

CHAPTER 5: THE FORMULA FOR ROAD INVESTMENT AND ECONOMIC DEVELOPMENT

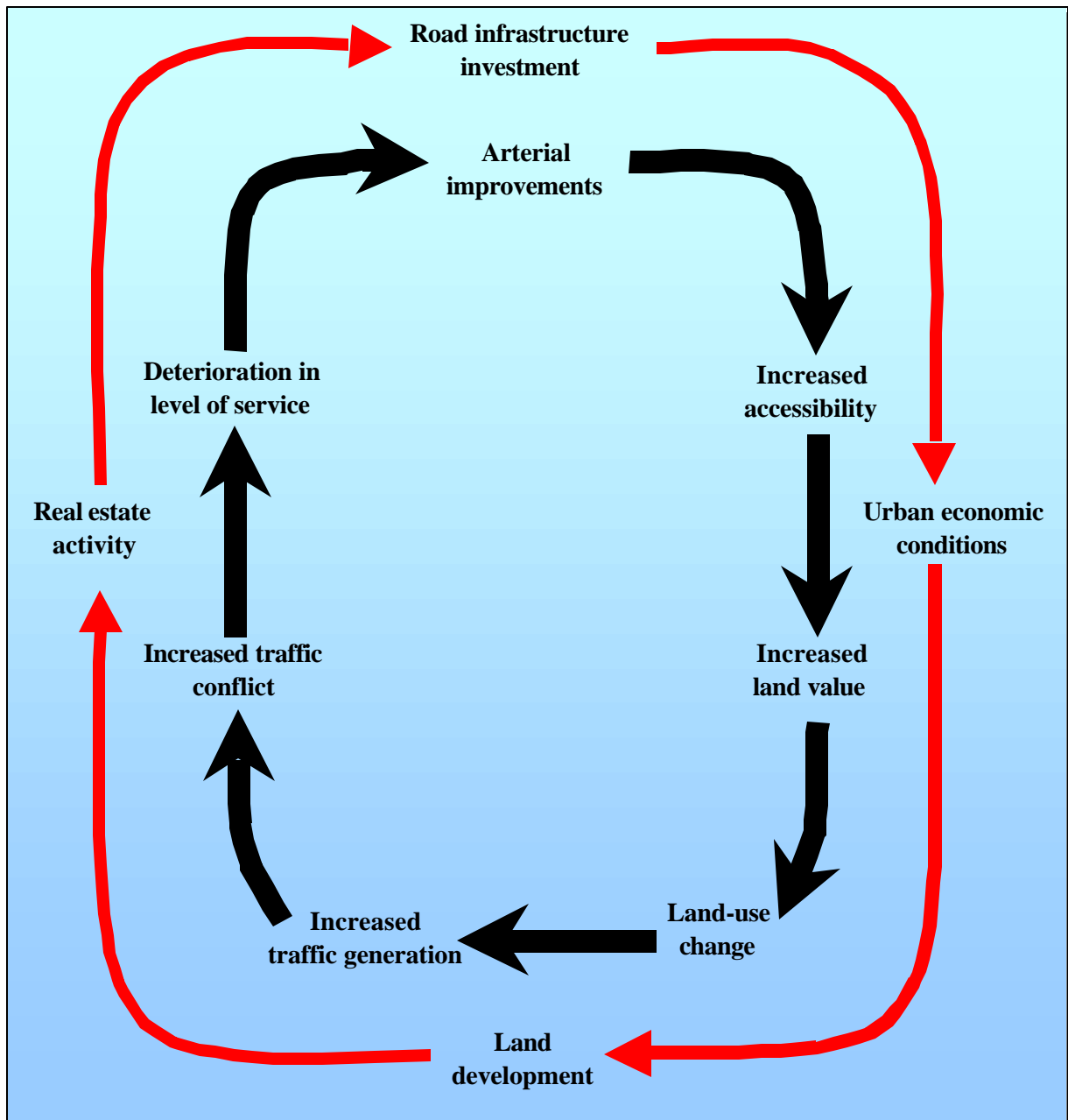
5.1 INTRODUCTION

Chapter 1 (secs 1.1, 1.4 & 1.5) highlighted the lack of an applicable formula for road investment and economic development. The aim of this chapter is to develop an appropriate formula for road investment that will be applicable as an early and cost-effective method to prioritise road projects in terms of their economic potential. The method that will be used is that of multicriteria analysis. The intention is to interpret the economic effects of road investment, and then to develop the formula by using the principal findings of chapters 1 to 4, to substantiate it. Certain performance indicators will be assigned to this formula and used to test its practical application. Finally, the author intends assessing the application of this formula using the VISA software application model.

5.2 INTERPRETATION OF THE ECONOMIC EFFECTS OF ROAD INVESTMENT

The aim of this section is to interpret the key factors that influence the causal relationship between road infrastructure investment and economic development. Although these factors were discussed in chapters 2 and 3, it is necessary to illustrate their relationship on a practical application. Figure 5.1 depicts the road network and land-use cycle.

Figure 5.1: Road network and land-use cycle



Source: Adapted from Stover & Koepke (1988:2)

This figure shows that improved economic conditions lead to improved land values. These land values result in pressure for changes in land-use with subsequent land development applications. The construction of new buildings and increased real estate activity in the area is thus apparent. This results in increased traffic generation and subsequent traffic congestion. These traffic conditions are

characterised by a deterioration of the levels of service on the road network – hence the need for additional road infrastructure.

One may infer from figure 5.1 that the following factors are of importance in the road investment and development relationship:

- urban economic conditions
- land development pressure
- real estate activity
- road infrastructure provision

In section 5.1, it was stated that multicriteria analysis (MCA) will be used as a foundation to develop the theory of road investment and economic development. It is thus necessary to describe this method in more detail. The strength of the MCA technique is that it is particularly useful in project selection because it offers a quick and cost-effective way of short-listing projects and comparing them against strategy objectives in a structured way (Anon 1996:28). This strength is in direct support of the purpose of this chapter, namely to develop a formula that will prioritise road projects in a cost-effective manner, while comparing them against the strategic objective of maximised economic returns. The use of MCA for decision making in a transport environment is supported by Schutte (2002:34) who propose MCA as the most appropriate tool for transport investment decisions. The other strength of MCA is that the number of criteria used in decision making is limited. MCA allows for a number of criteria described by the subcriteria. The number of subcriteria should ideally not exceed 10 to 16. More subcriteria will affect the cost effectiveness of the MCA technique. Schutte and Naude (2003:7) concur, and state that as few as possible subcriteria should be used consistent with completeness. It is argued that the introduction of many side issues should be avoided. MCA also allows for the weighting of criteria that will assist in the

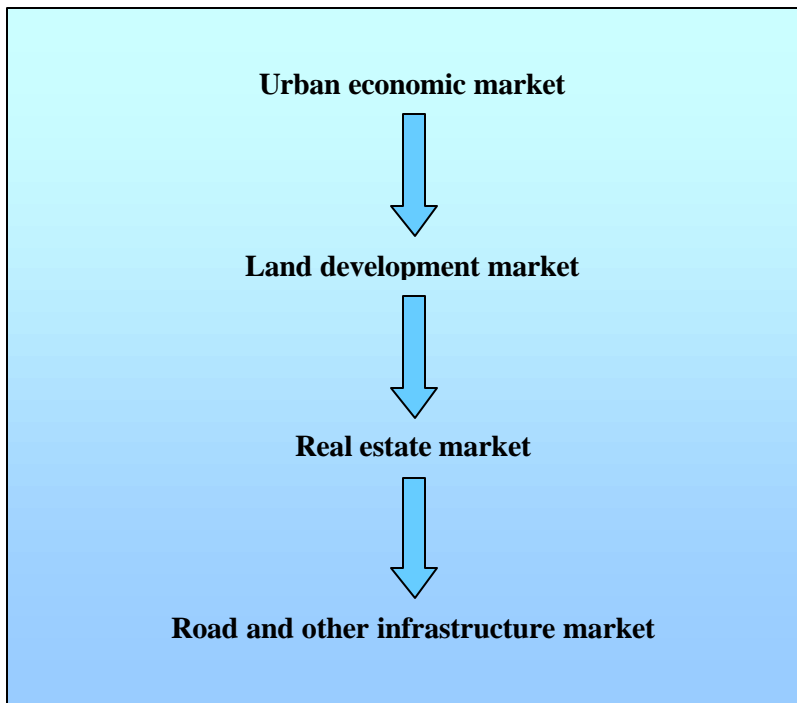
scoring of alternatives. This is not recommended because of the concern that MCA may be criticised for over-reliance on largely subjective weighting systems made by the analyst or imposed by the decision maker (Anon 1996:29).

These general guidelines will be used as the foundation for the development of a formula for road investment and economic development. Four important factors were identified in figure 5.1. These will form the basis of the formula to be developed. The four factors are the four **criteria** of the MCA technique and will be termed the “**markets**”. Each of these markets will have a weighting of 25% in order to avoid the subjectivity of differential weights. The subcriteria of each market will be limited to four in order to limit the total amount of subcriteria to 16. These **subcriteria** will be termed the **characteristics** because they describe each market.

Figure 5.1 indicates that there is a specific market flow sequence. This sequence is depicted in figure 5.2 and is of importance to the formulation of the proposed theory. Figure 5.2 shows that the urban economic market must be such that it will attract land development. Land development will lead to the provision of real estate which, in turn, will create a demand for infrastructure.

These markets will thus be integrated into the formula for road investment and economic development. It is necessary to identify the four subcriteria that characterises each of these four markets. These markets and the identification of their characteristics are explained below.

Figure 5.2: Market flow sequence



5.2.1 Urban economic market

Urban economics is concerned with the activities that occur in the urban complex (Wurtzebach & Miles 1994:47). The outputs of these activities are the economic effects. In section 3.7, the economic development component addressed aspects of the economic effects such as employment creation, business sales and contribution to the GDP, as well as urban competition. The aspects relate to economic effects that have been discussed at length in this study. The economic tools as discussed in chapter 4 measure these effects.

According to Gillis et al (1996:487), a well-established urban economic market creates reinforcing attractions. They state that firms will be pulled towards this area if the urban economic conditions are favourable. This characteristic of the urban economy is referred to as its **natural attraction for business**.

The importance of urban economic conditions has been emphasised throughout this thesis. In section 3.7.1 it was stated that transport infrastructure improvements allow the integration of urban markets, hence also introducing more competition. The effectiveness and efficiency of the market location plays a key role in the competitiveness of that urban location. The competitiveness of urban locations is influenced by economics of scale and agglomeration economies. Firms locating in that area also benefit from agglomeration economies resulting from the presence of many other firms, because a wide range of necessary inputs and services become available (Gilles et al 1996:487; Wurtzebach & Miles 1994:48). The urban economic conditions are further illustrated by the occurrence of directly productive activities or DPA (see sec 2.3.2).

The economic conditions can also characterise the maturity of the economy of an urban location. According to Ratcliff (1979:236), a city is a dynamic thing, growing and shifting in great spurts during periods of rapid expansion and building boom, but never quiescent even when growth has stopped and decline sets in. Growth is accompanied by the lateral expansion of the city as new districts are developed and there is also growth in the form of filling the vacant lots in the areas that are already partially built up (Ratcliff 1979:237). Another form of urban change relates to urban redevelopment. According to Ratcliff (1979:251), urban redevelopment occurs when the long life of the urban form is such that it becomes obsolete and inefficient with the nature of demand. From this it can be deduced that strong growth and development of the urban market take place in partially built-up areas, while vacant areas or areas requiring redevelopment will not have a strong urban economy.

The characteristic of urban competition is also significant in urban economics. The competitiveness of an urban area describes its attractiveness for new business wishing to relocate there. Wurtzebach and Miles (1994:41) agree in stating that

businesses and households locate where they can gain more than they can elsewhere. This is referred to as the comparative advantage of one area over another, and is often related to the accessibility of an area (Wurtzebach & Miles 1994:40). Inaccessible or remote areas thus have unfavourable market exposure, while areas with comparative advantages through their location and accessibility within the urban activity have favourable market exposure.

Conclusion 1 is thus based on the importance of the **urban economic market**. From the aforementioned discussion it is clear that the principal characteristics describing the urban economic market are

- the natural attraction for business
- the occurrence of agglomeration economies and DPAs
- the strength and maturity of the market
- the comparative advantages of the location

The urban economic market will be discussed in depth in section 5.3.2.

5.2.2 Land development market

Transport economic behaviour, as discussed in section 3.6, relates to factors such as land development and real estate activity. Since one of the aims of this study is to determine the relationship between transport and economic development, it is imperative to analyse the land development factor separately from the real estate factor. This is supported by the discussion in section 2.1 which highlighted the fact that the impacts of economic development are made by land development which, in turn, cause an increase in property values. Figure 5.1 also illustrated the difference between these two factors.

The discussion in section 3.6.1 highlighted the difference in development pressure between the different locations of roads K8, K16 and PWV9. The impact of transport access on land development was also discussed. It was shown that the construction of new roads may open areas for further land development. Ratcliff (1979:230), however, alludes to the impact of market forces on land development. These market forces may produce imperfections in the land market. This is especially relevant in slow-growing areas of the city. External action is thus required to rectify these imperfections. These external actions include specific city planning policy interventions. This is supported by Ratcliff (1979:230), who contends that the objective of city planning interventions is to attain the same land-use pattern that would emerge naturally from the processes of the urban land development market under conditions of perfect competition.

