CHAPTER 3: THE RELATIONSHIP BETWEEN ROAD INFRASTRUCTURE INVESTMENT AND ECONOMIC DEVELOPMENT

3.1 INTRODUCTION

Developing adequate infrastructure, including a transport network, was the foundation of economic development. Dullah Omar, South African Minister of Transport (25 October 1999, Sapa: Pretoria).

One can infer from the preceding chapters, that road infrastructure contributes to economic development. It was also shown that infrastructure investment does not always lead to economic development. From this it is evident that much still needs to be understood about roads and their role in economic development. The purpose of this chapter is thus to answer the following key questions on the relationship between road infrastructure investment and economic development:

- Under what conditions does road infrastructure act as an effective catalyst for economic development?
- What is meant by economic development?
- How is economic development measured?

This chapter will also outline the role of transport as an essential input into all spheres of the socioeconomic life of the country. In this regard the contention by Niewenhuizen (DOT 1984:20) that transport services should be seen as more than a derived phenomenon is supported. They argue that it is "… in many cases an important catalyst opening up new opportunities for production, consumption and external relationships of a country". Eberts (1999:1) supports this opinion, in stating that the interface between road investment and economic development has broad implications that go beyond transport's basic purpose of moving goods and people from one place to another. Transport fulfils a broader role in shaping development and the environment. In South Africa, the strong dualistic nature of the economy, with a strong divide between rich and poor, also reflects on the transport sector. Better transport provision is an important prerequisite for the economic development of these people. This economic duality emphasises the need to ensure social equity in the provision of transport infrastructure. This requires not only the achievement of pure economic goals, but also goals related to economic empowerment and social upliftment.

3.2 THE MEANING OF ECONOMIC DEVELOPMENT

The meaning of the word "economic development" has elicited much debate amongst economists in recent years. It can mean many things – some economists attach a wider meaning to it, while others define it more narrowly. Meier (1995:7) reiterates this by stating that it requires careful interpretation, and the best definition is one that defines economic development as the process whereby the real per capita income of a country increases over a long period of time – subject to the stipulations that the number of people below the so-called "absolute poverty line" does not increase, and that the distribution of income does not become more unequal.

The problem of this definition is further exacerbated by the fact that the terms "economic growth" and "economic development" are sometimes used interchangeably. Gilles et al (1996:7-8) caution that there are fundamental differences between them, as explained below.

- Economic growth refers to a rise in national or per capita income and product such as increases in gross national product (GNP). This implies that if the production of goods and services rises one can speak of economic growth. The focus is thus on output.

- Economic development implies more than economic growth. Economic development also brings about fundamental changes to the structure of the economy such as increases in the transport and the agricultural sectors, while another sector may experience a decline. The focus is thus on output and changes to the economy with the main emphasis on improving people's quality of life.

Meier (1995:7) essentially agrees with this definition and maintains that economic development involves something more than economic growth. It means growth and change. This provides a framework for the objectives of economic development (Siebrits 1998:7), namely:

- economic growth
- employment creation
- poverty alleviation (including measures for redistributing income and wealth)
- satisfaction of basic needs

From these views it is evident that economic development cannot occur without growth. It is therefore necessary to go beyond the definition of economic growth in order to assess its relation to road infrastructure investment. The above definitions imply that it would be rather difficult to relate the impact of an individual transport project to a rise in the national product or to a fundamental change to the structure of the economy, or even to its impact on people below the absolute poverty line. Thus economic development can be defined as bringing more business sales, employment, personal income and population growth to an area.

3.2.1 Economic growth and road infrastructure

The Development Bank of South Africa (DBSA) (1998:8) describes the critical relationship between infrastructure and growth as follows: "Infrastructure lowers the cost of production and consumption, and makes it easier for participants in the economy to enter into transactions. Increasing the efficiency of infrastructure will improve growth performance, service provision and development outcomes."

However, the notion of economic growth cannot be defined as readily in relation to road infrastructure. The concept of economic growth is thus by no means clear. In a rigorous sense, economic growth occurs when the average income per capita rises, as stated above. The problem with this is that even though the GDP may be growing, this may be accompanied by a corresponding increase in the population, with the result that real incomes for most of the population will not rise (DOT 1996:1-2). If the population increase exceeds the growth in the aggregate output of the society, as expressed in GDP, average real incomes will decline. This has been happening in South Africa in the past few years. It is quite clear that in such circumstances the real growth in GDP cannot be regarded as economic growth according to the actual terminology. However, in a general sense, any improvement in road infrastructure can be regarded as contributing to economic growth. This infrastructure will only influence economic growth to the extent that the associated expenditure is reflected in the national accounts.

Studies in Europe have shown that until recently the GDP had been an effective predictor of both passenger and freight growth (Vickerman 2001:2). Passenger traffic grew a little faster than GDP, and freight typically at around the same rate as the GDP until the late 1980s, when it started to develop more rapidly. According to Vickerman (2001:2), the more rapid traffic growth occurring concurrently with the government cutting back on public investment, created fears that the lack of infrastructure investment would stifle economic growth. In certain instances the provision of transport infrastructure has not led to the anticipated economic growth, despite the fact that traffic growth exceeded the forecast levels. In particular cases, the provision of road infrastructure designed to help the economy of a certain area, resulted in the opposite effect of helping to drain the economy of that area. This can only be ascribed to the occurrence of transport externalities.

