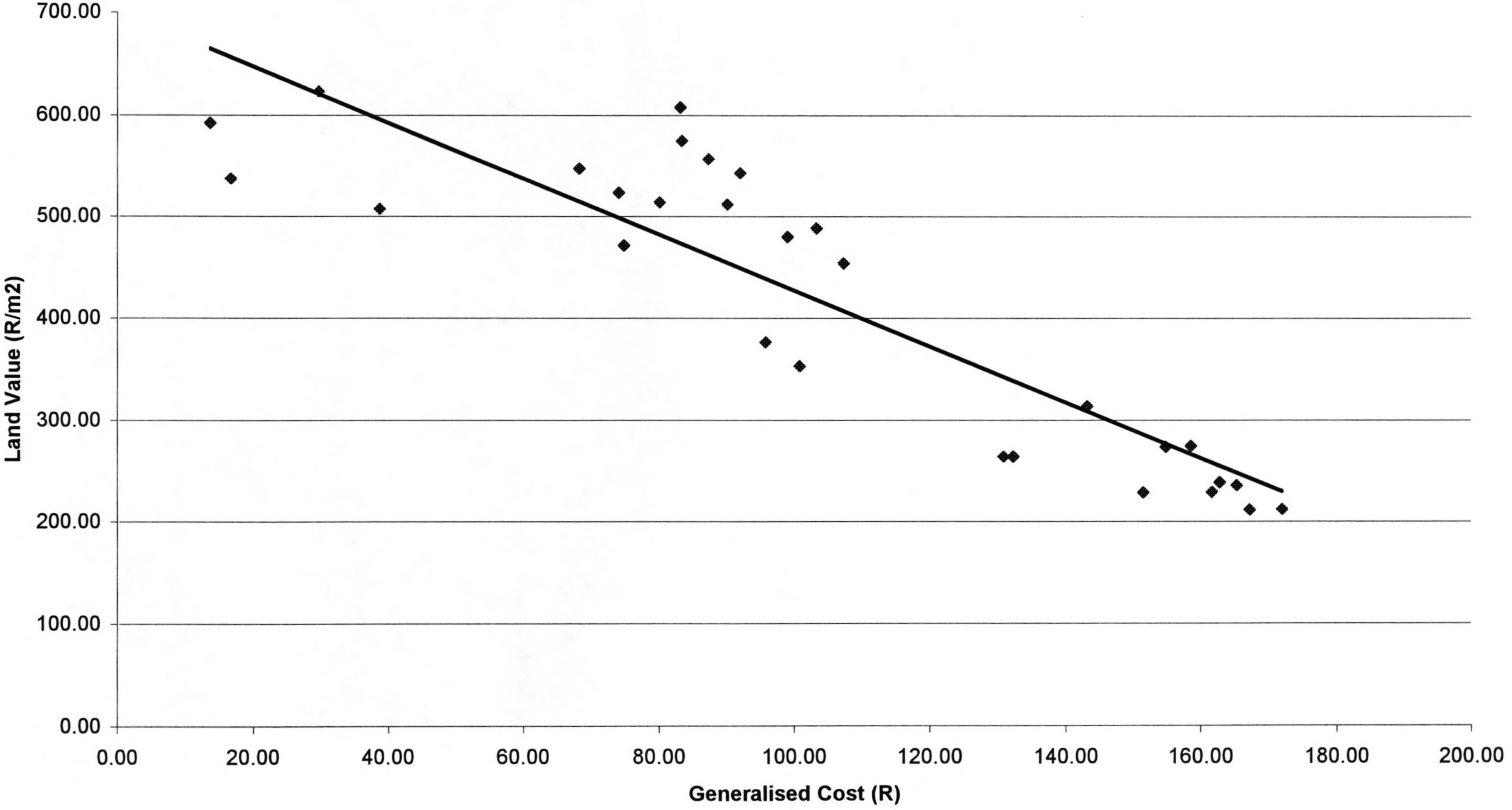


Figure 7.4: Relationship between land value and accessibility (Scenario C) for category 2500 m²