According to Wurtzebach and Miles (1994:78-80), land development goes through a succession process, which includes a period of uncertainty characterised by stagnant land or even decline in land-uses. On the other hand, competition occurs where different land-uses compete for sites within a given area. This results in changing land-use patterns.

From the above it is evident that stagnant areas will have almost no application for development in terms of the applicable town planning scheme of the area. However, it was also stated that there is competition for land by different land-uses. This implies that development applications will be required as a site is restricted in terms of its land usage allowed. If changing land-use patterns occur, it is inevitable that a high number of development applications will be submitted to the relevant local authority.

The zoning of land sets limitations on the use of land. If this zoning is not appropriate, given the changing land development needs, then it may result in

nonconforming (illegal) land-uses. Ratcliff (1979:244) concurs in his statement that: “Zoning simply serves to direct the forces of growth into a desirable geographical pattern. If the forces of growth are quiescent, zoning is inoperative; if zoning fails to conform to the basic forces of the market, it can do more harm than good.” From this discussion it is evident that improper zoning in an area may entice illegal land uses.

In conclusion, the land development factor is impacted on by the demand for development in the study area. These factors characterise the land development market. This leads to **conclusion 2**, namely that the **land development market** plays a vital role in the relationship between road investment and economic development, because the land development pressure of an area determines the need for road infrastructure. From the above it is clear that this market is characterised by

- the development stimulus
- the number of development applications
- changing land-use patterns
- the occurrence of illegal land-uses

The **land development market** will be analysed in section 5.3.3.

5.2.3 Real Estate Market

Section 3.6.1 provided information on the importance of real estate activity for this study. The characteristics of the real estate market underline the importance of location, the role of supply and demand in the real estate industry and the impact of gestation time. However, one also needs to note the factors that influence the

demand for property. According to Cloete (1994:65), the following is a list of factors that influence the demand for property:

- the size of the market
- the demographic and socioeconomic characteristics of the study area
- the preferences of consumers
- income and spending levels
- credit facilities
- the presence of competition
- the rentals asked
- vacancy rates
- expectations regarding price
- seasonal aspects of the property market

According to Greer and Farrel (1993:93-96), the following factors should be considered when conducting a demand analysis for real estate:

- location
- rental range
- vacancy rates
- trade areas
- future trends
- competitive buildings

From the above discussions, one may infer that the following factors are important in characterising the real estate market demand:

- **The vacancy rates of buildings.** Both sources reiterated the importance of vacancy rates because this is a direct reflection of the demand for real estate. For instance, high vacancy rates will be indicative of low demand.
- **Rental rates.** High rental rates will indicate a strong demand, while low rentals will be indicative of a poor demand.
- **The future trends as well as the demographic and socioeconomic characteristics of the study area.** These trends are vital because they impact on the future demand for real estate in the area.
- **Competitive buildings.** This refers not only to existing buildings, but also to the planned construction of new buildings. It is thus advisable to obtain information on building plan approvals of the study area.

Conclusion 3 is based on the fact that the **real estate market** also plays a key role in the relationship between road investment and economic development. The real estate market is influenced by subcriteria related to the vacancy rates of buildings in the study area, rental rates, predicted real estate demand and actual construction activities as reflected in building plan approvals.

The **real estate market** will be analysed in section 5.3.2.

5.2.4 Road and other infrastructure market

In chapter 2 it was concluded that the characteristics of roads imply that they form networks, the high capital costs combined with their substantial sunk costs imply a scarcity factor. Roads are thus not unlimited in supply. The provision of roads is not the only requirement for any study area to be useful for development. This is supported by Maritz (1993:54) who contends that before urban land can become useful it must be served by improvements. These improvements include

- electricity
- water
- sewerage
- streets
- stormwater systems

It is argued that the nonprovision of these utilities impacts adversely on land values and the usefulness of the area. The discussion in section 2.4.1 also emphasised that an irreducible minimum social capital industry mix is a condition for stimulating economic growth. Road infrastructure alone cannot stimulate economic activity because there is also a need for other economic infrastructure such as water and electricity. The scarcity factor of infrastructure also comes into play because it is essential for a minimum level of economic infrastructure to be provided in order to support economic development in the study area. In this regard, the unbalanced growth doctrine, as outlined in section 2.3.3, is especially relevant. This is based on the fact that this doctrine is relevant to situations where limited resources are available for investment and only the infrastructure projects that will make the greatest contribution relative to their cost can be undertaken.

In chapter 2 (secs 2.2 & 2.3), the demand and supply characteristics of roads were analysed. The findings of this chapter cautioned against the balanced approach (which implies the supply of roads in an effort to stimulate demand) for road investment because this could lead to overestimation of demand and a subsequent burden on society. The unbalanced approach, however, emphasises the provision of road infrastructure based on actual demand. From this it is evident that the provision of roads should be based on the actual demand and not on theoretical demand. The characteristics of roads (see section 2.4.1) further support this argument. The demand for road infrastructure improvements is measured by the deterioration of levels of service (LOS) of the road network. Annexure B provides

information on the different levels of service. A LOS A is indicative of free-flowing traffic conditions (with no demand for road improvements), while a LOS F is indicative of poor conditions (with a high demand for road improvements).

The provision of roads may have a positive or negative impact on the urban location. Maritz (1993:69-70) concurs and states that location is the most variable characteristic of many properties and urban areas because movement and exposure networks are continuously subjected to change. It is argued that productivity is future oriented – hence the importance in an assessment of productivity, to foresee locational changes over the period of use. In this regard, the provision of roads reflects changes in the movement channels. According to Maritz (1993:70) any developments that change the costs of movement will have an impact on the productivity of establishments in that urban location. If productivity is influenced in a detrimental way, the establishment will relocate to other more favourable locations. This is also referred to as displacement effects.

Given this limited supply in road infrastructure, it is necessary to ensure proper investment decisions in order to reduce transport costs. Section 3.4 emphasised the need for proper investment in roads in the discussion on the investment component addressing factors related to the type of the investment (eg roads), the size of the investment (eg the construction cost and physical extent) and the efficiency of the investment. The network performance component, as discussed in section 3.5, addressed factors related to travel flows, vehicle-operating costs, network efficiency and intermodality. These factors must be analysed to determine the improvements effected by the road construction. It is evident that appropriate investment based on actual demand will optimise the road network performance because it will ensure a reduction in transport costs.

Conclusion 4 can be derived from the above discussion, namely that road infrastructure must be provided only if there is an actual demand for it. This will ensure greater efficiency in the provision of road infrastructure and a higher probability of meaningful economic activity and stimulation. This conclusion is also subject to the condition that other economic infrastructure is also provided in the study area. This point will be discussed in section 5.3.5 and is regarded as the **road and other infrastructure market**. The road and other infrastructure market comprises the following characteristics or subcriteria:

- infrastructure provision
- traffic demand
- potential economic leakage
- reduction in transport costs

From the above discussion one may conclude that the following four markets fulfil a key role in determining the relationship between road investment and economic development:

- (1) the urban economic market
- (2) the land development market
- (3) the real estate market
- (4) the road and other infrastructure market

5.3 FORMULATION OF THEORY AND PERFORMANCE INDICATORS

During the course of this study it was found that the economic returns of road investment decisions are primarily influenced by many factors. In section 5.2, these factors were collated into four markets:

- (1) the real estate market
- (2) the land development market
- (3) the urban economic market
- (4) the road and other infrastructure market

The characteristics or subcriteria of each of these markets need to be analysed. Before doing so, it is necessary to briefly explain the formula of road investment.

5.3.1 Explanation of formula

The four markets that will form the basis of the formula of road investment were mentioned in the introduction in section 5.3. On the basis of the discussions in section 5.2, the author explained why each market should be allocated a weight of 25%. Each of the four markets must comply with a number of characteristics or subcriteria that describe that specific market. In section 5.2 it was argued that each market should be limited to four characteristics in order to comply with the requirements (not more than 16 subcriteria) of the MCA technique.

These characteristics of each market will be measured by a value. The values are based on numbers from 1 to 5, with 1 denoting the lowest value (or noncompliance with the characteristic), and 5 the highest value (or full compliance). A value of 5 thus indicates that a specific characteristic is highly visible or evident in the study area, while a value of 1 describes the nonoccurrence of that characteristic or poor compliance with it. The values of 2, 3 and 4 indicate increased compliance with that characteristic.

A scoring system was developed in sections 3.5.2 to 3.5.5 for the different subcriteria. The majority of these values will thus be substantiated with evidence or supporting documentation. No fixed value can be assigned as each area has its

own characteristics. For example, a characteristic of the real estate market is the number of building plans approved. The approval of, say, 100 building plans is meaningless unless it is stated in context. This implies that the approval of 100 building plans cannot be awarded a value of 5 or 1, unless the extent of the study area or the cost of the road is understood. For instance, the study area of a national road spanning hundreds of kilometres will have a relatively poor real estate market if only 100 building plans are approved. A value of 2 may be awarded. However, an urban road with a length of 2 km, will achieve a mark of 5 if 100 building plans are approved within that study area. To compensate for this it is necessary to divide the figure (say, the 100 buildings plans) by the cost of the road. This will give a ratio of the project's result per million rand (say, 10 building plans per million rand). It will then be possible to compare the results of individual projects with one another because everything is expressed per million rand. This, however, is not possible for all the factors.

Using four characteristics (or subcriteria) per market (or criterion) will help to obtain a proper evaluation of the market since no market is characterised by only one characteristic. This theory is used as a procedure to estimate the probability that economic returns will be maximised when investing in the said road project. It is thus important to highlight noncompliance with the said markets because this is an indication that economic returns will not be maximised.

From the above, the following formula is derived:

$$ER = f (D; R; U; T)$$

where: ER = economic returns
 D = Land development market
 R = real estate market
 U = urban economic market
 T = road and other infrastructure market
(Note: each market weighs 25%.)

with: $D = \frac{\text{total value}}{4} * 100\%$

$$R = \frac{\text{total value}}{4} * 100\%$$

$$U = \frac{\text{total value}}{4} * 100\%$$

$$T = \frac{\text{total value}}{4} * 100\%$$

Thus: $ER = \frac{D + R + U + T}{4}$

(Note: The actual calculations in this formula are indicated in secs 5.4.1 – 5.4.4.)

According to the MCA technique, the project with the highest ER value will receive the highest priority because it has the highest probability of maximising the economic returns. The ER value is thus based on probability theory because it measures the probability of achieving maximised economic returns. It is subsequently meaningful to classify the ER values based on the probabilities of maximised economic returns. It is contended that a probability of less than 50% is poor, while a 70% probability is quite high. The ER values can be classified as follows:

- $ER < 50\%$ = Poor economic returns expected, with a high investment risk. Carefully reconsider this project and abandon if necessary.
- $50\% < ER < 70\%$ = Average to good economic returns expected with moderate investment risk. Prior to investing in this project, assess poor characteristics, especially those factors with low scores.
- $ER > 70\%$ = Maximum economic returns are expected, with low investment risk. This project seems highly feasible.

In chapter 1 it was stated that no formula of investment in road infrastructure has been developed in South Africa. The above discussions have proposed a formula of road investment and economic development. The main focus of this formula is to establish under what conditions road infrastructure investment will lead to economic growth and development. From this formula, one can deduce that the economic returns (ER) associated with road infrastructure investment are a function of the land development market (D); the real estate market (R); the urban economic market (U); and the road and other infrastructure market (T). The formula is thus:

$$ER = f(D; R; U; T)$$

From this it is obvious that the conditions of all four markets must be favourable to maximise the economic development implications of road infrastructure investment. The strength of the formula, however, lies in the fact that it quantifies each market's contribution to the economic returns. For instance, if only the real estate (market 1) and the road infrastructure market (market 4) are favourable, one can expect that the poor agglomeration economies and insignificant land development demand will result in limited economic growth, even if the construction of the road leads to improved accessibility within the area. Similarly, if the urban economic market (market 3) and the road infrastructure market (market 4) are favourable, the study area will be negatively influenced by limited land development and poor real estate conditions. Road investment may lead to insignificant economic development implications. The same applies to the other relationships. One can thus reiterate that economic development will only be maximised if the conditions of all four markets are favourable.

These factors impact on the causal relationship between road infrastructure and economic development, which manifests itself in economic returns. Each of these markets and the scoring of the characteristics (subcriteria) will now be explained.

5.3.2 The urban economic market

According to section 5.2.1, the following four characteristics are used to describe this market:

- (1) **Attraction for business.** The attraction for business can be stimulated by assessing the type and strength of business activity in the area. Larger and more prominent businesses tend to locate in areas with a natural attraction

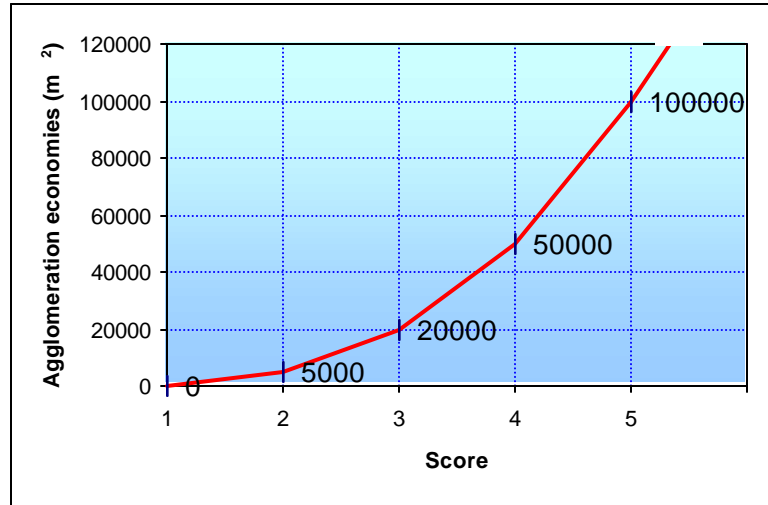
for business. A site inspection will provide a satisfactory interpretation of this characteristic. The scoring on this characteristic is based on the visual perception of the study area by the economist. The scoring system is listed in table 5.1.