Where transport infrastructure constitutes public goods, strictly speaking, the benefits and disbenefits are externalities that will affect welfare and not growth. Roads are typical of such an infrastructure. In this instance, Jordaan and Floor (DOT 1996:1-3) state that in the case of roads, their benefits

> … in the form of savings in vehicle operating costs, productive time and accident costs, will influence the national output and be taken up in the national accounts, but their benefits consisting of savings in leisure time, improvements in accessibility, reductions in the risk of accidents and their effect on the environment will influence welfare but not economic output. On the premise that the purpose of economic growth is to improve welfare, the evaluation of these externalities warrants their inclusion in any analysis of the relationship between transport infrastructure and economic growth, in the broad sense.

Banister and Berechman (2000:18-19) join the debate by raising two main criticisms against the relationship between productivity and infrastructure investment. The first question, similar to the above discussion, relates to whether the simple relationship between output increase (GDP) and input (rate of investment in infrastructure) is not influenced by other factors not included in the analysis. The second is the nature of causality – whether growth leads to additional infrastructure, or whether investment leads to growth, or whether there is an interactive effect. Worldwide research has concluded that public capital has an impact on economic growth, on private capital and on labour productivity, but the magnitude and significance of these are not clear (Banister & Berechman 2000:20).

From the above it is evident that the use of economic growth as a measure of the impact of road infrastructure investment creates many uncertainties. A careful analysis of the effects of road infrastructure investment is thus required. Although economic growth should not be ignored, real economic impacts should rather be measured. Section 3.4 will address the issue of measurement, while the types of economic impacts will be discussed in section 3.2.3.

3.2.2 Development and road infrastructure

The DBSA (1998:8) defines development as improving people's quality of life through sustainable economic growth and equitable distribution of the benefits of that growth. The key to such sustainability is economic diversification and the mitigation of risks to the natural environment. The development argument is that good infrastructure raises productivity and lowers production costs, but has to expand fast enough to accommodate growth and open up new areas for development (Banister & Berechman 2000:21). Road infrastructure can provide an economic injection into an area if it opens up the area to better trade flows. However, it may also have a leakage effect if the area is in close proximity to other markets that offer greater economic opportunity.

Macroeconomic studies by the World Bank (1996) show that investing in transport promotes growth by increasing the social return to private investment without crowding out other productive investment. Microeconomic analysis confirms the high social value of transport. The estimated economic rate of return on transport (mainly roads) projects is 22% (in South Africa, road projects must have an internal rate of return of between 16 and 30% to qualify for implementation), half as high as the bank average (DOT 1996:1). Although this figure is based on the averages of international transport projects of the World Bank, it does give an indication of the economic importance of transport projects. Improvements in urban roads have increased labour market efficiency and access to amenities, making changes in scale and form of urban agglomeration possible. One can infer from this discussion that road infrastructure can stimulate development if invested correctly.

3.2.3 Economic impacts

Economic impacts can be distinguished according to their type and measurement. It is also important to note that both the terms "economic impacts" and "economic effects" are regarded as synonyms.

The following three types of economic impacts (or effects) are typically found:

(1) Direct impacts
(2) Indirect impacts
(3) Induced impacts

The DETR (1999:10) in the UK, describes **direct impacts** as the immediate economic impacts of capital and operational expenditure required to build, operate and maintain any scheme. The direct economic effects are thus the changes in local business activity occurring as a direct consequence of a public project (Weisbrod & Weisbrod 1997:4). From a project perspective it takes into account the direct purchases made within the region by the project, the number of people employed, and the effect of the household incomes of those people (UE 2000:12). The size of a road infrastructure project will thus have a major influence on the extent of direct economic impacts. For instance, it is quite clear that a small road maintenance project will have little if any direct economic impacts, while a multimillion rand highway construction project should have a significant direct economic impact.

The **indirect economic effect** takes into account the fact that the supplying industries will also have to purchase more inputs, employ more labour and pay more wages (UE 2000:12). The supplying industries are those industries that supply building material and other resources to the construction companies and those firms involved in the road investment project. In this regard, the DETR (1999:10) considers indirect economic impacts as all the other economic impacts stemming from a scheme or project. One can infer that indirect impacts relate to the growth or decline in businesses as a result of changes in demand for the suppliers' products/services from the businesses directly involved in the road investment schemes. A chain reaction of multiplier effects is therefore expected. The indirect and induced effects are also referred to as multiplier effects, since they can make the overall economic impacts substantially larger than the direct impacts alone. The indirect effects are sometimes referred to as backward linkages. Industries with backward linkages make use of inputs from other industries (Gillis et al, 1996:63). Road construction projects create a demand for stone, cement, bitumen and other construction materials. These items may be imported from other regions, but if the demand is sufficient, local businesses will acquire such materials – hence stimulating local sales.

Induced effects take into account the fact that the increased household income leads to an increase in household expenditure and in regional production (UE 2000:12). This thus entails further shifts in spending on food, clothing, shelter and other consumer goods and services, as a consequence of the change in workers and payroll of the business that is directly and indirectly affected (Weisbrod &

Weisbrod 1997:5). These effects are also known as forward linkages. In essence, they have little or no relation to the actual road project.