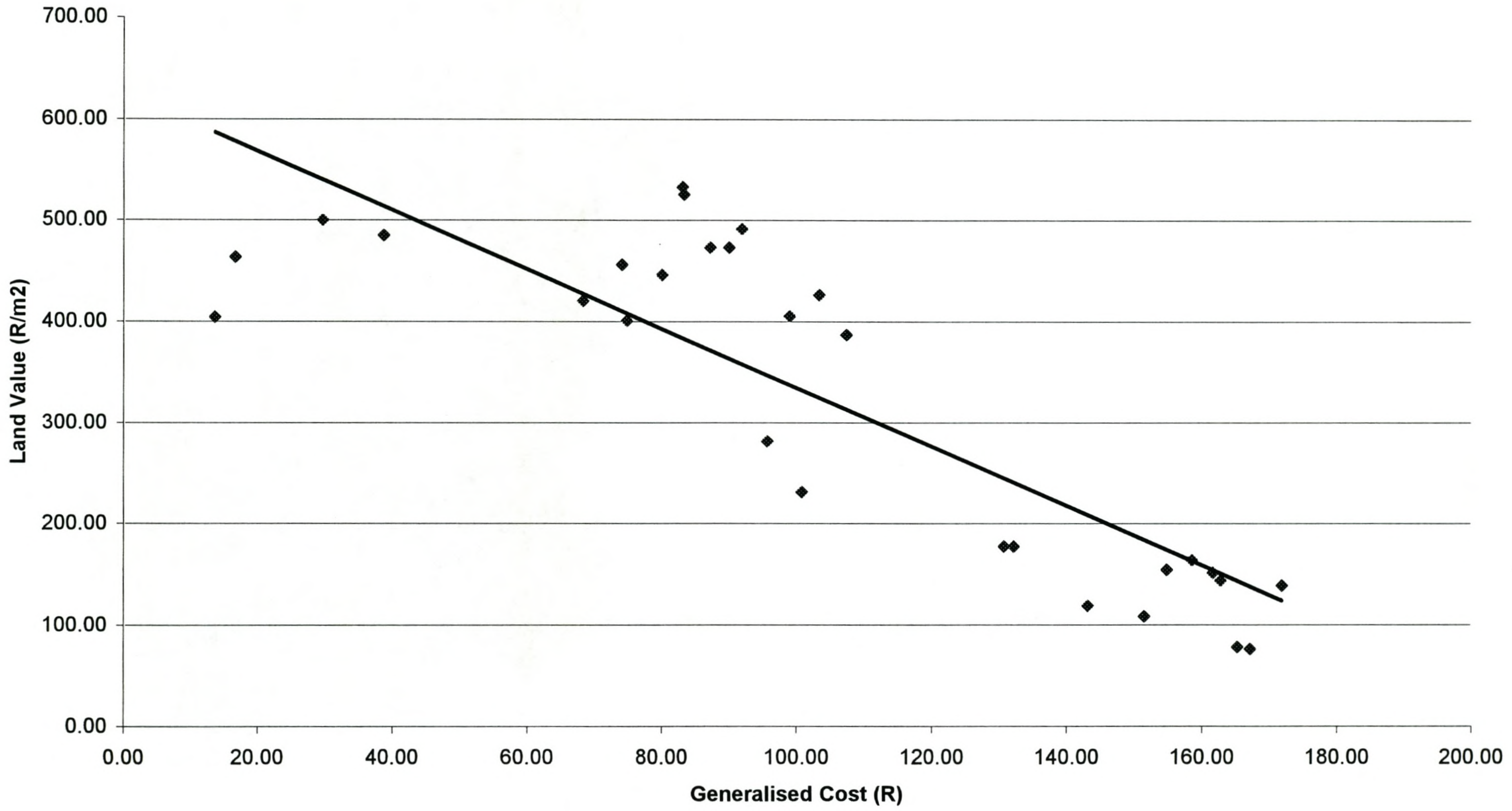
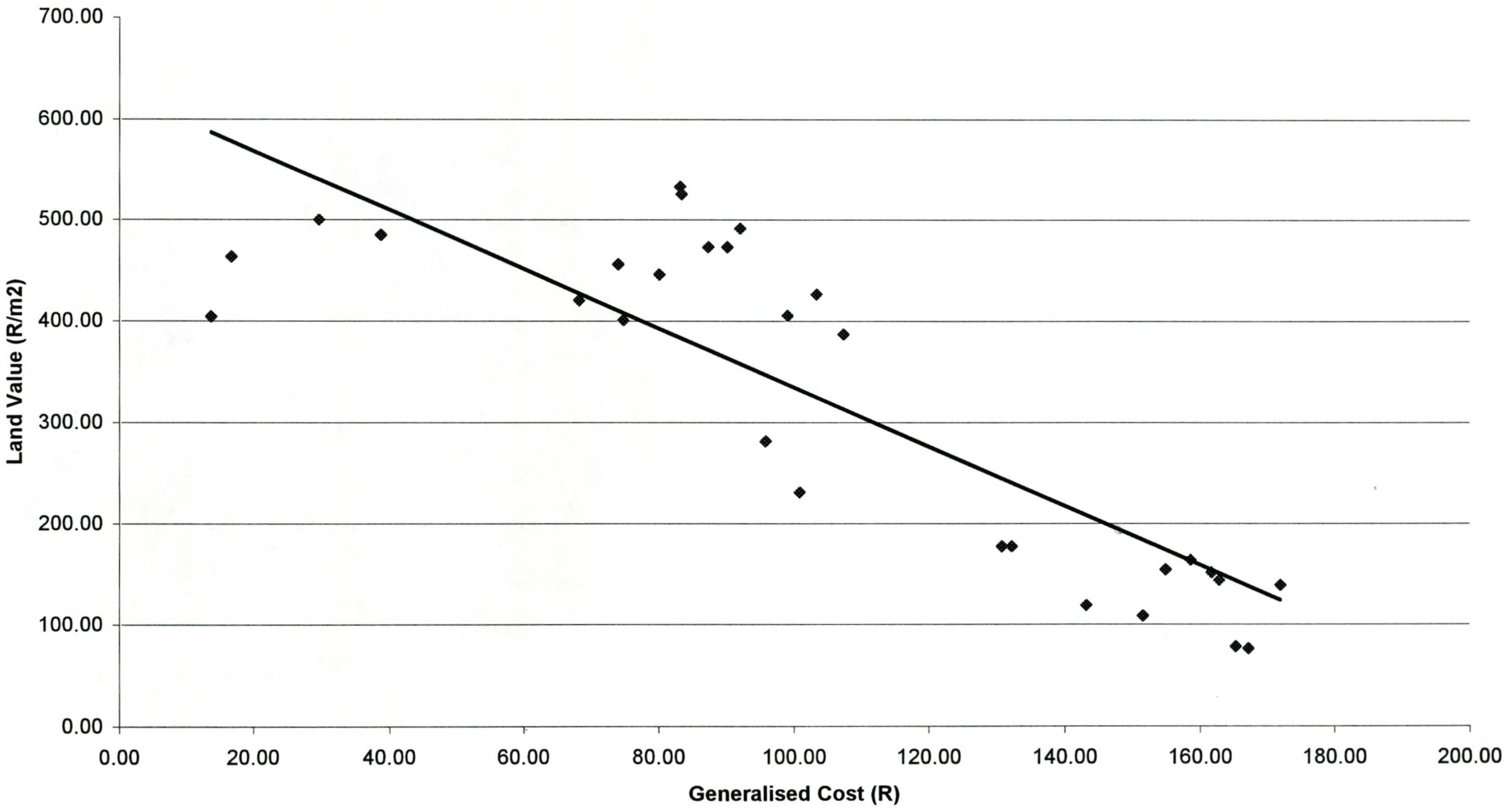