Table 5.1: Scoring for business attraction

Visual observation	Score
No attraction for business	1
Limited business attraction	2
Average business attraction	3
Good business attraction	4
High natural attraction	5

- (2) **Agglomeration economies.** This relates to the occurrence of a relatively large activity such as a shopping centre or industrial plant that attracts other related or even nonrelated uses. These activities are also known as directly productive activities (DPA). Areas with no such activities have no agglomeration economies. A site inspection, as well as local knowledge of the study area, should provide sufficient information. The scoring system is based on the relative size of the agglomeration economies in terms of floor area. According to Van der Merwe (1987:154), shopping centres can be classified in terms of their relative size. These centres are local shopping centres (3 000 m² to 10 000 m²), neighbourhood centres (10 000 m² to 30 000 m²) and regional centres (up to 100 000 m²). The scoring system was roughly based on these guidelines because other land-uses also have agglomeration economies (see fig 5.3).

Figure 5.3: Scoring for agglomeration economies



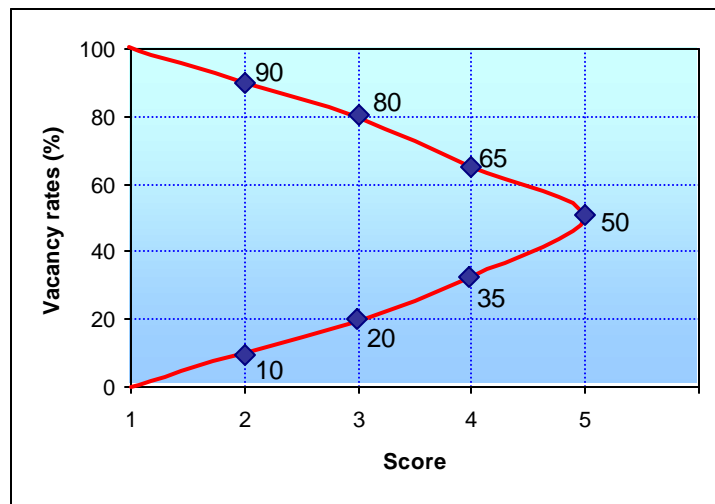
- (3) **Maturity of market.** A site inspection is required to determine the maturity of the market. For instance, an area with vacant farmland and no business activity is considered to be immature for economic activity, while a fully developed area may be fully mature, and any intervention to stimulate the economic activity may be meaningless. On the other hand, an area with a relatively small proportion of vacant agricultural holdings and other nonagricultural development already taking place may have a strong developing urban market. The maturity in the urban market may be characterised by changing economic patterns (mature for development) or stagnant areas with no economic new activity taking place (immature or fully mature). The product life cycle stages will be used as the foundation for this assessment. The urban market will be the product and the stages will include introduction, growth, maturity and decline (Churchill & Peter 1995:354). It is important to note that a stagnant as well as a fully developed market will form part of this life cycle. Both the stagnant or fully developed areas need the introduction of interventions in the urban market to stimulate new development or redevelopment. These interventions may be a new shopping centre. Once this stage has been successfully introduced, growth will take place with the development of the urban market. The next

stage is that of maturity when growth can only be achieved by attracting businesses from other competing urban markets. Decline occurs when other more favourable markets emerge within the urban area with a subsequent relocation to these markets.

In order to accurately identify these stages it is necessary to assess the relationship between the market life cycle and the market diffusion. According to Marx and Dekker (1986:427) a cumulative format of the market diffusion curve is in actual fact the life cycle curve. The market diffusion curve is depicted as a noncumulative curve. It is through the diffusion process that increasing numbers of firms adopt the urban market, with early firms influencing later ones. These firms are categorised as innovators, early adopters, early majority, late majority and laggards (Churchill & Peter 1995:356). Innovators are the first firms locating or investing in the urban market – once it is evident that the market location is working, the early adopting firms will locate in the area. The early majority are firms that will only locate to the market if risk is reduced, while the late majority of firms will only locate when it is common knowledge that the specific urban market is an excellent location that has attracted a great majority of firms. Laggards will only relocate during the market decline. Of significance is the fact that 50% of the market indicates the point at which the early and late majority joins (Churchill & Peter 1995:357; Marx & Dekker 1986:427). This point also links up with the high growth stage just before the maturity stage. The early adopters fall within the 10% category, while the laggards will enter the market only after it is 90% mature. The early majority will enter the market if it is only 35% developed, while the late majority will only enter the market until it is 65% mature. Table 5.2 and figure 5.4 provide information on the scoring system.

Table 5.2: Scoring for maturity of market

Observation	Score
No market activity; or market fully developed	1
Market only 10% developed; or already 90% mature	2
Market only 20% developed; or already 80% mature	3
Market only 35% developed; or already 65% mature	4
Market 50% developed with high demand	5

Figure 5.4: The scoring for the maturity of market

Source: Adapted from Churchill & Peter (1995:357)

- (4) **Market exposure.** Market exposure fulfils a key role in the urban economic market. Remote, inaccessible areas have poor market exposure, while study areas in prominent locations characterised by the urban activity have favourable locations. According to Maritz (1993:64), the exposure network is a less tangible element of location, but poor exposure may have a profound impact on the productivity of a business enterprise. Exposure includes elements such as the land-use environment and exposure to the socioeconomic environment. The scoring of this characteristic is based on a descriptive assessment of the market exposure of the study area. Table 5.3 will be used to score this market.

Table 5.3: Subcharacteristics of market exposure

Characteristics	Presence of subcharacteristic (Yes or No)
Comparative advantage of location	
Good market accessibility	
Close proximity to market	
Attractiveness of location	
Positive market exposure	

The above discussion explained the operation of the urban economic market. Table 5.4 is used to analyse the urban economic market.

Table 5.4: The urban economic market

LOW VALUE	1	2	3	4	5	HIGH VALUE
No natural attraction for business						High natural attraction for business
Absence of agglomeration economies and DPAs						Strong presence of agglomeration economies and DPAs
Market very immature or fully mature						Market developing strongly
Unfavourable market exposure and location (remoteness)						Favourable market exposure and location (within urban activity)

5.3.3 The land development market

Section 5.2.2 justified the use of the following four characteristics used to describe this market:

- (1) **Development stimulus.** This characteristic focuses on the development potential of the area. It distinguishes between the natural occurrence of land development (free-market forces) on the one hand, and external intervention by government, on the other. In this regard, it is necessary to ascertain whether government had to intervene in some way. This may be done in terms of the approval of the project as an SDI or other actions. Areas with natural development stimuli need no government interaction (unless the demand is such that government intervention is required to control or limit development – this issue does not fall within the ambit of this study) and are market driven.

The scoring of this characteristic is based on the market forces or market control prevalent in the study area. If government policy is introduced to stimulate activity, then the score is 1 if no external market forces are evident. If the area has a natural stimulus for development with numerous private developers, then a scoring of 5 is appropriate. The scoring will be based on the presence of certain subcharacteristics of the development stimulus as described in table 5.5.

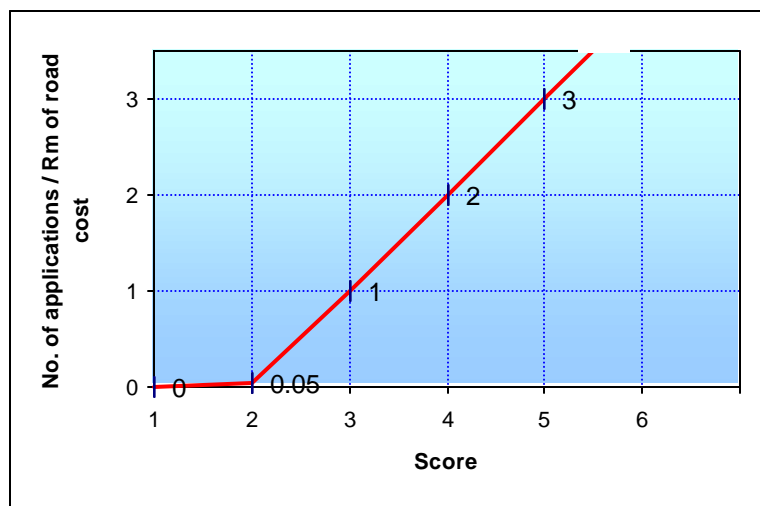
Table 5.5: Subcharacteristics of development stimulus

Subcharacteristics	Presence of subcharacteristic (Yes or No)
Fast-growing area	
Limited land-use imperfections	
No external action required	
No planning policy interventions to stimulate development	
Conditions of good market competition	

- (2) **Development applications.** The number of development applications reflects the potential of the land development market. Areas with no development applications have a poor land development market, while the converse is true of areas with a large number of applications. Information can be obtained from local government in terms of the number of rezoning applications, consent uses and township applications. It is meaningful to obtain the number of applications for a specific time frame, say, a year, because this will make comparisons more meaningful.

The scoring is based on the number of development applications per million rand invested in the road. This figure will be relatively small since road projects are extremely costly (in excess of R300 million). This figure is compared with the annual applications in the specific study area of each project. Of significance is the fact that major metropolitan municipalities receive about 1 500 to 2 000 development applications per year for the entire metropolitan area. The following scoring system is proposed (see fig 5.5):

Figure 5.5: Scoring for development applications

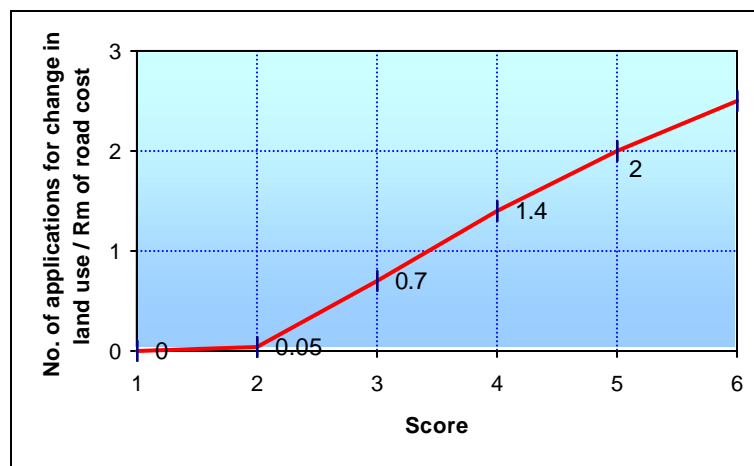


- (3) **Development activity.** A site inspection of the area will indicate whether the area is stagnant or changes in land-use patterns are evident. These

changes could be instances where agricultural holdings are being converted into businesses, or dwelling houses are being converted into home offices, etc. Stagnant areas are characterised by limited changes to the built environment such as old residential buildings or vacant farmland.

The scoring of the development activity characteristic will be based on the number of applications for a change in land-use, measured against the investment cost of the road (see fig 5.6). The figures are expected to be lower than those for development applications.

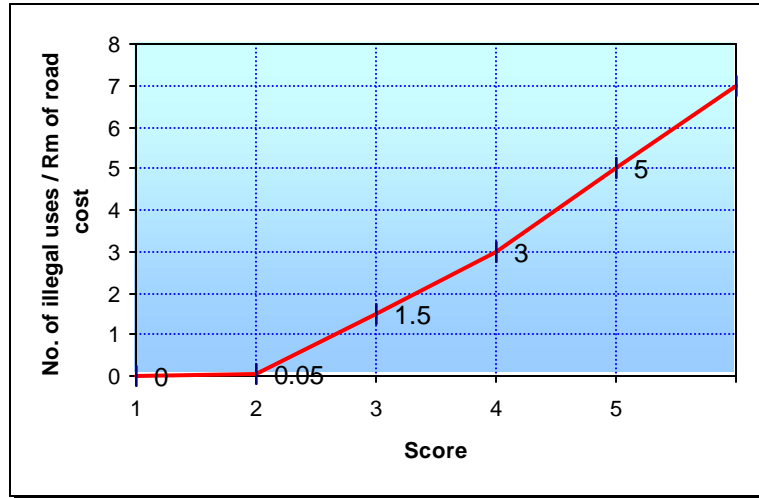
Figure 5.6: Scoring for development activity



- (4) **Illegal land-uses.** Experience has shown that areas under development pressure are usually characterised by the number of illegal land-use activities. This is because the market takes full advantage of good conditions, and cannot wait for the cumbersome and time-consuming procedures of local government to approve changes in land-use. Areas experiencing poor conditions have no need to conduct illegal practices. Site inspections together with information from local government will provide sufficient information. A comparison between the zoning of land and the actual land uses on site is generally made to assess the potential number of

illegal uses. The scoring of illegal land-uses is also measured against the cost of the road (see fig 5.7).

Figure 5.7: Scoring for illegal land-uses



Given the above, the land development market is collated into table 5.6. This table is thus used to analyse the land development market.