These economic impacts of projects are usually measured in terms of changes that the road project has brought to the economy of the area. According to Weisbrod and Weisbrod (1997:1), economic impacts are changes on the level of economic activity in an area in terms of

- business output (or sales volume)
- value added (or gross regional product)
- wealth (including property values)
- personal income (including wages)
- job creation

These impacts are generally measurable and comply with the requirement for evaluating the relationship between road infrastructure investment and economic development as discussed in section 3.2.2. The DETR (1999:9) use the term "economic impacts" to include all the effects of a transport change outside the transport system itself. As stated earlier, money savings to transport users are not regarded as economic impacts, only the actions taken in response to such money savings. The author concurs with this approach. In South Africa, too much emphasis is placed on the savings of road users costs, thus totally ignoring the wider benefits of road investment. Although there is still a need for the calculation of road user costs and savings, this should be limited to the evaluation of mutually exclusive projects. This implies that these costs and savings should only be used to calculate the best alternative for a specific road project. This may be that the alignment of alternative B may be the best, and not alternative A, with the lowest cost to road users. This calculation does not indicate economic impacts.

Changes to the economy of an area as a result of the construction of a road project, are known as net economic impacts. The net economic impact is usually viewed as the expansion or contraction of an area's economy, resulting from changes in a project or facility. As stated previously, the economic impacts differ from the valuation of individual user benefits of a particular transport facility, and are also different from broader social impacts. Economic impacts also lead to fiscal impacts, which are changes in government revenues and expenditures.

3.3 CAUSALITY BETWEEN ROAD INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

The analysis of the impact of road infrastructure investment on economic development must consider the local economy, market and other conditions, as well as the factors that influence decision making. Banister and Berechman (2000:36-37) hold that the above argument must be based on three important premises.

(1) The investment must be effective. In other words, it must have tangible effects on the performance of transport networks. Investments whose composition, magnitude or locations do not considerably alter the performance of transport networks are considered to be ineffective, and as a consequence do not generate economic development. Alternatively, an investment that improves transport is regarded as effective, because it generates measurable effects.

(2) The causal linkage between road infrastructure investment and economic growth must manifest in changes in transport economic behaviour. This implies that economic development ensues only if economic agents such as households, firms and the market react to changes in the performance of the

transport system. The result is that to constitute economic development, changes in accessibility from road infrastructure improvements need to be accompanied by changes in economic behaviour and prices.

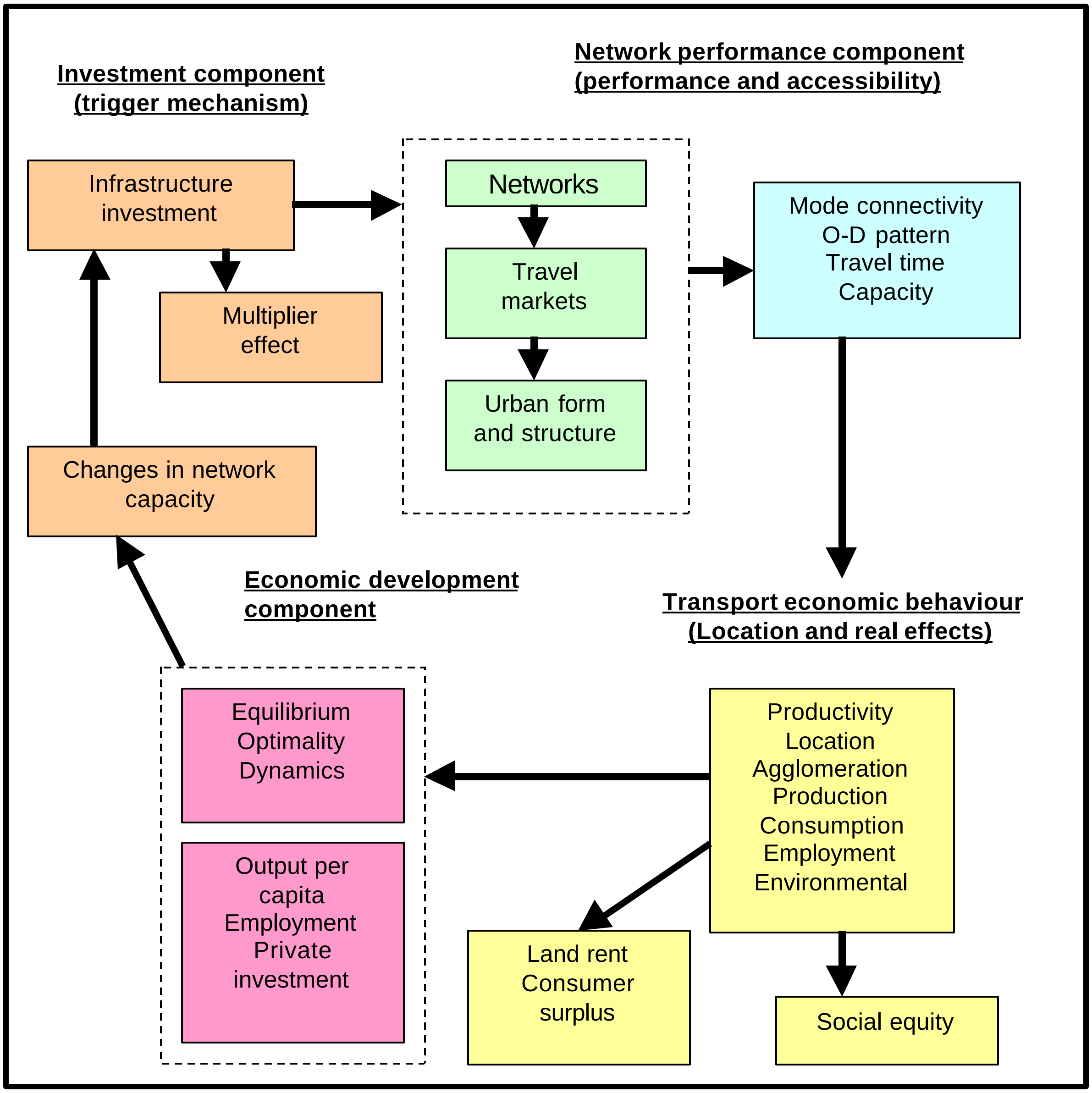
(3) Transport improvements that influence travel behaviour and transport markets must ultimately be transformed into measurable economic benefits. These factors may include improved factor productivity, larger output, increased demand for inputs, increased property values and greater demand for consumer goods.