Figure 7.5: Relationship between land value and accessibility (Scenario C) for category 5000 m^2



7.2.2 Findings of the regression analyses

The findings of the regression analyses can be interpreted as follows:

a) The relationship between land value and generalised cost is explained well by a straight line function with a generalised cost range of between R5 and R180. If a straight line function is used to describe the relationship it would mean that an increase in generalised cost has a similar impact on properties irrespective of whether they are situated close to the CBD or further away.

b) In the simple regression analysis the coefficient of determination R square for the dependent variable "Average Land Values" in for example Scenario C (250m^2) is 0.82. In other words 82% of the variation in land value in this scenario is explained by the variability in total generalised cost. There is thus a strong negative relationship between average land value and total generalised cost. As accessibility is the inverse of generalised cost (higher accessibility means lower generalised cost), there would be a similar positive relationship between average land value and accessibility.

c) Smaller rent categories (250m^2, 500m^2 and 1000m^2) generally show a better correlation between land rent and generalised cost. This is probably due to the fact that the activity at smaller locations are more intense than at larger sprawling industrial sites with the result that transport cost has a bigger impact on the operation of smaller industrial sites.

d) The results of the regression analysis show total generalised cost to be a reliable measure of accessibility. One of the objectives of the study was to quantify accessibility.

e) It can be observed from Figure 7.1 that accessibility of industrial properties in Cape Town covers a wide spectrum ranging from a generalised cost of less than R20 to more than R170. In terms of distance from the CBD, this ranges from 5 km to 40 km, the latter representing the outer eastern boundary of the study area.

f) It emerges that there are three main accessibility groupings. These groupings and their generalised transport cost ranges can be defined as follows:

   Group A. Within close proximity of the CBD: R10 - R40 (4 observations)
   Group B. Central core: R60 – R100 (14 observations)
   Group C. Perimeter: R130 – R170 (11 observations)

g) Regional accessibility is the most important factor in determining land value of industrial properties. Although such a generalisation is meaningless when comparing specific locations (townships closer to the CBD will obviously have a smaller percentage regional accessibility than those further away), it does challenge the view of property brokers as well as of some analysts (see Chapter 6) who believe that "distance to the freeway" are the major determinant of property value. Industry places a far greater value on transport cost along the Class 1 (freeway) road network to the Cape Town CBD/Port.

This is also confirmed by the results of the multiple regression analysis, which indicates that there is no correlation between internal accessibility and industrial land value (Scenario D). Even though there is correlation between local accessibility and land value, this is small compared to regional accessibility.

Visual location inspections confirmed the results. For example, property values in Paarden Eiland are almost twice those of Kraaifontein Industria. However, whereas Kraaifontein Industria has ample on-site parking and wide uncongested internal roadways for heavy vehicles, Paarden Eiland has a narrow grid road system and no on-site parking on the majority of properties.

7.3 Development of the local industrial development model

Based on the fact that an increase in the value of industrial land will result in a similar increase in the industrial development potential of the land (land rent is equal to the yield of the land), the impact that an improvement in transport accessibility will have on economic development potential at a local level can be expressed by means of the following Equation 7.1.

$$EDP_n = \left(a + b * DTA1_{ij}\right) - \left(a + b * DTA0_{ij}\right) \quad \ldots\ldots(7.1)$$

where:

EDP_n is the economic development potential per square metre of an industrial property of which the size of the gross leasable area *n* could be 250, 500, 1000, 2500 or 5000 square metres respectively;

$DTA0_{ij}$ is the current generalised transport cost between locations i and j, where i is the industrial accessibility node and j is the industrial township that is under investigation;

$DTA1_{ij}$ is the generalised transport cost between locations i and j after the transport improvement, where i is the industrial accessibility node and j is the industrial township that is under investigation.

The input values for variables ***a*** and ***b*** as determined by the regression analysis (see Appendix D) are presented in Table 7.5. It is important to note that the input variables could only be applied to industrial land use in Cape Town and should be validated through the processes outlined in this study before being applied to other areas.

Table 7.5: Input variables for the urban industrial development model

	Occupation rent category (m^2)				
	250	**500**	**1000**	**2500**	**5000**
a	1072.55	778.08	702.60	627.03	518.83
b	-4.26	-3.50	-2.76	-2.93	-2.64

It is also important to note that the increase in land value will depend to some extent on the type of industry being established on the land. It was previously pointed out that the type of industry which typically locates in an urban area such as Cape Town can be categorised according to their rent size categories. The overall impact of the improvement in transport accessibility, where different types of industry are accommodated on the same land use pocket or industrial township, can therefore be computed by means of Equation 7.2 below.

$$EDP = DLA[(L_{250} * EDP_{250}) + (L_{500} * EDP_{500}) + (L_{1000} * EDP_{1000}) + (L_{2500} * EDP_{2500}) + (L_{5000} * EDP_{5000})] \quad \ldots (7.2)$$

where:

EDP is the economic development potential of the industrial township under investigation;

DLA is the developable land area of the industrial township under investigation;

L_n is the percentage of the developable land area that would be covered by industrial units which has a size gross leasable area of n square metres.