Table 5.6: The land development market

LOW VALUE	1	2	3	4	5	HIGH VALUE
External action required to create development						Natural development stimulus
Almost no development applications						High number of development applications
Stagnant area						Changing land-use patterns highly evident
Almost no illegal land-uses						High number of illegal land uses

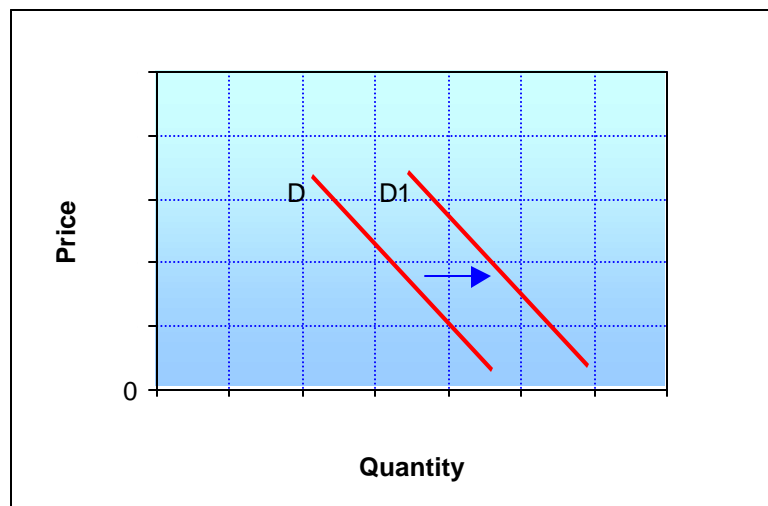
5.3.4 The real estate market

The following characteristics are used to describe the real estate market:

- **Real estate demand.** The activity in the real estate market is characterised by the demand for real estate space in an area. Demand for real estate space in terms of retail, office, industrial and other uses must be determined. A poor real estate market will have extremely limited activity or demand. This information can be obtained from various sources, including socioeconomic projections based on future demand.

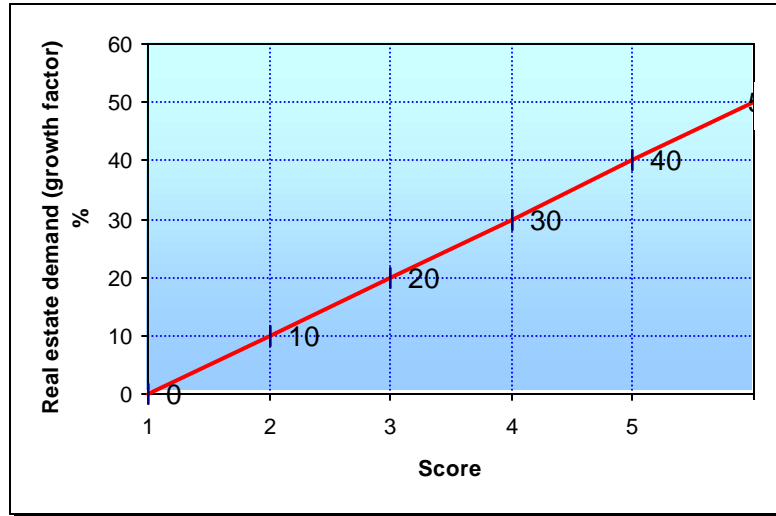
Given the availability of information, for this study it was decided to use socioeconomic projections to indicate future demand. The change in real estate demand is depicted in figure 5.8.

Figure 5.8: Changes in real estate demand



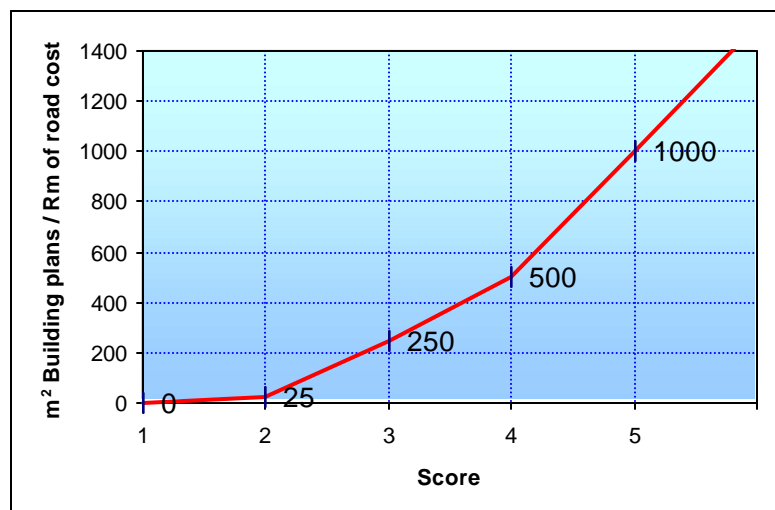
This change in real estate demand will be expressed in the expected growth rates. The scoring system will thus be based on growth rates for a 10-year period (2000 – 2010). Figure 5.9 illustrates the scoring system.

Figure 5.9: Scoring for real estate demand (10-year growth)



- Building plans and new buildings.** Highly active real estate markets are also characterised by the number of new buildings erected or building plans submitted for approval. A site inspection will provide sufficient information on the construction activities within the area, while the local government can provide information on the number of building plans submitted for approval as well as the actual floor area proposed. The scoring of this characteristic is based on the relationship between the floor areas (m²) of business building plans submitted in one year and the cost of the road project. The following scoring system is proposed for this study (see fig 5.10):

Figure 5.10: Scoring for building plans



- Rental rates.** This is another supply and demand issue. A high demand for building space usually manifests itself in high rental rates (rate/m²). The converse is also true. These rates are usually compared with averages for the city per building type. There are a number of information sources available, the Rode Report being the most useful. According to the Rode Report (2000), the Pretoria average rental rate for industrial buildings is R11,50/m²/month. That of retail rates is R40/m²/month. The scoring system is depicted in figures 5.11 and 5.12.

Figure 5.11: Scoring for industrial rental rates

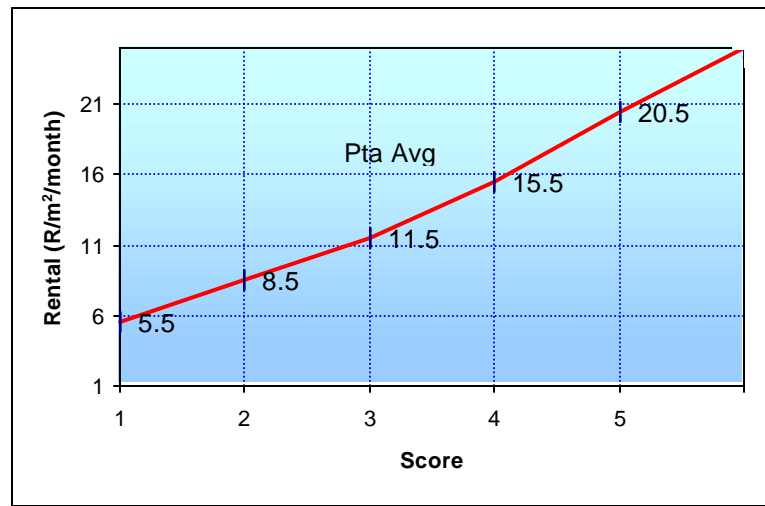
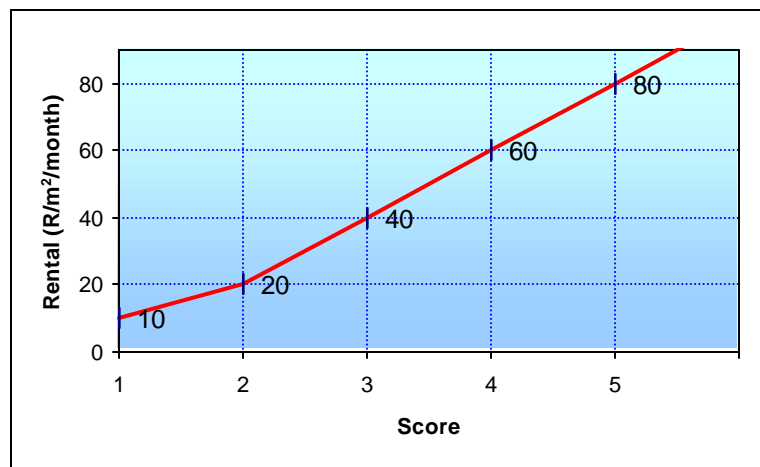


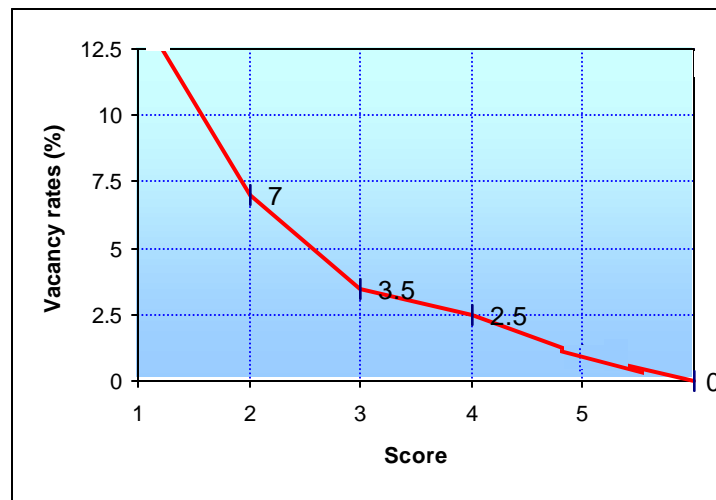
Figure 5.12: Scoring for retail rental rates



- **The vacancy rate of buildings.** The demand for buildings (offices, industrial sites and commercial buildings) is reflected by the vacancy rates in the study area. A high demand for building space will usually occur in areas with extremely low vacancy rates for these commercial buildings, and vice versa. Information can be obtained from SAPOA, the Rode Report or other property information sources provide details of vacancy rates in certain areas. In addition, a site inspection will provide supportive information, while estate agents in the area can also provide useful information.

The actual scoring of the vacancy rate of building may be difficult if no formal statistics are available. Surveys and visual observations will then be required. The scoring system is depicted in figure 5.13.

Figure 5.13: Scoring for vacancy rates



This figure indicates that the average vacancy rate for commercial buildings in Pretoria in the year 2000 was 3,5% (Rode 2000:2). This average receives a value of 3, vacancies higher than 3,5% will score a 2, and those higher than 10% a 1. Lower vacancies will score between 4 and 5. The study area may have different industrial, office and retail buildings and this may require

an analysis of each of these types. The vacancy rates of cities will also differ, as will the vacancy rate over time – hence the need for decision makers to use the appropriate information.

The following table is used to analyse the real estate market:

Table 5.7: The real estate market

LOW VALUE	1	2	3	4	5	HIGH VALUE
No real estate demand						High demand for real estate space
No building plans approved						Substantial number of building plans approved
Rental income low (rate/m ²)						Rental income high (rate/m ²)
Many vacant buildings						Almost no vacant buildings

5.3.5 The road and other infrastructure market

The following characteristics describe this market:

- Infrastructure provision.** This section deals with the availability of economic infrastructure in the area. This includes roads. If the area has no water, sanitation and electrical infrastructure, then the provision of road infrastructure will do little to stimulate development in the area. This information can be obtained from local government, although a site investigation can also give one a good idea of the availability of infrastructure. Some analysts use aerial photographs to assess the provision of road infrastructure. The provision of road infrastructure is thus highly

relevant to this characteristic. The scoring system will be based on table 5.8.

Table 5.8: Scoring for infrastructure provision

Observation	Score
No supporting infrastructure	1
Limited provision of supporting infrastructure	2
Acceptable provision of supporting infrastructure	3
Good supply of supporting infrastructure	4
Well-developed infrastructure	5

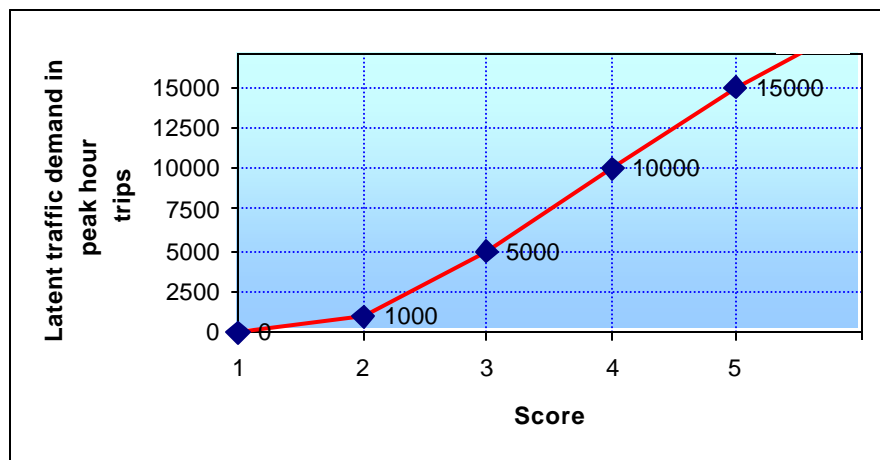
- Traffic demand.** The traffic demand gives an indication of the need for road infrastructure in the area. For instance, severe traffic congestion and long queues indicate that additional road infrastructure is required. Free-flowing traffic conditions do not warrant additional road infrastructure. Peak hour traffic observations will provide good information, although traffic models of the study area can provide more reliable information. Transport studies may also provide invaluable information. For the purposes of this thesis, the levels of service will be used to indicate traffic demand (see table 5.9). Annexure B provides information on the levels of service.