Banister and Berechman (2000:37), however, caution economists that the degree to which infrastructure will affect economic development is obviously not independent of the level and performance of the infrastructure that is in place. These words of warning cannot be overemphasised. However, the motivation behind this warning is not entirely agreed with. It is stated, that in areas where the stock of transport infrastructure is highly developed, even sizeable infrastructure investment is unlikely to affect travel behaviour and markets significantly, and as a consequence, economic development. Banister and Berechman (2000:37) contend generally that declining marginal economic development can be expected from additional infrastructure investment. It is even stated that in the extreme, in areas with fully developed transport infrastructure, any additional transport infrastructure investment will not even improve accessibility, and no economic development effects will result, except for some multiplier effects.

These arguments seem to support the supply-side approach of the big push theory as discussed in chapter 2. Although not specifically stated, it is suggested that the provision of infrastructure in areas with limited infrastructure will effect significant changes in travel behaviour and markets, hence resulting in economic development. The main constraint of the insignificant economic development impacts of the MCDC can be ascribed to the lack of supporting infrastructure and market activities. The construction of road PWV9 will not lead to high economic activity, but may actually cause a decline in the limited current activity of the area as it improves access to other destinations. This is because of the leakage effect that will be caused by the construction of new road infrastructure – linking the area to "better" markets and opportunities. On the other hand, the construction of road K8 will complement the well-developed existing transport infrastructure. It will also result in changed travel behaviour and major economic activity. These changes in travel patterns will also bring about positive technological transport externalities – the diverted traffic from Zambesi Drive to road K8 creates spare capacity that is taken up by new traffic which is attracted to the area with its favourable market conditions. The net effect is thus significant economic development. The counterargument is thus ultimately based on the premise that insufficient road capacity constrains economic development opportunities in well-developed areas or areas with elastic market demand. These arguments are largely based on short-term implications (1 – 5 years), because most investment proposals will result in some economic spinoffs in the longer run.

Since this section is aimed at addressing the causality between road infrastructure investment and economic development it is essential to analyse the methodological framework of this relationship. Figures 1.1 to 1.3 in chapter 1 gave introductory views on the relationship between transport and economic development, as well as between other important social and environmental outcomes. These figures created broad analytical frameworks of the said relationships. It is, however, evident that these frameworks need further elaboration. One of the most comprehensive methodological frameworks depicting the basic causality paradigm of the relationships between transport infrastructure investment and economic development, is provided by Banister and Berechman (2000:41). See figure 3.1.

Figure 3.1: The basic causality paradigm of the relationships between transport infrastructure investment and economic development



Source: Adapted from Banister & Berechman (2000:41)

Four main themes arise from the above framework:

(1) **The investment component.** This is also termed the so-called "trigger mechanism", because the road investment project will trigger changes in the economy of the area.

(2) **The network performance component.** This component will measure the improvement to the road network as a result of the new road project.

(3) **Transport economic behaviour manifested in location and real effects.** Certain areas will receive locational advantages that may result in increased real estate values.

(4) **The economic development component.** This is the measurement of the actual economic impact as a result of the road scheme.

These four themes will form the basis of the rest of this chapter. Figure 3.1 will be used to do a qualitative assessment of the potential contribution of the three case studies to economic development.

3.4 THE INVESTMENT COMPONENT

3.4.1 Introduction

A major concept of transport supply analysis is the network structure of the transport system. Chapter 2 explained the characteristics of transport, and more specifically, road infrastructure. Transport investment decisions should be carefully considered because one of the key characteristics of roads is their high fixed cost.

It is a known fact that major changes have occurred in transport and the economy, in the last 30 years. Banister and Berechman (2000:57-58) categorise these changes into the following three groups:

(1) The first change relates to the nature of transport investment and how it has changed in recent years. In Western countries with their top-quality networks, much of the debate is on the replacement or maintenance of

infrastructure, rather than on the construction of new infrastructure. In developing countries, however, new transport investments are still required. (See the discussion on the different forms of investment in section 1.2.1.) In South Africa, the spatial development initiatives (SDIs) indicate the government's views on investment. Investment in new transport and road infrastructure is thus supported, provided that it promotes economic development. Chapter 1 (sec 1.4.1) provided introductory comments on SDIs. These initiatives are regarded as one of the key investment strategies of government to unlock the inherent economic potential in specific Southern African locations by enhancing their attractiveness for investment (DTI 2000:1).