7.4 Application of the local industrial development model

Road authorities in Cape Town proposed that an interchange be constructed at the location of the current at grade intersection of the N7 and Contermanskloof Road at a cost of R32 million. An economic evaluation showed that, although the saving in the generalised cost amounts to R 13,28 per vehicle trip, the current traffic volumes at the intersection, as well as the volume of diverted traffic from other routes, are too low to justify the construction of the interchange.

However, a currently undeveloped pocket of land measuring 160 hectare gross has been rezoned as an industrial township in the immediate vicinity of the N7/Contermanskloof Road intersection. Engineers estimate that 70 percent of this land can be sold as industrial stands, which means that 112 hectares can be sold by the developer as serviced industrial plots. An investor is interested in purchasing the land for development purposes as he believes that there is a sufficient demand for industrial properties to sell the units in a reasonable time. A number of future road improvements will further enhance the value of the land. The generalised transport cost to the site is currently R86,64 per vehicle trip. After the implementation of the proposed interchange, this will be reduced to R73,36 per vehicle trip.

By applying Equations 7.1 and 7.2 of the industrial development model, it was found that the economic development potential of the industrial land will increase by R47,25 million. The benefit/cost ratio of the interchange based on its economic development impact alone would therefore be 1,48. Based on the results of this analysis the construction of the interchange could be justified on its economic development impact alone.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

8.1.1 Hypothesis and postulations

The following conclusions are drawn with regards to the study hypotheses and postulation.

a) Accessibility consists of three elements namely proximity, connectivity and mobility. Accessibility of any particular node is always relative to that of another node from which it receives input or to which it dispatches output. The node with which industrial townships (the subject nodes) collectively have the most interaction is referred to as the industrial accessibility node. It is important to note that there may be specific industries that do not regard the accessibility node as the node with which they have the most interaction. However, from a land-use planning perspective the accessibility node is the most significant attractor for all industries combined. The accessibility nodes for different economic activities within an urban area may differ from one another. It is not a forgone conclusion that the retail or office accessibility notes would be similar to the industrial activity node. Similarly, the industrial accessibility nodes of the same economic activity may differ from urban area to urban area.

b) In order for accessibility to have a meaningful impact on economic development it is important that the generalised transport cost between the subject node and the accessibility node is improved. A procedure was developed to determine the accessibility node of a specific economic activity, such as retail, business, office or industrial in an urban area. Through the application of this procedure it was established that the CBD/Port is the industrial accessibility node of Cape Town. Although this may differ for other major areas and economic activities, the procedure can also be used to determine the accessibility nodes of other major urban areas, as well as for other land uses such as retail and office.

c) There is significant quantifiable relationship between the generalised cost of accessibility and the economic value of industrial land as determined through the shadow price technique. This relationship can be expressed numerically by means of a linear function.

d) Based on land price theory, which states that the economic value of land reflects the yield of that land, i.e. its economic product, it can be concluded that a change in the economic value of a pocket of land would have a similar impact on the economic development potential of that land, provided that all the other production factors are present. It has to be recognised that an increase in the development potential of a pocket of industrial land will only translate into a similar increase in gross geographic product (GGP) of the region if it leads to an overall increase in overall industrial output through either an increase in established industries or through the development of new industries in the region. In other words, the increased accessibility should not merely result in a transfer of industrial production that is already being generated on other pockets of land, or that would be attracted to the study area from elsewhere in any event.

The following conditions should therefore be met in the study area and the subject areas for an increase in local industrial production to be translated into an equal amount of regional product:

- Buildings, structures, services and layout of the land pocket that benefits from the increase accessibility should conform to current market demands, otherwise the land will not realise its full development potential.

- All other conditions/requirements for development should be present in the region.

- From a global location perspective accessibility is as important to new investors as it is to established industries within the region. This means that potential investors have full knowledge of accessibility in Cape Town and that of competing cities.

e) It is important to understand that all growth occurs at a local level and that regional or national economic development is merely the summation of all local developments. This study has attempted to move the debate on the relationship between transport and economic development from a broad macro-economic perspective towards explaining economic development at its source, where it occurs within a land use pocket or industrial township.

8.1.2 Transport and spatial planning

Spatial planners should take note of the following findings of this study:

a) The most cost effective way to improve accessibility is to reduce the proximity of industrial townships to the industrial accessibility node. Planners should therefore encourage industrial development around the CBD/Port and be sympathetic to developers that apply for industrial rezonings close to the CBD.

b) The implementation of urban road infrastructure projects alone is not sufficient to encourage economic development as it could merely result in a transfer of industry from one area to another without increasing the industrial output. Even if a potential industrial township meets all other criteria for development, it should be established whether or not an increase in the development potential could offset the cost of infrastructure investment.

c) Planning officials should actively encourage redevelopment of old industrial areas around the CBD of Cape Town. Similarly the establishment of industrial townships on the periphery of the metropolitan area in decentralised zones should be resisted.

d) Planners will have to re-evaluate the methods that they use to develop future planning frameworks, both spatial frameworks and road network planning. A case in point is the fact that the findings provide proof that the current planning principles as outlined in the Cape Town Metropolitan Spatial Development Framework would not optimise land use strategy regarding industrial location. It is evident from the results that a monocentric city structure surrounded by industrial areas would optimise the usage of industrial land.

e) Knowledge about the increase in the value of land that would result from increased transport accessibility will assist the road authorities to determine the amount which a developer/land owner can contribute to the proposed road improvements.