Table 5.9: Scoring for traffic demand

Level of service (LOS)	Score
LOS A	1
LOS B	2
LOS C	3
LOS D	4
LOS E or F	5

- **Economic leakage versus inflow.** This characteristic must be assessed in conjunction with those of the urban economic market. In this regard, it is necessary to assess the probability that the construction of the road will cause economic activity to decline (leakage) in the study area because of better access to more attractive markets; or ensure the inflow of economic activity to the area on account of the improved accessibility of the area. The scoring will be based on the latent traffic demand which is directly linked to economic activity. A poor or negative traffic demand is indicative of economic leakage, while that of high latent traffic volumes of potential economic inflow. The latent traffic demand can be obtained from transport models or trip generation tables for different land-uses as provided by the Department of Transport. Figure 5.14 provides information on the scoring system.

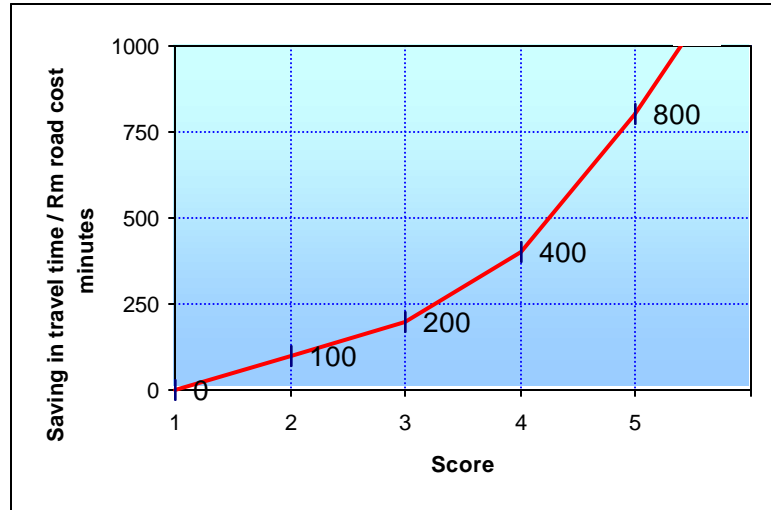
Figure 5.14: Scoring for leakage or inflow



- **Reduction in transport costs.** This characteristic will provide a rough estimate of whether or not the road will reduce transport costs. The information obtained from the other characteristics, such as the modelled impacts of road user costs, can assist. This information is available from transport studies. The scoring system is expressed in expected savings in

travel time in relation to each million rand invested in the road project. See figure 5.15.

Figure 5.15: Scoring for reduction in transport cost



The above discussions dealt with the road and other infrastructure market. Table 5.10 is used to analyse this market.

Table 5.10: Road and other infrastructure market

LOW VALUE	1	2	3	4	5	HIGH VALUE
Almost no infrastructure						Well-developed infrastructure
Low traffic demand						High traffic demand
Potential of economic leakage by new road						Potential of economic inflow by new road
Insignificant reduction in transport costs due to new road						Sizeable reduction in transport costs due to new road

Sections 5.3.1 to 5.3.5 provided information on the characteristics and the scoring of the four markets. The theory is based on the fact that there is interaction between the four markets. The stronger this interaction, the

higher the probability will be that the road project will maximise economic returns and associated economic development.

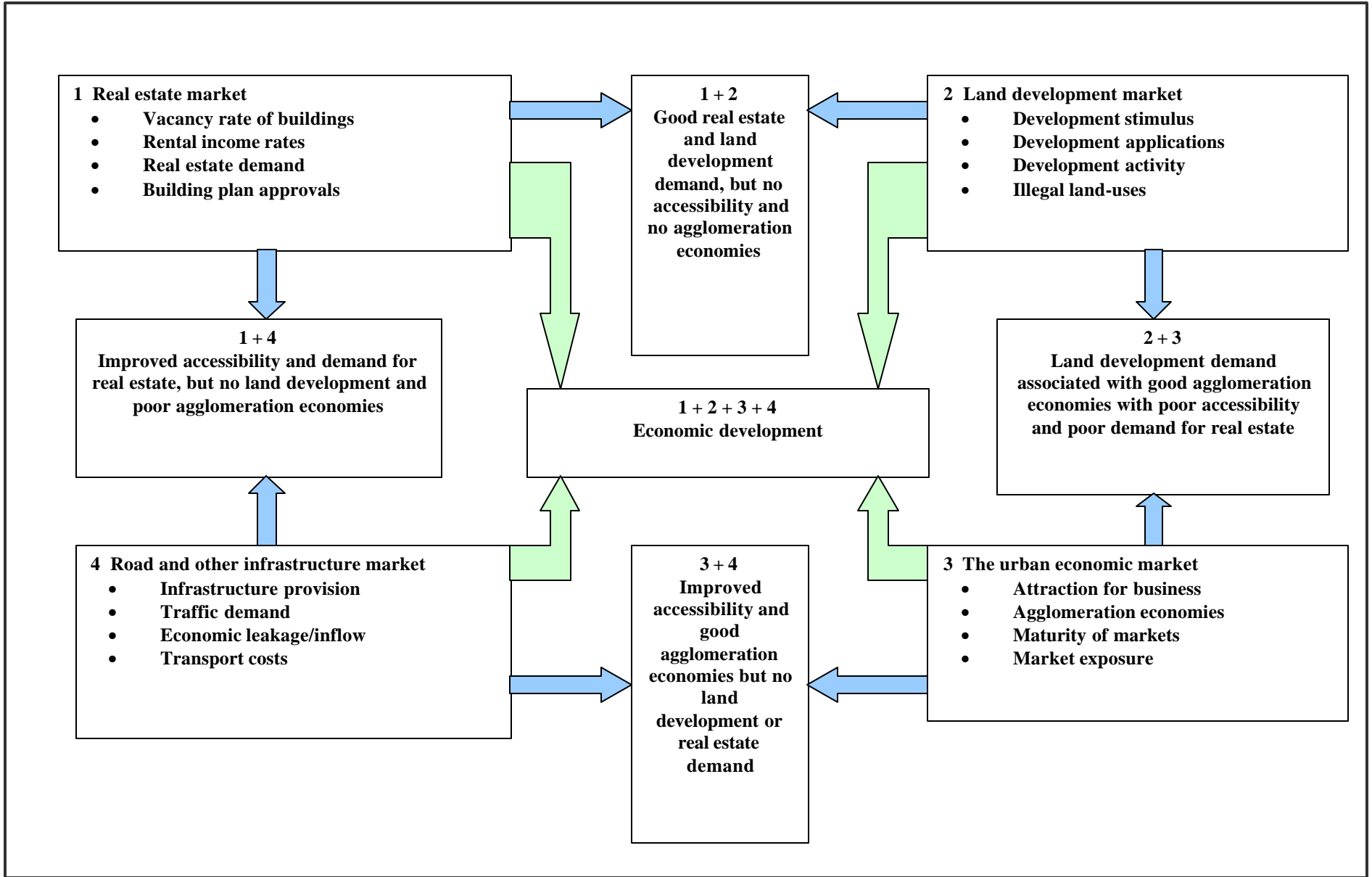
This interaction is depicted in figure 5.16 below. One can infer from this figure that if the study area of a specific road project has only strong real estate and land development markets, economic development is improbable because the area will have poor accessibility and no agglomeration economies. On the other hand, if the area is characterised only by a strong infrastructure and urban economic market, then economic development is also improbable because the area will have poor land development and real estate demand.

To assess the applicability of this formula it is necessary to test it against the three case studies used in this thesis, namely roads K8, K16 and the MCDC (Road PWV9).

5.4 APPLICATION OF FORMULA

The formula of road investment developed and discussed in section 5.3 will now be applied to the different case studies. The scoring system developed in the previous section will form the basis of allocating scores to the different characteristics. Road K8 will be the first case study.

Figure 5.16: Illustration of necessary preconditions and relationships between road infrastructure



5.4.1 Road K8

5.4.1.1 *The urban economic market*

- **Attraction for business.** As stated in chapters 2 and 3, the area has a high natural attraction for business. This is supported by the retention of existing businesses as well as the high number of new businesses being established in the area. In terms of table 5.1, a score of 5 is justified.
- **Agglomeration economies.** The strong presence of agglomeration economies is highlighted by the Kolonade shopping centre. This centre of approximately 55 000 m² is the main reason for an agglomeration economy in the area. A number of retail shopping centres larger than 20 000 m² are located in the area which suggests economy of scale, while fairly large commercial activities are also present. This serves as a stimulus in the area, resulting in many other activities locating here. A score of 4 can thus be plotted in figure 5.3.
- **Market maturity.** The market of the area is developing strongly. About 50% (based on recent aerial photographs) of the area has been developed and there is still a strong demand for further activity in the area. The presence of agricultural holdings in the area means that the area can develop fairly easily because no formal structures and buildings have to be demolished, large portions of this land form part of development applications. A score of 5 is derived from table 5.2 and figure 5.4.
- **Market exposure.** The format of table 5.3 will be used to score market exposure. This area has a favourable market exposure and location. It forms part of the Economic Development Zone for the Pretoria area, and is





characterised by an excellent mix of business and economic activity. In addition, road K8 will be constructed parallel to Zambesi Drive which is characterised by high traffic volumes. The only constraint is the relative north-south inaccessibility of the area – hence a score of 4 is allocated (see table 5.11).

Table 5.11: Scoring of market exposure for road K8

Characteristics	Presence of subcharacteristic (Yes or No)
Comparative advantage of location	Yes
Good market accessibility	No
Close proximity to market	Yes
Attractiveness of location	Yes
Positive market exposure	Yes

The scoring of the characteristics of the urban economic market for road K8 is shown in table 5.12.

Table 5.12: The urban economic market of road K8

LOW VALUE	1	2	3	4	5	HIGH VALUE
No natural attraction for business						High natural attraction for business
Absence of agglomeration economies and DPAs						Strong presence of agglomeration economies and DPAs
Market very immature or fully mature						Market developing strongly
Unfavourable market exposure and location (remoteness)						Favourable market exposure and location (within urban activity)

The urban economic market is also extremely strong in the study area, with an average value of 4,5 or 90% compliance.

5.4.1.2 *The land development market*

- **Development stimulus.** The format of table 5.5 will be used to score the development stimulus. This area has a natural development stimulus with many active developers. In fact the study area has had such a demand for development that the developers in the study area have established a committee (The Zambesi Developers Committee) to protect developers' interests. No external or governmental action was required to provide this development stimulus. Many private developers are active in this area – hence a score of 5 is allocated (see table 5.13).

Table 5.13: Scoring of development stimulus for road K8

Subcharacteristics	Presence of subcharacteristic (Yes or No)
Fast-growing area	Yes
Limited land-use imperfections	Yes
No external action required	Yes
No planning policy interventions to stimulate development	Yes
Conditions of good market competition	Yes





- **Development applications.** The area is also known for its high number of development applications. Information obtained at the municipality has shown that at least 500 000 m² of additional floor space is being applied for in terms of township applications. In addition, 101 development applications were submitted during 2002. This equates to 3,4 applications submitted per

million rand invested in the road – a significant number. According to figure 5.5, a score of 5 is allocated.

- **Development activity.** The area is experiencing a number of changes in land-use patterns, and some 43 applications for a change in land-use were submitted during 2002 (or 1,43 applications per million rand invested in the road). Essentially characterised by agricultural holdings, residential homes and retail complexes, the area now also has motor trade, commercial trade, storage facilities, medical facilities and offices. In terms of figure 5.6 a score of 4 is derived.
- **Illegal land-uses.** The area is also characterised by the high number of illegal land-uses and businesses in operation. A total of 120 cases have been reported since June 2003. Alternatively, this implies four illegal uses per million rand invested. This aspect of illegal uses was so severe that the municipality had to implement policies to restrict illegal trade in the area. A score of 4 is derived from figure 5.7.

The compliance of the characteristics of the **land development market** for road K8 is shown in table 5.14.

Table 5.14: The land development market of road K8

LOW VALUE	1	2	3	4	5	HIGH VALUE
External action required to create development						Natural development stimulus
Almost no development applications						High number of development applications
Stagnant area						Changing land-use patterns highly evident
Almost no illegal land-uses						High number of illegal land-uses

The land development market scores a high 4,5 or 90% compliance. This is an extremely high score.

5.4.1.3 *The real estate market*

- **Real estate demand.** According to a study by Plan Associates (1999), the demand for real estate space will increase dramatically in the study area during the next 10 years. It is important to note that this study specifically excluded the impact of AIDS, and also that other areas will experience a decline in demand as the expected growth in job opportunities for the entire Pretoria metropolitan area will only be 2,6 to 2,7% per annum. Based on formal job opportunities in the study area, the growth will be as follows:

– retail	3 579 jobs
– office	6 968 jobs
– industrial	1 690 jobs
– other services	90 jobs
Total	12 327 jobs

Given the current number of jobs of 24 170 in the study area, a growth rate of 51% is expected in the next 10 years in the broader study area – hence the prediction of a high demand for real estate space. This is depicted in figure 5.17.

Figure 5.17: Increase in real estate demand for road K8 (2000 – 2010)



This increase is considerable and implies that the real estate market is fairly vibrant. If plotted on figure 5.9 it is evident that a score of 5 is achieved.

- Building plans.** Information obtained from the municipality revealed that many building plans have been submitted for approval in recent years (2001/2002). These include shopping centres, home industries, motor-related industries, offices and residential buildings totalling 29 793 m² of floor area. By dividing the floor area by the cost of road K8, it is evident that 993 m² of building plans are submitted per million Rand invested in the road. This is a significant floor area and the score of 4 is thus obtained according to figure 5.10.