(2) The second change goes much wider than the actual infrastructure and includes changes in the economy itself. In South Africa there are indications that technological changes have allowed the economy to move from a primary sector-dominated one to a secondary and tertiary one. These technological changes impact on the ability of firms and industry to locate, thus changing their locational considerations. The result is changes in travel demand and locational choices. These changes impact on transport patterns and on the requirements of a transport network.

(3) The third change has been the greater priority accorded to distributional and environmental issues. There is now a need to improve levels of equity and reduce the negative environmental impacts of transport. The distributional changes relate to the requirement that some road construction projects must be labour intensive in order to improve local employment and equity. This country has introduced significant environmental legislation, aimed at reducing the negative impacts of road construction activities in particular. See section 3.6.2 for a discussion on social equity and the environment.

From the above it is clear that in assessing the effects of an investment in transport infrastructure on economic growth, certain principal aspects of the transport network have to be considered. Banister and Berechman (2000:42) identify the following factors:

- the type of investment
- the relative size of the investment
- the efficient provision and consumption of the investment

3.4.2 The type of investment

The type of investment has two dimensions, that of its particular technology (ie roads or rail) and that of its purpose (Banister & Berechman 2000:42). Road K8 is a case in point. The construction of this particular transport link must be that of road infrastructure. The specific purpose of this road link is to open up the area for development, because of increased capacity. An investment in a rail link will not serve the same purpose as a road link in this particular instance, and will not have the same impact of improving the transport problem of the area. The area has severe traffic congestion and most of the demand is that of short distance vehicular trips (home-work trips and home-shopping trips). A railway line will mainly alleviate longer distance commuter trips or goods movement – which is not the core transport problem of the area. The type of investment for all three projects (roads K8, K16 and PWV9) is thus that of road infrastructure (see tables 3.5 – 3.7).

The public good characteristics, and associated market imperfections, place a responsibility on government to be the main provider of roads, with only limited contributions from the private sector. Detailed information is required to understand the types of investment taking place. This seems to be a problem because information about the level of investment in transport infrastructure is difficult to obtain. Similar problems are experienced in Australia (Allen Consulting 1993:23).

From a historical perspective, the investment in road infrastructure has seen many changes. The construction of rural road infrastructure seems to have declined, and has made way for toll roads in South Africa. Budgets constraints have forced government to form public-private partnerships to ensure private investment in national and provincial road infrastructure. Overall, the construction of new roads has seen a decline in recent years, following similar downward patterns in the USA and Australia (Allen Consulting 1993:23). Cox (1994:41) supports this view and contends that federal expenditures have in real terms been falling since 1988. Allen Consulting (1993:28) provides evidence of the decline in road investment. This is expressed as net road capital stock as a percentage of the GNP. See table 3.1.

Table 3.1: The net road capital stock in Australia and the USA

(Percent of gross national product)				
Year	**1960**	**1970**	**1980**	**1990**
United States	*17*	*18*	*16*	*13*
Australia	*n/a*	*17*	*15*	*11*

Source: Allen Consulting (1993:28)

This general decline in road investment is also true of South Africa. The DOT (1984:25) underlines this dilemma by stating "… that investment in transport facilities has not only become more prone to the ups and downs of the business cycle, but that it has also come under more and more pressure generally as a result of the erratic and slower growth pattern of the country, increasing pressure on its external resources and the many competing demands". This statement is still relevant, because it is stated in the Strategic Plan (DOT 2004:10) that roads in the urban and rural areas are generally inadequate, both for reasons of historic neglect, and of population shifts and rapid growth in certain areas. It is further stated that the backlog in the provision and maintenance of roads is growing. From an international perspective, these low expenditures on roads are exacerbated when expenditure on new road construction is analysed in table 3.2.

Table 3.2: Expenditure on new road construction (1988)

Country	**% *of* GDP**
UK	*0.48*
Germany	*0.70*
Italy	*0.71*
France	*0.83*
Spain	*1.19*
Switzerland	*0.88*
USA	*0.61*
Japan	*1.44*

Source: Banister & Berechman (2000:80)

Given the information in this table it is evident that the expenditure on new road construction is generally less than 1% of the GDP of developed countries. This is expected to be less for developing nations. This reflects a totally inequitable share, because it is a known fact that transport's contribution to GDP is significantly higher than 1%. In South Africa, the contribution of transport to GDP over the period 1970 to 1982 was relatively stable at 7,5 to 7,7% (DOT 1984:20). This contribution has seen a steady growth in recent years and was 10% of GDP during 2003 (DOT 2004:10).

It is also meaningful to assess the proportion of total road expenditure on the construction of new roads. This will give a fair estimate of the potential economic impacts of road infrastructure investment. The amounts (costs of project) play no role in this regard because this will only be meaningful in the analysis of individual projects. A breakdown of the total arterial road system expenditures into type of expenditure is given in the following table.

From table 3.3 it is evident that only 44% of total road expenditure was devoted to the investment (construction and improvements) of new road infrastructure.