8.1.3 Economic evaluations

The economic developmental impact of industrial land can be introduced in the economic evaluation through the model that was developed under the following conditions:

a) It should be proven that all other requirements for industrial development have been fulfilled and buildings, structures and services comply with current market demand;

b) The increase in economic land value is introduced as a one-off external benefit in the first year after completion of the project to reflect increase in development potential;

c) Impact only on industrial land or land earmarked for industrial zoning;

d) Road user cost savings that are generated by existing industrial developments should be subtracted in order to avoid double counting;

e) Full benefit would apply to new developments on condition that no provision is made for generated traffic/induced traffic from potential development on this land.

8.1.4 Choice of industrial location

The following conclusions can be drawn regarding the choice of industrial location:

a) Industrial location within metropolitan areas is not affected by location of the labour supply. A possible reason for this is that the urban passenger transport system/network provides sufficient access to work opportunities.

b) Future levels of accessibility are an important consideration in the location decision. The model that was developed could be used to assess what the impact of expected changes in accessibility levels would be on the value of industrial land. This will assist in the long-term location decision as well as in speculative buying of industrial property in the hope that certain infrastructure will be built.

c) Industrial properties that are located closer to the accessibility node would be much less affected by a reduction in mobility than those that are situated further away.

d) There are considerable opportunities for developers to redevelop ageing industrial areas, particularly those that are located close to the CBD. The model will assist in undertaking such feasibility studies.

8.2 Recommendations for further study

It is recommended that further studies address the following aspects:

a) Transport accessibility nodes should be studied in more detail with a view to determining accessibility nodes for economic activities other than industrial in Cape Town. It would also be interesting to compare accessibility nodes of major urban areas with those of rural areas, as well as those of monocentric cities with that of multicentric cities.

b) The generalised transport cost can be quantified to a finer level of detail by including the value of freight, as well as the loading/offloading tasks.

c) The model could be extended to include all economic activities, which will assist in ultimately determining which economic activity would benefit the most from establishing on a particular land use pocket. This will be of great benefit in the land use planning process.

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APPENDICES

Appendix A.1: CBD/Port

Regression Statistics	
Multiple R	0.832030533
R Square	0.692274807
Adjusted R Square	0.680877578
Standard Error	103.3936211
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	649331.8863	649331.8863	60.74062256	2.2175E-08
Residual	27	288636.5037	10690.24088		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	776.6655195	50.64948913	15.33412346	7.54142E-15	672.7414217	880.5896173
X Variable 1	-16.13021901	2.069667808	-7.793627047	2.2175E-08	-20.37682373	-11.88361428

Appendix A.2: Wynberg

Regression Statistics	
Multiple R	0.654186857
R Square	0.427960444
Adjusted R Square	0.406773794
Standard Error	140.9695293
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	401413.3691	401413.3691	20.19953321	0.000118458
Residual	27	536555.0209	19872.40818		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	635.4741751	56.31429786	11.28441975	9.99756E-12	519.9268576	751.0214925
X Variable 1	-10.7031799	2.381453788	-4.494389081	0.000118458	-15.58951618	-5.816843618

Appendix A.3: Bellville

Regression Statistics	
Multiple R	0.470323578
R Square	0.221204268
Adjusted R Square	0.192359982
Standard Error	164.4841295
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	207482.6112	207482.6112	7.668911107	0.010033438
Residual	27	730485.7788	27055.02885		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	244.4622788	67.57294265	3.61775393	0.001205228	105.8141459	383.1104117
X Variable 1	10.01509342	3.616497362	2.76927989	0.010033438	2.594658736	17.4355281

Appendix A.4: Philippi

Regression Statistics	
Multiple R	0.113207019
R Square	0.012815829
Adjusted R Square	-0.023746548
Standard Error	185.1873473
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	12020.84264	12020.84264	0.350519586	0.558744778
Residual	27	925947.5474	34294.35361		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	497.7038977	149.8016128	3.322420156	0.002570567	190.3365831	805.0712123
X Variable 1	-4.81248764	8.128557494	-0.592046946	0.558744778	-21.49089879	11.86592351

Appendix A.5: Airport

Regression Statistics	
Multiple R	0.568962932
R Square	0.323718819
Adjusted R Square	0.298671367
Standard Error	153.2766044
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	303638.019	303638.019	12.92422196	0.001278315
Residual	27	634330.371	23493.71745		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	165.1172997	74.17959112	2.225912777	0.034560689	12.91345288	317.3211465
X Variable 1	15.33771373	4.266369085	3.595027394	0.001278315	6.583853314	24.09157415

Appendix A.6: N1

Regression Statistics	
Multiple R	0.61658273
R Square	0.380174263
Adjusted R Square	0.357217754
Standard Error	146.7394957
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	356591.441	356591.441	16.56063063	0.000368177
Residual	27	581376.949	21532.47959		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	183.7035355	62.23090088	2.951966513	0.006461558	56.01635951	311.3907115
X Variable 1	9.594575189	2.357693332	4.069475473	0.000368177	4.756991302	14.43215908