- **Rental rates.** According to information obtained from property practitioners, the rental incomes (rate/m²) of this study area are higher than those of the study areas of roads K16 and PWV9, but lower than those of commercial buildings in the eastern areas of Pretoria. Retail varies from R35,37/m²/month in Pretoria North to approximately R100/m²/month in the Kolonade Shopping Centre (based on interviews with property practitioners). If these rental rates are plotted on figure 5.12 it is evident that the scores vary between 2 and 5. This anomaly is addressed by calculating the weighted average of rental rates for the respective centres and their total floor area. This calculation provided a score of 3.
- **Vacancy rates.** A site investigation on commercial buildings revealed that two fairly large commercial buildings are vacant. The one building, the so-called “Waterfront Development” is vacant because it focussed on the entirely wrong target market. The land-use rights for this building only allow flea-market type tenants – but because this industry is not accustomed to paying for floor space, the resultant tenant occupation has been poor. However, if these two buildings are excluded, the situation of vacancy rates for commercial buildings is totally different. According to an assessment of the availability of rental floor area, it was found that the vacancy rates are extremely low (below 3,5%). This information justifies a score of 3 in terms of figure 5.13. Had this was not been the case, a value of 2 would have been more appropriate.

The compliance of **the real estate market** of the study area of road K8 is shown in table 5.15 below.

Table 5.15: Real estate market of road K8

LOW VALUE	1	2	3	4	5	HIGH VALUE
No real estate demand					✓	High demand for real estate space
No building plans approved				✓		Substantial number of building plans approved
Rental income low (rate/m ²)			✓			Rental income high (rate/m ²)
Many vacant buildings			✓			Almost no vacant buildings

From this table it is evident that the real estate market is fairly strong in this area with an average score of 3,75 or 75% compliance.





5.4.1.4 *The road and other infrastructure market*

- Infrastructure provision.** The area is well-developed with road and other infrastructure. Information obtained from the Council confirmed the availability of spare bulk services. If the area had no infrastructure or bulk service connections then township development would have been extremely costly. According to table 5.8, a score of 4 is awarded.
- Latent traffic demand.** As stated previously, the area is characterised by a high traffic demand evident from the high traffic volumes on Zambesi Drive. The latent demand (based on approved but unexercised development rights) is in excess of 10 000 peak hour vehicle trips. The area is known for its severe traffic congestion during peak hours and various intersections operate at a LOS E or F (LOS F is the worst traffic condition and based on vehicle delays – see annexure E). The average speed of the network during peak hours is also a low 55,86 km/h. This congestion highlights the need for road K8. A score of 5 is derived from table 5.9.

- **Leakage or inflow.** The latent traffic demand (up to 10 000 vehicles per peak hour) and new construction activity evident in the area strongly suggest that the construction of road K8 will support the inflow of economic activity to the area. There is no reason to expect that a leakage will be caused by road K8. A score of 5 is plotted on figure 5.14.
- **Reduction of transport costs.** The construction of road K8 will improve traffic flow conditions – hence lower transport costs are expected. Modelling results indicate that the travel time on the network will be reduced from 370 310 minutes in the morning peak hour to 358 111 minutes, if road K8 is built, or a saving of 406 minutes per million rand invested in the road. A score of 4 is awarded (see fig 5.15).

Table 5.16 provides information on the performance of **the road and other infrastructure market**.

Table 5.16: The road and other infrastructure market of road K8

LOW VALUE	1	2	3	4	5	HIGH VALUE
Almost no infrastructure						Well-developed infrastructure
Low traffic demand						High traffic demand
Potential of economic leakage by new road						Potential of economic inflow by new road
Insignificant reduction in transport costs due to new road						Sizeable reduction in transport costs due to new road

The road and other infrastructure market also scores a high 45 or 90% compliance.

From this the following scores were obtained:

$$D = 90\%$$

$$R = 75\%$$

$$U = 90\%$$

$$T = 90\%$$

$$\text{Thus ER} = \frac{D + R + U + T}{4} * 100\%$$

4

$$\mathbf{ER = 86,25\%}$$

The findings of this study indicate that the construction of road K8 will have a high probability (86,25%) of maximising the economic returns associated with its construction. The construction of road K8 has a low investment risk profile and its construction is highly recommended.

5.4.2 The MCDC (Road PWV9)

The demarcation of the study area is fairly complex. However, for the purposes of this study it is assumed that the Rosslyn industrial area forms part of the **wider study area**, while in certain instances, reference will be only be made to the **direct study area**.

5.4.2.1 The urban economic market

- **Business attraction.** As stated previously this area has a limited natural attraction for business. Government action is required to stimulate this market. A score of 2 is derived from table 5.1.





- **Agglomeration economies.** The direct study area is characterised by the absence of sizeable production facilities. These facilities are only evident in the wider study area of Rosslyn. Only the Rosslyn area has agglomeration economies for the motor industry in particular (sizes exceed 20 000 m² in general). No other agglomeration economies were observed. A score of 3 is awarded in terms of figure 5.3.
- **Market maturity.** Site investigations revealed that the urban economic market of the area is extremely immature. The primary study area is characterised by almost no development. Almost 70% of the study area is vacant or has agricultural activities. It thus scores a 3 in terms of table 5.2 and figure 5.4.
- **Market exposure.** The format of table 5.3 will be used to score the market exposure for road PWV9. The area is extremely remote and can be seen as having an unfavourable market exposure and poor location. This can be ascribed to the absence of economic activity in the direct study area. The only positive aspect of the market exposure is the proximity of the Rosslyn industrial area which is located in the wider study area. The direct study area is currently almost inaccessible because of the absence of a road network – hence a score of 1 is allocated (see table 5.17).

Table 5.17: Scoring of market exposure for road PWV9

Characteristics	Presence of subcharacteristic (Yes or No)
Comparative advantage of location	No
Good market accessibility	No
Close proximity to market	Yes
Attractiveness of location	No
Positive market exposure	No

The urban economic market also has an average performance as indicated in table 5.18.

Table 5.18: The urban economic market of road PWV9

LOW VALUE	1	2	3	4	5	HIGH VALUE
No natural attraction for Business						High natural attraction for business
Absence of agglomeration economies and DPAs						Strong presence of agglomeration economies and DPAs
Market very immature or fully mature						Market developing strongly
Unfavourable market exposure and location (remoteness)						Favourable market exposure and location (within urban activity)

The urban economic market scores 2,25 or 45% compliance.

5.4.2.2 *The land development market*

- **Development stimulus.** The format of table 5.5 will be used to score the development stimulus of this road. As stated previously in this study, the MCDC forms part of the government’s SDIs. This basically means that government introduced external action to create development in this area.

Hence the area has almost no natural stimulus for development. The only positive aspect of this area relates to the limited occurrence of land-use imperfections which can largely be ascribed to the nonoccurrence of development. Caution should be exercised when considering land development proposals in this area. A score of 1 is awarded (see table 5.19).

Table 5.19: Scoring of development stimulus of road PWV9

Subcharacteristics	Presence of subcharacteristic (Yes or No)
Fast-growing area	No
Limited land-use imperfections	Yes
No external action required	No
No planning policy interventions to stimulate development	No
Conditions of good market competition	No

- Development applications.** An investigation revealed that a limited number of development applications was received – only 21 in total, in the recent past (2002) for this area. From this one can infer that only 0,06 applications were submitted per million rand invested in road PWV9 (the figure for road K8 is 3,4 applications). A score of 2 is derived in terms of figure 5.5.
- Development activity.** The land development market of the direct study area can almost be described as stagnant. Only 16 applications for a change in land-use were received (or a figure of 0,05 applications per million rand invested in the road). This figure is much lower than that of road K8. A score of 2 is derived in terms of figure 5.6.
- Illegal land-uses.** According to Council records, only 21 formal cases of illegal land-uses were reported in the area during 2003 (a figure of only 0,06

per million rand invested versus the figure of 4 for road K8). The limited number of illegal land-uses supports a score of 2 in terms of figure 5.7.

The performance of the characteristics of the land development market is provided in table 5.20.

Table 5.20: The land development market for Road PWV9





LOW VALUE	1	2	3	4	5	HIGH VALUE
External action required to create development						Natural development stimulus
Almost no development applications						High number of development applications
Stagnant area						Changing land-use patterns highly evident
Almost no illegal land-uses						High number of illegal land-uses

Table 5.20 shows the poor conditions of the **land development market** – it scores a mark of 1,75 and compliance of 35%.

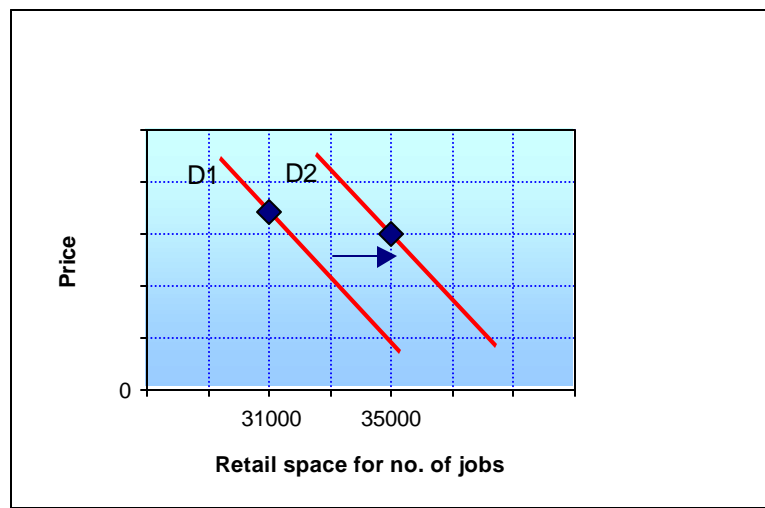
5.4.2.3 *The real estate market*

- **Real estate demand.** The study by Plan Associates (1999) predicts that the future demand (next 10 years) for real estate space in terms of formal job opportunities in the direct study area will be as follows:

– retail	837 jobs
– office	1 762 jobs
– industrial	642 jobs
– other services	753 jobs
Total	3 994 jobs

In total, the employment (or the demand for real estate space) is expected to grow by 12,7% during the next 10 years. This is reflected in figure 5.18. The demand for real estate space is thus expected to be low. This section receives a score of 2 in terms of figure 5.9.

Figure 5.18: Increase in real estate demand for PWV9 (2000 – 2010)







- **Building plans.** Council records indicate that a limited number of building plans were approved (only 12 357 m²) during 2001/2002, while a site investigation confirmed that no new structures were erected in the direct study area, with only a few new buildings being erected in Rosslyn (wider study area). This amounts to only 35 m² of building plans submitted per million rand invested in the road (compare this with the figure of 993 m² for road K8). A score of 2 is derived in terms of figure 5.10.
- **Rental rates.** Limited rental information could be obtained from the primary study area because of the limited property activity in the area. According to the Rode Report (2000:2), industrial market rentals in Rosslyn (the wider study

area) are lower than those of the Pretoria average (8,50 versus 11,50 R/m²/month). In terms of figure 5.11, a score of 2 is awarded.

- **Vacancy rates.** The vacancy rates for industrial buildings in the area are higher than those of the Pretoria average. According to the Rode Report (2000:2), vacancy rates in Rosslyn are 7,0% compared with the Pretoria average of 3,5%. Although relatively low, it scores a 2 because of the fact that it is lower than the Pretoria average (see fig 5.13).

The performance of the characteristics of the real estate market for road PWV9 is depicted in table 5.21.

Table 5.21: The Real Estate Market of Road PWV9

LOW VALUE	1	2	3	4	5	HIGH VALUE
No real estate demand						High demand for real estate space
No building plans approved						Substantial number of building plans approved
Rental income low (rate/m ²)						Rental income high (rate/m ²)
Many vacant buildings						Almost no vacant buildings

The real estate market scores an average value of 2 or 40% compliance.





5.4.2.4 *The road and other infrastructure market*

- **Infrastructure provision.** The direct study area is primarily agricultural land with almost no supporting infrastructure. The indirect study area has supporting road and other infrastructure. A score of 2 is awarded in terms of table 5.8.

- **Traffic demand.** There is a high traffic demand with a LOS E or F being experienced at intersections during peak periods because of poor regional accessibility. The study area has no north-south linkage. Road PWV9 will provide this linkage. The construction of this road will increase the average speed during peak hours from 54,34 km/h to 61,11 km/h. According to table 5.9, a score of 5 is thus awarded.
- **Leakage or inflow.** Given the relative poor location and exposure of the area, there is some concern that the construction of the PWV9 will result in economic leakage and an outflow of business from the area. The latent traffic demand is calculated at about 1 000 vehicle trips during the peak hours. A score of 2 is awarded in terms of figure 5.14.
- **Transport costs.** The construction of road PWV9 is not expected to have a major impact on reducing transport costs because the modelled travel times show an increase from 357 385 to 424 947 minutes after construction of the road (compare this with the reduction in travel time for roads K8 and K16). According to figure 5.15, a score of 1 is awarded because of the increase in travel time.

The performance of **the road and other infrastructure market** is shown in table 5.22.

Table 5.22: The road and other infrastructure market of road PWV9

LOW VALUE	1	2	3	4	5	HIGH VALUE
Almost no infrastructure						Well-developed infrastructure
Low traffic demand						High traffic demand
Potential of economic leakage by new road						Potential of economic inflow in new road
Insignificant reduction in transport costs due to new road						Sizeable reduction in transport costs due to new road

The road and other infrastructure market scores a satisfactory average value of 2,5 or compliance of 50%.