Table 3.3: Australian arterial road expenditures by type of expenditure (1992-1993)

Expenditure Category	Amount ($ billion)	Percent of Total
Servicing & Operating Expenses	*0.14*	*3*
Maintenance- Pavement & Shoulder	*0.73*	*18*
Bridge Maintenance & Rehabilitation	*0.04*	*1*
Road Rehabilitation	*0.47*	*12*
Traffic & Safety Improvement Projects	*0.17*	*4*
Construction & Improvements	*1.73*	*44*
Miscellaneous Activities	*0.72*	*18*
TOTALS	***3.98***	***100***

Source: Cox (1994:43)

This figure is similar to that in South Africa, where about 47% of funding is required for road improvements and construction activities (DOT 1998:80). Most expenditure relates to maintenance and other road-related matters. This implies that less than half the road budget may be spent on projects with real economic potential, further necessitating the need for appropriate road infrastructure investment decisions. In South Africa, investment in new roads is also relatively small. During 1999 the annual transport budget by provincial and local government for transport was R14 921 million with only R3 010 million earmarked for infrastructure provision for all modes (private, rail, bus and taxi) (Colto 1999:10). This means that a much smaller component of this amount was available for road construction. Of the above amount, R11 911 million was earmarked for operations which included maintenance.

The above discussion dealt with the question of road infrastructure investment in other countries as well as South Africa. A different approach towards road infrastructure investment is required in order to address the various constraints being experienced. This will ensure that road infrastructure investment contributes to economic development.

3.4.3 The magnitude of investment

The magnitude of infrastructure investment reflects its relative size. Banister and Berechman (2000:42) contend that even a large investment (in monetary or physical terms) usually represents only a modest expansion of the network in place and, as a consequence, will have small mobility and economic effects. The argument is thus to assess the relative size rather than the absolute size, when considering infrastructure investment. The expectation with this approach is that the economic effect of a modest investment is likely to be quite small and localised. This is especially true of areas in which substantial road infrastructure already exists. However, the cumulative effects of such road infrastructure investment will be associated with regional or country level economic development. This analysis of the magnitude of infrastructure investment implies that local and regional effects of road infrastructure investment must be examined.
In terms of the magnitude, road PWV9 has the highest construction cost, namely R350 million (GPMC 1997), followed by road K16 with R64,25 million (UE 2001:57) and lastly, road K8 with a construction cost of R30 million (UE 2000). Thus all three projects are sufficiently large to have positive economic development potential (see tables 3.5 – 3.7). The next section will focus on the complexity of project impacts, and that will be followed by a discussion on the measurement of project impacts.

3.4.3.1 The complexity of project impacts

The above requirement that both local and regional economic impacts be measured, complicates project investment analysis. In this regard, Weisbrod

(1995:1) confirms that transport system improvements may involve a variety of positive and negative impacts on travellers and nontravellers. These classes of impacts include traffic movement, public safety, business, environmental and social/community impacts, as well as expenditure of funds. Depending on the road project, any combination of those potential impacts may be positive or negative, intentional or unintentional. These projects also have distributional geographic impacts, which will either be positive or negative. Some of these project impacts only become evident after they have been implemented. The challenge for road infrastructure investment projects is to find ways to consider the full range of potential project impacts with limited information and other resources. This can partly be achieved by defining the study area explicitly. According to Weisbrod and Weisbrod (1997:6), this can be done by considering the following four factors when defining the study area for an economic impact analysis:

(1) **The area of jurisdiction for the sponsoring agency.** This could be the agency responsible for project funding, project implementation and/or project evaluation. The area may be the suburb, city, province or even larger regions.

(2) **The area of direct project influence**. In road infrastructure this area includes the areas in which people (road users and nonusers) are influenced.

(3) **Interest in distributional impacts of subarea**. Some projects are justified by economic development outcomes for a specific subarea, which may be deemed a "socially desirable" goal, even if the net impact of the project is merely a redistribution of income and wealth. In other road projects, fear of so-called "dis-benefits" to a specific subarea is of social concern.

(4) **Interest in external area consequences**. What might be economically efficient for the direct project area may have either favourable or unfavourable consequences for the broader area.

3.4.3.2 Measuring economic development benefits

At this stage, it is necessary to explain how project-specific analysis methods can shed light on the overall macroeconomic effects of road infrastructure spending. The different functional elements of economic development benefits and business productivity need to be identified at micro level. In addition, both the aggregate-level analysis of capital investment benefits and local-level analysis of specific road project impacts have to be assessed. Vickerman (2001:11) supports this approach and emphasises the importance of the interaction between market size, scale economies and transport costs, plus agglomeration and urbanisation externalities of transport provision.

Weisbrod (1995:2-3) contends that the economic impacts of transport projects tend to fall into two general categories. They are localised abutter impacts associated with shifts in traffic flow patterns and routes, and regional business attraction impacts of transport improvements.

(a) Localised abutter commercial business impacts

These are mainly the unintentional business impacts of projects intended to improve road safety, capacity or improved traffic flow. They apply primarily to retail stores, filling stations and businesses that depend on good access and pass-by traffic. The shifts in traffic flow are considered to be technological externalities, while the business impacts are the so-called “pecuniary externalities”.

According to Weisbrod (1995:3), in order to assess the potential impacts of transport access changes on abutting businesses it is necessary to identify the types of existing retail and commercial service businesses that tend to be most dependent on pass-by traffic and customer convenience. It is then necessary to evaluate the extent to which they are potentially vulnerable to the impact associated with localised changes in vehicular accessibility to stores. It is not the purpose of this study to identify the specific land uses that rely on pass-by traffic or customer convenience. Property analysts have sufficient knowledge of this matter. In general, filling stations and convenience retail stores are expected to fall into this category, while offices are not. Koepke and Levinson (1992:35) caution prospective objectors that courts have supported the principle of "reasonable access" – implying that a property owner must have reasonable access to the street system, rather than being guaranteed that potential patrons should have convenient access from a specific roadway to the owner's property.