Appendix A.7: N2

Regression Statistics	
Multiple R	0.466536642
R Square	0.217656438
Adjusted R Square	0.188680751
Standard Error	164.8583602
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	204154.8591	204154.8591	7.511691953	0.010736682
Residual	27	733813.5309	27178.27892		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-88.91159914	185.0887255	-0.480372853	0.634831582	-468.68204	290.8588417
X Variable 1	13.17879709	4.808469729	2.740746605	0.010736682	3.312638766	23.04495541

Appendix A.8: N7

Regression Statistics	
Multiple R	0.308152154
R Square	0.09495775
Adjusted R Square	0.061437667
Standard Error	177.3154776
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	89067.36797	89067.36797	2.832861397	0.103883576
Residual	27	848901.0221	31440.77859		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	615.151805	125.4645808	4.902991753	3.95277E-05	357.7199218	872.5836882
X Variable 1	-8.330116026	4.949238554	-1.683110631	0.103883576	-18.48510792	1.82487587

Appendix A.9: All Locations

Regression Statistics	
Multiple R	0.898789104
R Square	0.807821853
Adjusted R Square	0.730950594
Standard Error	94.93603827
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	8	757711.3628	94713.92035	10.50876316	1.10591E-05
Residual	20	180257.0272	9012.851362		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	489.1843795	419.4144442	1.166350817	0.257192948	-385.698414	1364.067173
X Variable 1 CBD/Harbour	-24.13413299	5.12384593	-4.710159774	0.000134221	-34.82228334	-13.44598263
X Variable 2 Wynberg	20.29974251	9.283745732	2.186589669	0.040827839	0.934197251	39.66528776
X Variable 3 Bellville	26.59265321	12.23352911	2.173751578	0.041906087	1.073970512	52.11133591
X Variable 4 Philippi	-34.38097026	12.73364714	-2.700009657	0.013777696	-60.94288041	-7.819060105
X Variable 5 Airport	-1.871243958	16.56460361	-0.112966419	0.911183396	-36.42438555	32.68189763
X Variable 6 N1	-5.638929822	7.640765993	-0.738005827	0.46908261	-21.57728099	10.29942134
X Variable 7 N2	10.09466602	9.577542994	1.053993287	0.304453449	-9.883729302	30.07306134
X Variable 8 N7	-0.088446454	6.076605636	-0.01455524	0.988531228	-12.76401781	12.5871249

Appendix B.1: Scenario A: Simple regression statistics for rent size category 250m^2 based on property value

Regression Statistics	
Multiple R	0.716423574
R Square	0.513262737
Adjusted R Square	0.495235431
Standard Error	142.5554691
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	578597.6574	578597.6574	28.47140532	1.23677E-05
Residual	27	548695.6675	20322.06176		
Total	28	1127293.325			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1587.148953	66.08273891	24.01760247	9.38399E-20	1451.558464	1722.739443
Total (X)	-3.086443292	0.57843405	-5.335860317	1.23677E-05	-4.273291132	-1.899595452

Appendix B.2: Scenario A: Simple regression statistics for rent size category 500m^2 based on property value

Regression Statistics	
Multiple R	0.637661094
R Square	0.406611671
Adjusted R Square	0.384634325
Standard Error	133.6611934
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	330533.3403	330533.3403	18.50140047	0.0001986
Residual	27	482363.4947	17865.31462		
Total	28	812896.835			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1292.677399	61.9597256	20.86318792	3.48071E-18	1165.546628	1419.808169
Total (X)	-2.332800516	0.542344576	-4.301325432	0.0001986	-3.445598922	-1.220002111

Appendix B.3: Scenario A: Simple regression statistics for rent size category 1000m^2 based on property value

Regression Statistics	
Multiple R	0.631715168
R Square	0.399064054
Adjusted R Square	0.376807167
Standard Error	138.9581654
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	346215.3618	346215.3618	17.92991335	0.000237455
Residual	27	521353.0364	19309.37172		
Total	28	867568.3982			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1202.124772	64.41517973	18.66213487	5.84769E-17	1069.955829	1334.293714
Total (X)	-2.387498643	0.563837606	-4.23437284	0.000237455	-3.544397073	-1.230600213

Appendix B.4: Scenario A: Simple regression statistics for rent size category 2500m^2 based on property value

Regression Statistics	
Multiple R	0.632558072
R Square	0.400129715
Adjusted R Square	0.377912297
Standard Error	148.6805029
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	398121.1618	398121.1618	18.00973073	0.000231568
Residual	27	596859.0828	22105.89196		
Total	28	994980.2446			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1126.553665	68.92204783	16.34533071	1.58117E-15	985.1373986	1267.969931
Total (X)	-2.560221839	0.603287029	-4.24378731	0.000231568	-3.798063747	-1.322379931

Appendix B.5: Scenario A: Simple regression statistics for rent size category 5000m^2 based on property value

Regression Statistics	
Multiple R	0.564464349
R Square	0.318620002
Adjusted R Square	0.293383705
Standard Error	157.516822
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	313257.3725	313257.3725	12.62546606	0.001424152
Residual	27	669911.8287	24811.54921		
Total	28	983169.2011			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1018.352732	73.01819488	13.94656132	7.39774E-14	868.5318719	1168.173592
Total (X)	-2.271018212	0.639141338	-3.553233184	0.001424152	-3.582427035	-0.959609388

Appendix C.1: Scenario B: Multiple regression statistics for rent size category $250m^2$ based on property value