From this the following scores were obtained:

$$D = 35\%$$

$$R = 40\%$$

$$U = 45\%$$

$$T = 50\%$$

$$ER = \frac{D + R + U + T}{4} * 100\%$$

4

$$ER = 42,5\%$$

From this it is evident that the construction of road PWV9 will result in poor economic returns with a high investment risk. The good value achieved in respect of the road market indicates that there is a need for the road, based on regional accessibility and mobility requirements. However, this road will not result in high economic returns (only 42,5% probability).

5.4.3 Road K16

5.4.3.1 *The urban economic market*





- **Attraction for business.** As stated previously, the area has limited attraction for business, with only small-scale commercial activities taking place. This was confirmed by an economic study conducted by Urban-Econ (2001). A score of 2 is awarded in terms of table 5.1.
- **Agglomeration economies.** Commercial activities include manufacturing activities at Koedoespoort, and offices larger than 2 000 m². Two important shopping centres are located in the area, namely the Jacaranda Centre and the Gezina Galleries Centre (larger than 20 000 m²). These are considered to be the agglomeration economies in the area since approximately 78% of all economic activity (UE 2001:34) in the area is in the retail and wholesale trade. A score of 3 is awarded in terms of figure 5.3.
- **Maturity of market.** The area is located in a fully developed market (approximately 90% of area in terms of aerial photographs) which requires change in order to revitalise development. From this it is evident that a score of 1 will be awarded in terms of table 5.2 and figure 5.4.
- **Market exposure.** The format of table 5.3 will be used to score the market exposure of road K16. The study area has a reasonable market exposure and location. The only negative aspect of this study area is that it is located in the lower end of the market. However, it is in close proximity of the Pretoria central business district. K16 is planned on the alignment of Stormvoël Road which carries high traffic volumes. It scores a 4 (see table 5.23).

Table 5.23: Scoring of market exposure for road K16

Characteristics	Presence of subcharacteristic (Yes or No)
Comparative advantage of location	Yes
Good market accessibility	Yes
Close proximity to market	Yes
Attractiveness of location	No
Positive market exposure	Yes

The scoring of the characteristics of the urban economic market of road K16 is reflected in table 5.24.

Table 5.24: The urban economic market of road K16

LOW VALUE	1	2	3	4	5	HIGH VALUE
No natural attraction for business						High natural attraction for business
Absence of agglomeration economies and DPAs						Strong presence of agglomeration economies and DPAs
Market very immature or fully mature						Market developing strongly
Unfavourable market exposure and location (remoteness)						Favourable market exposure and location (within urban activity)

The urban economic market scores an average value of 2,5 or a compliance of 50%.

5.4.3.2 *The land development market*

- **Development stimulus.** The format of table 5.5 will be used to score the development stimulus of road K16. The area is well established and there are already signs of economic activity. The external action by the local government is required to rejuvenate the area. The positives of the area relate to the good balance of land-uses, and the presence of market competition. It thus scores a 2 in terms of table 5.25.

Table 5.25: Scoring of development stimulus of road K16

Subcharacteristics	Presence of subcharacteristic (Yes or No)
Fast-growing area	No
Limited land-use imperfections	Yes
No external action required	No
No planning policy interventions to stimulate development	No
Conditions of good market competition	Yes





- **Development applications.** A high number of development applications have been submitted to Council – a total of 214 during 2002. This amounts to 3,34 applications per million rand invested in the road (compared with 3,4 applications for road K8). The area is fully developed, and as such a limited number of township establishment applications have been submitted to Council. However, the high number of development applications warrants the score of 5 as per figure 5.5.
- **Development activity.** The area is experiencing a change in land-use patterns, mainly from residential to small-scale home industries and offices. During 2002, a total of 82 applications for a change in land-use were

submitted to Council (or 1,28 applications compared with 1,43 for road K8 for every million rand invested in the road). A score of 3 is awarded in terms of figure 5.6.

- **Illegal land-uses.** A fair number of illegal land-uses are evident in the study area – 84 reported cases during 2003 (or 1,31 illegal uses per million rand invested). This is mostly limited to industries and office activities in residences. According to figure 5.7, a score of 2 is awarded.

Table 5.26 reflects the scores obtained by the characteristics describing the land development market of road K16.

Table 5.26: The land development market of road K16

LOW VALUE	1	2	3	4	5	HIGH VALUE
External action required to create development						Natural development stimulus
Almost no development applications						High number of development applications
Stagnant area						Changing land-use patterns highly evident
Almost no illegal land-uses						High number of illegal land-uses

The land development market obtained an average value of 3 and a compliance of 60%.

5.4.3.3 *The real estate market*

- **Real estate demand.** Plan Associates (1999) predict that the formal job opportunities in the area in the next 10 years will grow as follows:

- retail	2 470 jobs
- office	590 jobs
- industrial	318 jobs
- other services	1 833 jobs
Total	5 211 jobs

In total, the employment growth is expected to be about 22,7% (from 22 555 to 28 167 jobs). See figure 5.19 for the expected growth in real estate demand.

Figure 5.19: Increase in real estate demand for road K16 (2000 – 1010)



The predicted demand for real estate space is thus higher than that of road PWV9 but lower than that of road K8. A score of 3 is awarded in terms of figure 5.9.





- **Building plans.** Records at the municipal offices indicate that only a small number of new building plans were approved namely 16 516 m² during 2001/2002. This equates to 258 m² of building plans per million rand invested in the road (compare this with 911 m² for road K8). This is substantiated by

the limited occurrence of new buildings in the study area. In terms of figure 5.10, it scores a 3.

- **Rental rates.** According to a study by Urban-Econ (2001:16-40), the retail rental income of this area is at the lower end of the scale, and generally lower than the Pretoria average (a score of 2 is derived from fig 5.12). It is also much lower than the figure for the eastern suburbs of Pretoria, such as Hatfield. Industrial rental rates are R18/m² in Derdepoort and R19/m² in the Hermanstad areas, and also lower than the rates for industrial areas in Centurion, but still higher than the Pretoria average (it scores a 4 in terms of fig 5.11). The weighted average for rental rates is a score of 3.
- **Vacancy rate.** A site investigation revealed that there were a number of vacant buildings in the study area. According to the Rode Report (2000), vacancy rates for this area vary between 16,5% (closer to CBD) and 6,4% (more decentralised). Since this area is fairly old, a number of vacant buildings were also in a dilapidated condition. In terms of figure 5.13, a weighted average score of 2 is awarded.

The compliance of the different characteristics of **the real estate market** of road K16 is reflected in table 5.27.

Table 5.27: The real estate market of road K16

LOW VALUE	1	2	3	4	5	HIGH VALUE
No real estate demand						High demand real estate space
No building plans approved						Substantial number of building plans approved
Rental income low (rate/m ²)						Rental income high (rate/m ²)
Many vacant buildings						Almost no vacant buildings

The real estate market in the study area of road K16 had an average value of 2,75 or 55% compliance.

5.4.3.4 *The road and other infrastructure market*





- Infrastructure provision.** The area is well established with good infrastructure. The local authority confirmed the availability of excess capacity on the bulk serves infrastructure network. According to table 5.8, a score of 5 is awarded.
- Traffic demand.** Stormvoël Road is characterised by high traffic volumes during peak hours, and requires upgrading. The fact that certain sections of the road are only single lanes per direction causes severe traffic congestion during peak hours. Many intersections operate at LOS F during peak hours. The improvements to road K16 will increase the average speed from 36,1 km/h to 40,7 km/h. A score of 5 is recorded in terms of table 5.9.
- Leakage and inflow.** Since the improvements to road K16 are in an east-west direction, there is no fear that a leakage will be caused by its construction. The construction will in actual fact lead to improved

connections with other areas such as Mamelodi which have limited commercial activities. The calculated peak period traffic demand is in excess of 11 000 vehicle trips. According to figure 5.14, a score of 4 is awarded.

- **Transport costs.** Sizeable reductions in transport costs are expected because the construction of road K16 will reduce traffic congestion. Modelling results indicate that after construction, travel time in the study area will be reduced from 457 686 to 426 887 minutes in the morning peak hour. The saving per million rand invested is similar to that of road K8 at 481 minutes. According to figure 5.15, a score of 4 is awarded.

From table 5.28 it is evident that the characteristics of **the road and other infrastructure for road K8** indicated satisfactory compliance.

Table 5.28: The road and other infrastructure market of road K16

LOW VALUE	1	2	3	4	5	HIGH VALUE
Almost no infrastructure						Well-developed infrastructure
Low traffic demand						High traffic demand
Potential of economic leakage by new road						Potential of economic inflow by new road
Insignificant reduction in transport costs due to new road						Sizeable reduction in transport costs due to new road

From this table it is evident that **the road and other infrastructure market** is excellent. An average value of 45 is awarded, while the compliance is 90%.

From the above, the following scores were obtained:

$$D = 60\%$$

$$R = 55\%$$

$$U = 50\%$$

$$T = 90\%$$

$$ER = \frac{D + R + U + T}{4} * 100\%$$

$$\mathbf{ER = 63,75\%}$$

From the ER obtained it is clear that the construction of road K16 will realise average economic returns (63,75% probability), with a moderate economic risk.

From these case studies it is evident that the findings of the formula of road investment comply with the discussions in this thesis on the economic returns associated with roads K8 and K16, as well as road PWV9.

The outcome of the formula indicates low economic returns associated with PWV9 (42,5% probability) and high investment risk, compared with the high economic returns associated with road K8 (86,25% probability) and low investment risk. The formula for road investment developed is thus sound and reduces road investment risk.

5.5 PRACTICAL APPLICATION

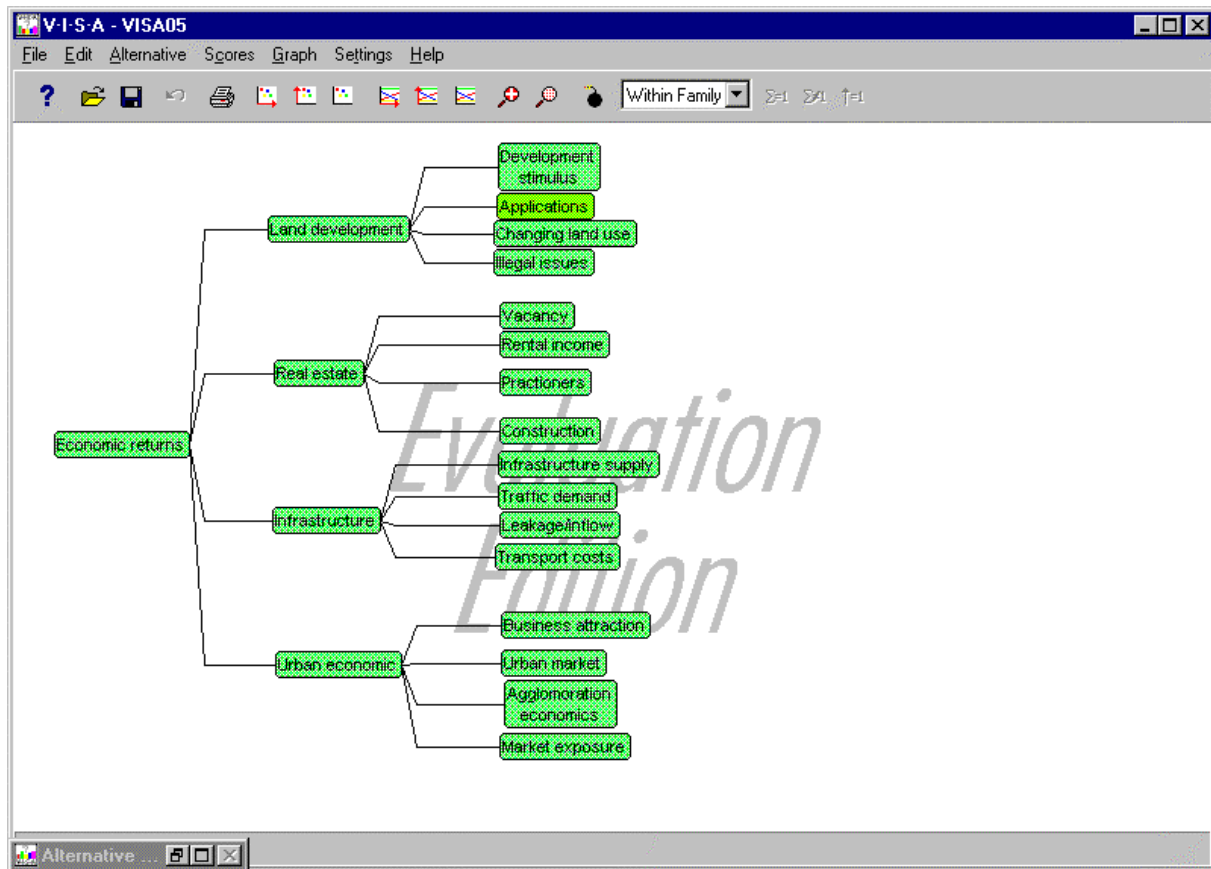
The different road projects can also be depicted graphically to assist with the comparisons and ranking process. Various software applications are readily available on the market. It is, however, important to note that these models must be adapted for specific road investment needs as they are generic in application. For the purposes of this thesis, it was decided to use the VISA model. VISA (Visual Interactive Sensitivity Analysis) is a decision support tool that helps to compare alternative strategic options against multiple criteria. It is also relatively inexpensive (\$199,00 – 2003 values).

VISA reflects the principal design objective to facilitate modelling and analysis in a way that is both visual and interactive, leading to improved understanding, better communication, and consequently better considered decisions.