From this it is clear that the construction of a median island on an existing road will definitely impact adversely on the adjacent businesses. Similarly, the construction of new roads will divert traffic away from existing roads, hence impacting on those businesses. Road construction projects thus have potential risk of loss or potential gains to abutter businesses. Road planners should take cognisance of these expected outcomes in order to reduce these negative effects, while capitalising on the expected positive effects.

Weisbrod (1995:3) highlights the fact that it is important to go beyond impact "potentials" by forecasting the actual change in sales or jobs experienced by the market in the area of the road improvement. These road improvements can reduce the business cost of current operations, or provide new opportunities for production economies associated with expanded operations. This results in greater income and business activity. It is a known fact that road improvements reduce transport costs. Weisbrod and Treyz (1998:3) place these costs in three broad categories:

(1) reduced travel cost for serving existing trips

(2) reduced inventory/logistic costs

(3) greater operating scale and accessibility economies

These cost categories merit further explanation.

i. Travel cost effects

Transport projects traditionally focus on user cost savings to justify project investment and identify project priorities. Travel cost savings include savings in travel time and vehicle operating costs. These cost savings can easily be translated into rand and compared with the project cost. Road users experience these savings. One should guard against overemphasising these savings. Although quite significant on a cumulative scale, individual savings are sometimes insignificant and thus ignored. However, Weisbrod and Treyz (1998:3) state that it is important to note that some elements of reduced travel times for shipment trucks and "on-the-clock" business travel, lead directly to cost savings, and hence productivity benefits for businesses.

When considering these cost savings as part of economic studies, a clear understanding of the composition of the local economy and travel patterns is essential. Weisbrod and Treyz (1998:5) identified the following three factors that affect the applicability of traditionally measured user travel costs for total benefit valuation, and their relationship with productivity:

(1) **Difference in non-business effects.** Only a small portion of user travel costs, namely those associated with business-related travel, directly affect business productivity.

(2) **Difference in short-term user and long-term business effects**. The values of time and cost used in traditional travel demand models are derived from measures of direct effects on driver and passenger decisions, which are not

necessarily the same as the long-term implications for transportation system speed or reliability changes on business inventories, logistics, scale economies or manufacturing processes.

(3) **Differences in business responses.** Even if a road project has the exact same user cost savings impact on every type of business in the effected area, there would still be extremely different effects on business growth and income generation in the various industries. This is because there are differences between industries in their ability to relocate, their ability to expand into broader markets, the nature of market response to lower prices, and the attractiveness of reinvesting cost savings in local expansion versus distributing or reinvesting profits elsewhere.

The above three factors need to be considered in any analysis.

ii. Logistic cost effects

Only by considering total logistical costs, including inventory-holding costs, can we fully capture the importance of road transportation for industrial production. McCann (1993:503) describes logistical costs as the costs that include ordering, inventory and absolute transportation costs. These costs are borne both for the use of inputs and supply of final output.

Logistical costs affect location choices. Inventory-holding costs are a significant part of production costs, the value of inputs and outputs determine the location of the producer, and the wage and rent the producer is willing to pay at any given location (Weisbrod & Treyz 1998:6). Furthermore, logistic cost considerations are central to freight modal choice. Transport options such as truck, rail or ship offer a trade-off between cost per unit and frequency of trips.

iii. Accessibility and agglomeration economy effects

Agglomeration economies can be achieved if many different industries locate together. According to Gilles et al (1996:48), it makes sense for many different kinds of industries to locate together so that common support facilities such as electric power stations, transport and wholesalers can also operate at an efficient level. The role of transport in achieving efficiency is thus not disputed. Road projects have important spatial location characteristics. They serve to expand the market reach of businesses, allowing them to realise economies of scale in serving broader markets more economically. In addition, road improvements can also afford businesses access to greater variety of specialised labour or specialised input products, helping them to become more productive (Weisbrod & Treyz 1998:7). However, the converse is also true. If road infrastructure improvements are not effected, the economy may decline. Studies in the USA have shown that a reduction in the average speed on roads actually reduces the market size of shopping centres. See table 3.4.

This illustrates the negative impact of poor accessibility on the economy. Weisbrod and Treyz (1998:7) contend that the importance of accessibility can be demonstrated by examining how industrial and urban agglomerations function. These concentrations of economic activity, while highly productive, often involve significant congestion and other costs.

Improvements to the transport system, that is, road infrastructure construction, may increase producers' access to products and labour. In this way the productivity benefits would mitigate the negative effects of urbanisation.

Table 3.4: Reduction in market area as a function of reduced travel speed

Reduction in Average System Speed	Market Area Relative to Previous Size
0%	100%
10%	81%
20%	64%
33%	45%
40%	36%
50%	25%

Note: Smaller activity centres attract trips from shorter distances. For example, about 70% of the traffic to a regional shopping centre comes from within 20 minutes of travel, whereas for a community shopping centre about 70% of the traffic comes from within 12 minutes and for a neighbourhood centre from within 7 minutes. Thus while their primary trade areas are of different sizes, for a given reduction in speed, each will suffer the same percentage reduction in market area.

Source: Stover & Koepke (1988:8)

(b) Regional business attraction impacts

These tend to be benefits of road improvements built with the specific intention of spurring on economic development in the area where they are upgrading the level of transport services and access.