Regression Statistics	
Multiple R	0.738431321
R Square	0.545280816
Adjusted R Square	0.490714514
Standard Error	143.1924441
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	614691.424	204897.1413	9.992995589	0.000164652
Residual	25	512601.9008	20504.07603		
Total	28	1127293.325			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1633.010312	79.89599082	20.43920221	4.04972E-17	1468.461554	1797.55907
Internal (X1)	-13.67416552	11.04597835	-1.237931588	0.22724157	-36.42376784	9.075436798
Local (X2)	-4.636439533	3.191207767	-1.452879246	0.158694768	-11.20885035	1.935971288
Regional (X3)	-2.907788313	0.612827766	-4.744870375	7.21775E-05	-4.169929839	-1.645646786

Appendix C.2: *Scenario B: Multiple regression statistics for rent size category 500m^2 based on property value*

Regression Statistics	
Multiple R	0.707548389
R Square	0.500624723
Adjusted R Square	0.44069969
Standard Error	127.4269331
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	406956.253	135652.0843	8.354183492	0.000511639
Residual	25	405940.582	16237.62328		
Total	28	812896.835			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1324.342331	71.09942948	18.62662388	3.59552E-16	1177.910418	1470.774245
Internal (X1)	-21.10266479	9.829814367	-2.146801964	0.041700567	-41.34753226	-0.857797315
Local (X2)	-1.540477464	2.839855282	-0.542449284	0.592312256	-7.389264805	4.308309876
Regional (X3)	-2.239651717	0.545355331	-4.106775139	0.000376454	-3.36283126	-1.116472174

Appendix C.3: _Scenario B: Multiple regression statistics for rent size category 1000m^2 based on property value_

Regression Statistics	
Multiple R	0.688368947
R Square	0.473851808
Adjusted R Square	0.410714025
Standard Error	135.1250598
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	411098.8538	137032.9513	7.505043488	0.000959799
Residual	25	456469.5444	18258.78178		
Total	28	867568.3982			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1229.974484	75.39469422	16.31380692	7.75526E-15	1074.696314	1385.252655
Internal (X1)	-19.39024212	10.42365394	-1.860215451	0.074659414	-40.85814424	2.077659995
Local (X2)	-1.558046677	3.01141686	-0.517379941	0.609438833	-7.760171453	4.644078099
Regional (X3)	-2.30772328	0.578301384	-3.990520073	0.000507652	-3.49875644	-1.11669012

Appendix C.4: Scenario B: Multiple regression statistics for rent size category 2500m² based on property value

Regression Statistics	
Multiple R	0.661523013
R Square	0.437612696
Adjusted R Square	0.37012622
Standard Error	149.6080555
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	435415.9876	145138.6625	6.484450209	0.002133052
Residual	25	559564.257	22382.57028		
Total	28	994980.2446			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1134.866489	83.4756604	13.59517833	4.73107E-13	962.945269	1306.78771
Internal (X1)	-13.81606276	11.54088369	-1.197140803	0.242480448	-37.584941	9.952815476
Local (X2)	-1.030384191	3.334187023	-0.309036111	0.759854886	-7.897266096	5.836497715
Regional (X3)	-2.557203401	0.640284975	-3.993851956	0.000503328	-3.875894068	-1.238512734

Appendix C.5: Scenario B: Multiple regression statistics for rent size category 5000m^2 based on property value

Regression Statistics	
Multiple R	0.586955868
R Square	0.344517192
Adjusted R Square	0.265859255
Standard Error	160.5553498
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	338718.692	112906.2307	4.379941868	0.013097555
Residual	25	644450.5091	25778.02036		
Total	28	983169.2011			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1024.719416	89.58383833	11.43866388	1.99173E-11	840.2181765	1209.220655
Internal (X1)	-11.36799995	12.38536663	-0.917857363	0.367464294	-36.87612214	14.14012223
Local (X2)	-0.973724811	3.578160027	-0.272130034	0.787756937	-8.343078171	6.395628549
Regional (X3)	-2.270743385	0.687136651	-3.304646002	0.002872044	-3.685926817	-0.855559954

Appendix D.1: Scenario C: Simple regression statistics for rent size category 250m^2 based on land value

Regression Statistics	
Multiple R	0.90551741
R Square	0.819961781
Adjusted R Square	0.813293698
Standard Error	94.60482598
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1100573.997	1100573.997	122.9681573	1.47752E-11
Residual	27	241651.9736	8950.073098		
Total	28	1342225.971			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1072.551477	43.85483108	24.45686031	5.87337E-20	982.568857	1162.534098
Total (X)	-4.256764169	0.383869191	-11.08910084	1.47752E-11	-5.044398162	-3.469130176

Appendix D.2: Scenario C: Simple regression statistics for rent size category 500m² based on land value

Regression Statistics	
Multiple R	0.891437951
R Square	0.794661621
Adjusted R Square	0.787056495
Standard Error	84.45926241
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	745367.4809	745367.4809	104.4902751	8.84505E-11
Residual	27	192600.9092	7133.367007		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	778.0799226	39.15177315	19.87342743	1.19653E-17	697.7471735	858.4126717
Total (X)	-3.503121393	0.342702483	-10.22204848	8.84505E-11	-4.206288335	-2.799954452

Appendix D.3: Scenario C: Simple regression statistics for rent size category 1000m² based on land value

Regression Statistics	
Multiple R	0.8934489
R Square	0.798250937
Adjusted R Square	0.79077875
Standard Error	65.70523361
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	461202.4472	461202.4472	106.829618	6.95684E-11
Residual	27	116563.7985	4317.177724		
Total	28	577766.2457			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	702.6046146	30.45819165	23.06783747	2.65624E-19	640.1096093	765.0996198
Total (X)	-2.755597411	0.266606007	-10.33584143	6.95684E-11	-3.302627385	-2.208567436