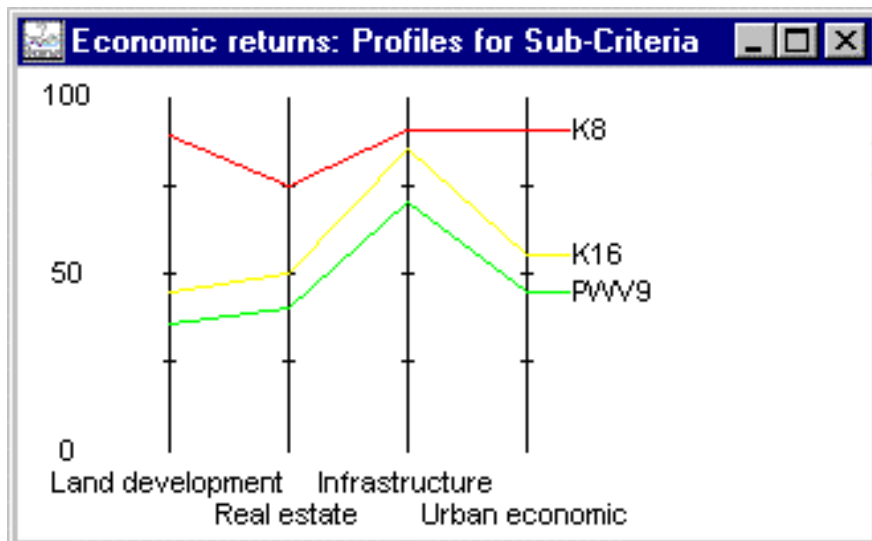
The criteria and subcriteria as formulated is then applied in the model, based on a decision-tree. This model graphically illustrates the relationships between the four main criteria and their respective subcriteria. This is depicted in screen 1.

The next graph illustrates the average scores for the four criteria for each road project, based on the respective tables that are used in the formula. From this it is obvious that road K8 has the highest scores and should thus receive the highest priority ranking.

Screen 1: Event tree for economic returns

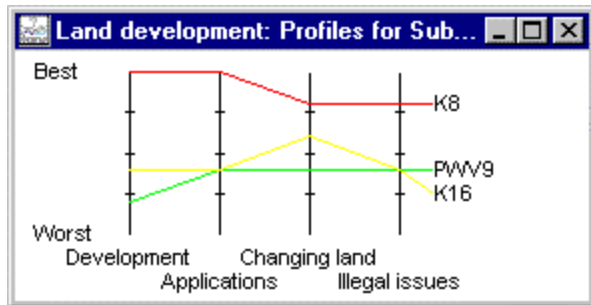


Screen 2: Economic returns: profiles for subcriteria

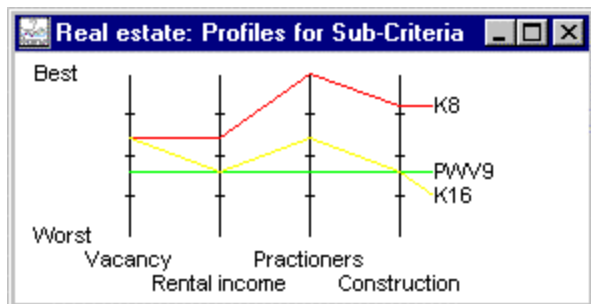


The scores for the subcriteria are depicted in the next four graphs (screens 3 – 6). This provides an excellent comparison of how each road project compares with the other roads in respect of the individual subcriteria and their market characteristics.

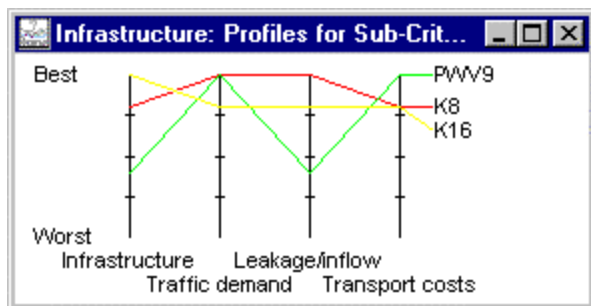
Screen 3: Land development: profiles for subcriteria



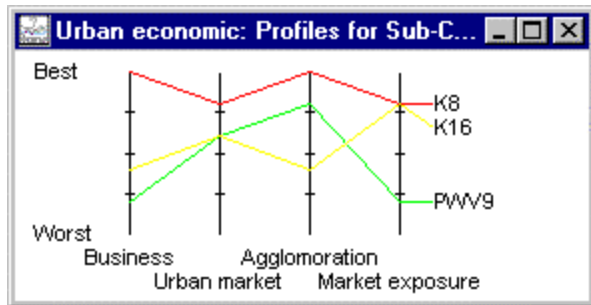
Screen 4: Real estate: profiles for subcriteria



Screen 5: Infrastructure: profiles for subcriteria

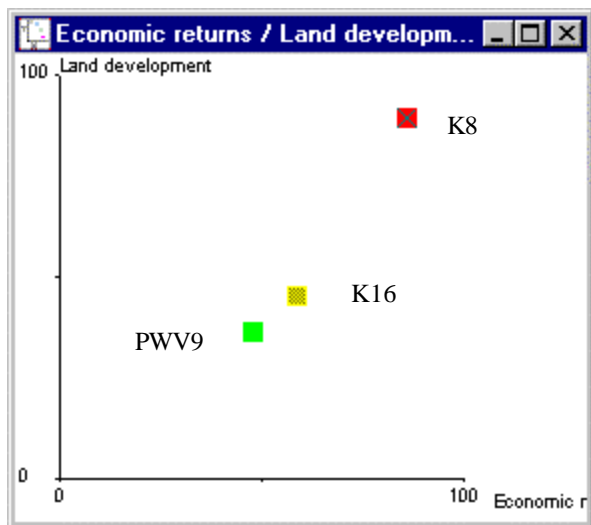


Screen 6: Urban economic: profiles for subcriteria



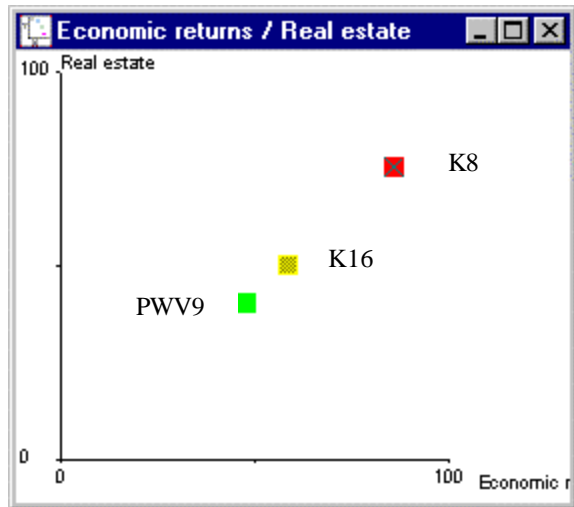
The next four graphs (screens 7 – 10) illustrate the relationship between economic returns and the individual subcriteria. Screen 7, for instance, clearly demonstrates that road K8 has the highest score when the relationship between economic returns and land development is analysed.

Screen 7: Economic returns and land development

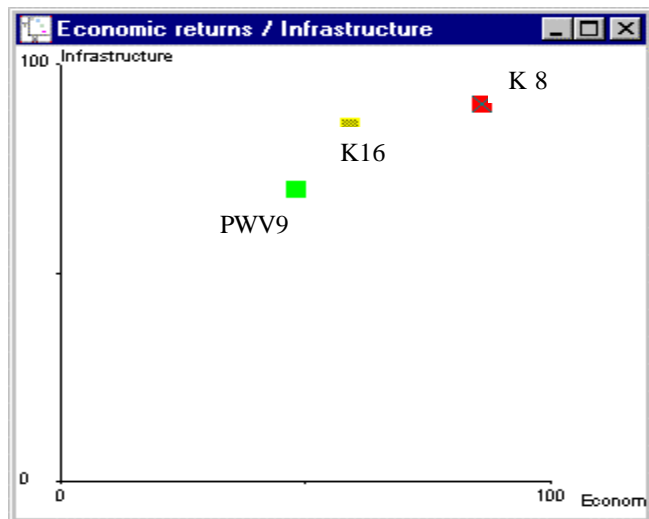


Road K8's high score is also evident in the other relationships.

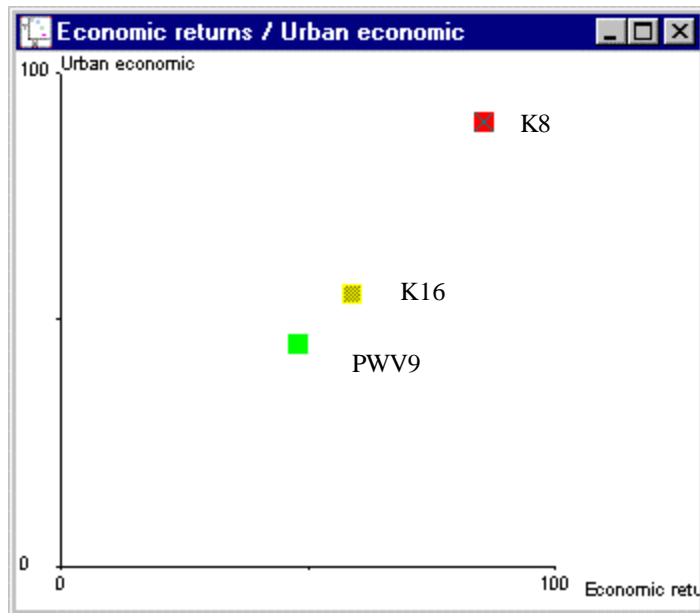
Screen 8: Economic returns and real estate



Screen 9: Economic returns and infrastructure



Screen 10: Economic returns and urban economics



The VISA model is thus an extremely handy tool for graphic demonstrations of the relationship between economic returns and the different markets for road projects. This practical application also proves that the formula of road investment and economic development is meaningful in practice.

5.6 SUMMARY

The main findings of this chapter can be summarised as follows:

- (1) In the interpretation of the economic effects of road investment, the following four conclusions were drawn:
 - **Conclusion 1.** The provision of road infrastructure should be based on actual demand – hence there must be an actual market for such infrastructure. This will ensure a higher probability of meaningful economic activity and stimulation.

- **Conclusion 2.** The land development market plays a crucial role in the relationship between road investment and economic development, because the land development pressure of an area determines the need for road infrastructure.
- **Conclusion 3.** The real estate market plays a key role in the relationship between road investment and economic development.
- **Conclusion 4.** This is based on the significance of the urban economic market. Factors such as natural attraction, the occurrence of agglomeration economies and the strength of the market describe this market.

From this discussion it is evident that the following four markets have a key part in determining the relationship between road investment and economic development:

- the infrastructure market
- the land development market
- the real estate market
- the urban economic market

(2) **The urban economic market** has the following characteristics:

- business attraction (scoring derived from table 5.1)
- agglomeration economies (scoring derived from fig 5.3)
- maturity of market (scoring derived from table 5.2 & fig 5.4)

- market exposure (scoring based on table 5.3)
- (3) **The land development market** has four characteristics:
- development stimulus (scoring based on table 5.5)
 - development applications (scoring derived from fig 5.5)
 - development activity (scoring derived from fig 5.6)
 - illegal land-uses (scoring derived from fig 5.7)
- (4) **The real estate market** is characterised by four elements. The scoring method used for each characteristic is provided by either a table or a figure. The characteristics are
- real estate demand (scoring derived from fig 5.9)
 - building plans (scoring derived from fig 5.10).
 - rental rates (scoring derived from figs 5.11 & 5.12)
 - vacancy rates (scoring derived from fig 5.13)
- (5) **The road and other infrastructure market** also has four characteristics, namely:
- infrastructure provision (scoring derived from table 5.8)
 - traffic demand (scoring derived from table 5.9)
 - economic leakage or inflow (scoring derived from fig 5.14)
 - transport costs (scoring derived from fig 5.15)
- (6) The formula of road investment and economic development is based on the following formula:

$$ER = f(D; R; U; T)$$

where: ER = economic returns
 D = land development market
 R = real estate market
 U = urban economic market
 T = transport and other infrastructure market

with: $D = \frac{\text{total value}}{4} * 100\%$

$$R = \frac{\text{total value}}{4} * 100\%$$

$$U = \frac{\text{total value}}{4} * 100\%$$

$$T = \frac{\text{total value}}{4} * 100\%$$

Thus: $ER = \frac{D + R + U + T}{4}$

Interpretation of ER values:

ER < 50% = Poor economic returns expected, with a high investment risk.

Reconsider this project carefully and abandon if necessary.

$50\% < ER < 70\%$ = Average to good economic returns expected with moderate investment risk. Assess poor characteristics prior to investing in this project.

$ER > 70\%$ = Maximum economic returns are expected, with a low investment risk. This project seems highly feasible.

- (7) The practical application of the theory proved that the formula is indeed sound and highly practical. The results obtained confirmed that road K8 provides the highest probability of maximised economic returns, while road PWV9 poses the highest investment risk.
- (8) There are various electronic tools available, such as VISA, which provide assistance with the graphic representation of the formula developed.

5.8 CONCLUSION

It was shown that the demand for development as well as the potential for maximum economic returns could be evaluated by means of the formula of road investment and economic development developed in this chapter. This formula, $ER = f(D;R;U;T)$, is an excellent tool for evaluating road infrastructure investment decisions at an early stage of the process. The importance of this formula is highlighted by the fact that an early and cost-effective indication is obtained of whether the proposed road will have a high probability of maximising economic returns associated with its construction.

The evaluation of the case studies has shown that this formula is indeed accurate and practical because it is easy to use for data collection and interpretation, by all levels of transport planners and economists.