Appendix D.4: Scenario C: Simple regression statistics for rent size category 2500m^2 based on land value

Regression Statistics	
Multiple R	0.84848228
R Square	0.719922179
Adjusted R Square	0.709548927
Standard Error	86.62901123
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	520831.5861	520831.5861	69.40177843	6.11227E-09
Residual	27	202623.8108	7504.585586		
Total	28	723455.3969			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	627.0335079	40.15757774	15.61432594	4.85176E-15	544.6370196	709.4299962
Total (X)	-2.928320607	0.351506471	-8.330772979	6.11227E-09	-3.649551827	-2.207089387

Appendix D.5: Scenario C: Simple regression statistics for rent size category 5000m^2 based on land value

Regression Statistics	
Multiple R	0.768794951
R Square	0.591045676
Adjusted R Square	0.575899219
Standard Error	104.1198832
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	423036.0211	423036.0211	39.02204308	1.10712E-06
Residual	27	292705.6522	10840.95008		
Total	28	715741.6733			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	518.8325751	48.2656127	10.74952841	2.94548E-11	419.7997844	617.8653658
Total (X)	-2.639116979	0.422477553	-6.246762608	1.10712E-06	-3.505968734	-1.772265225

Appendix E.1: Scenario D: Multiple regression statistics for rent size category 250m^2 based on land value

Regression Statistics	
Multiple R	0.908128401
R Square	0.824697193
Adjusted R Square	0.803660856
Standard Error	97.01463394
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1106929.991	368976.6635	39.20346021	1.32584E-09
Residual	25	235295.98	9411.839198		
Total	28	1342225.971			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1094.881855	54.13051194	20.22670424	5.18398E-17	983.3980573	1206.365653
Internal (X1)	-0.466249857	7.483785565	-0.062301338	0.950818298	-15.87938395	14.94688424
Local (X2)	-6.000416933	2.162082332	-2.7752953	0.010288227	-10.45330573	-1.547528136
Regional (X3)	-4.153738053	0.415198314	-10.00422668	3.17918E-10	-5.00885439	-3.298621717

Appendix E.2: Scenario D: Multiple regression statistics for rent size category 500m ^{2} based on land value

Regression Statistics	
Multiple R	0.898168356
R Square	0.806706396
Adjusted R Square	0.783511164
Standard Error	85.15944814
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	756665.0998	252221.7	34.77897	4.45127E-09
Residual	25	181303.2902	7252.132		
Total	28	937968.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	786.2138742	47.51576476	16.54638	5.6E-15	688.3533934	884.074355
Internal (X1)	-7.894749123	6.56926716	-1.20177	0.240714	-21.42439862	5.634900376
Local (X2)	-2.904454865	1.897875926	-1.530371	0.138481	-6.813200764	1.004291035
Regional (X3)	-3.485601457	0.364461091	-9.563714	7.83E-10	-4.236222599	-2.734980315

Appendix E.3: Scenario D: Multiple regression statistics for rent size category 1000m ^{2} based on land value

Regression Statistics	
Multiple R	0.898189447
R Square	0.806744283
Adjusted R Square	0.783553597
Standard Error	66.83012201
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	466109.6155	155369.8718	34.78742632	4.44047E-09
Residual	25	111656.6302	4466.265208		
Total	28	577766.2457			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	707.4327941	37.2886911	18.97177866	2.33938E-16	630.635351	784.2302372
Internal (X1)	-5.164689057	5.15532845	-1.001815715	0.32603128	-15.78227931	5.452901199
Local (X2)	-2.323814837	1.489385881	-1.560250346	0.131271592	-5.391260329	0.743630656
Regional (X3)	-2.74643719	0.28601617	-9.60238434	7.22513E-10	-3.335498105	-2.157376274

Appendix E.4: Scenario D: Multiple regression statistics for rent size category 2500m^2 based on land value

Regression Statistics	
Multiple R	0.850671031
R Square	0.723641203
Adjusted R Square	0.690478148
Standard Error	89.42779499
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	523522.134	174507.378	21.8207035	3.6966E-07
Residual	25	199933.2629	7997.330517		
Total	28	723455.3969			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	612.3247992	49.89734155	12.27169184	4.43825E-12	509.5593726	715.0902258
Internal (X1)	0.409490305	6.89853081	0.05935906	0.953138075	-13.7982899	14.61727051
Local (X2)	-1.79615235	1.993000929	-0.901230062	0.376066685	-5.900811722	2.308507022
Regional (X3)	-2.99591731	0.382728546	-7.827786417	3.48592E-08	-3.784160953	-2.207673668

Appendix E.5: Scenario D: Multiple regression statistics for rent size category 5000m^2 based on land value

Regression Statistics	
Multiple R	0.771531653
R Square	0.595261091
Adjusted R Square	0.546692422
Standard Error	107.6454373
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	426053.1693	142017.7231	12.2560717	3.99216E-05
Residual	25	289688.5041	11587.54016		
Total	28	715741.6733			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	502.1777259	60.06209981	8.360975182	1.04116E-08	378.4776024	625.8778493
Internal (X1)	2.857553111	8.303854138	0.344123712	0.733631018	-14.24454264	19.95964886
Local (X2)	-1.73949297	2.399001971	-0.725090263	0.475129396	-6.680326555	3.201340615
Regional (X3)	-2.709457295	0.460695488	-5.881232543	3.89443E-06	-3.658276748	-1.760637842