The travel and logistic costs described in section 3.4.3.2 above also impact on regional business attraction. Weisbrod (1995:4) advises that when conducting research into the regional business impacts of transport improvements, it would be meaningful to be concerned about how long-term business growth is affected by

- the relative cost of doing business in the region compared with competing regions in the country
- the size of the region’s consumer and labour markets
- the region’s natural and historical attraction for business, which is related in part to its proximity or access to raw materials or other product inputs

The importance of the region lies in the fact that it forms part of a wider potential market. As stated previously, road infrastructure links different markets together. If the market of the project-improvement area is more favourable than existing markets, businesses will tend to locate at this market. Access improvements thus increase market choice which is manifested in location decisions.

From the above discussion it is clear that the magnitude of road infrastructure investments is far reaching. Not only the local or direct impacts of roads are considered but also their impact on the regional economy. Although road investment in its absolute size may be modest, its relative size is significant and thus a crucial consideration.

3.4.4 The efficiency of investment

The efficiency of an investment is another element that should be included when considering the effect of road infrastructure investment on economic development. Banister and Berechman (2000:43) explain this by stating that it would be totally wrong to regard the economic benefits from an inefficient investment as the correct ones. A case in point relates to a proposed road project with extremely low user benefits. The only way to justify the project would be to focus on its economic development potential. One should bear in mind that roads are primarily built to serve traffic – other benefits are secondary, but equally important.

Road infrastructure forms part of public goods. Chapter 2 provided a general discussion of the efficiency of roads as public goods. The problem with road infrastructure is that it is neither a pure public good nor a private good. According to Labuschagne, Naude, Shaw, Schnackenburg and Coovadia (1998:16) roads have the following characteristics:

- ***Non-excludability.*** Road users are not excluded from road usage on the basis of the price of usage. This is not applicable to toll roads.
- ***Rivalness.*** Owing to traffic congestion, the use of vehicles interferes with other vehicles' use of road space.

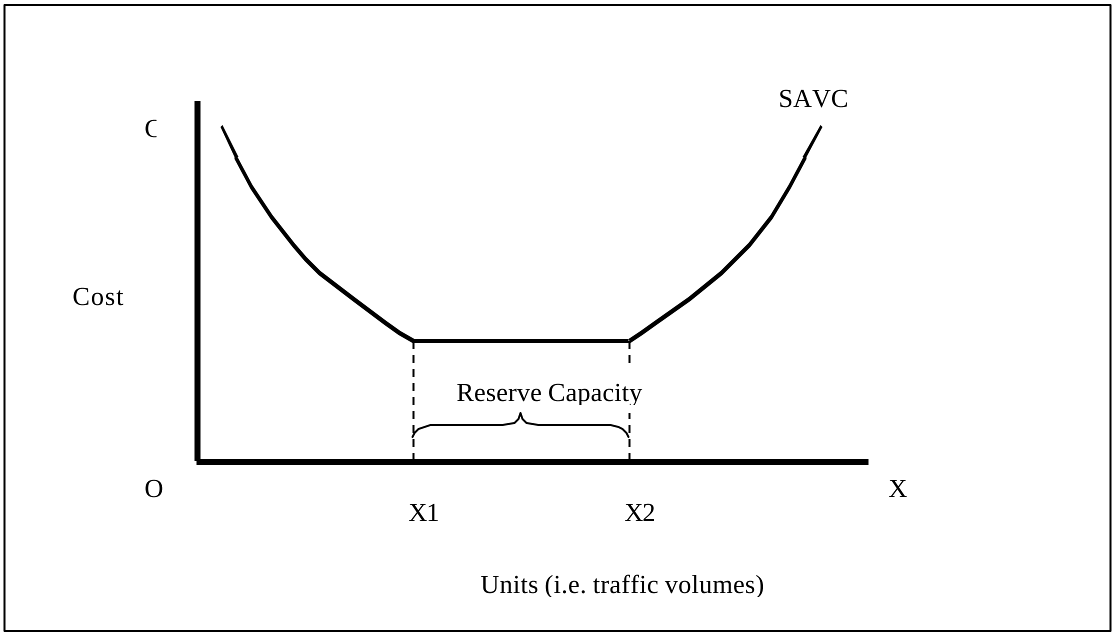
Given this view of road infrastructure, it is necessary to define the efficient provision of road infrastructure. According to Banister and Berechman (2000:43), this is defined in terms of technical and allocative efficiency.

3.4.4.1 Technical efficiency

This implies that the investment's output must meet the demand for the facility (Banister & Berechman 2000:43). In the case of roads, this means that the new capacity (or road space) created will relieve traffic congestion or at least meet the demand for road space. This should be seen in the context of the characteristics of road infrastructure as outlined in Chapter 2. It was stated that roads have a long gestation period, thus implying that new roads will not be used at full capacity for the first few years. Traffic volumes have annual growth rates – hence supporting the principle of spare capacity. This is the so-called "reserve capacity approach". Figure 3.2 illustrates this point.

In the modern theory of costs, the range of output X1 to X2 in figure 3.2, reflects the planned or reserve capacity that does not lead to increases in costs. Additional road investment is usually required when the existing road infrastructure operates at poor levels of service, usually level E or F (the worst condition). This is usually the result of an excessive traffic demand or insufficient provision of road infrastructure or both.

Figure 3.2: Reserve capacity approach



Source: Adapted from Koutsoyiannis (1994:118)

These are the conditions that occur from point X2 to X on the figure above. Roads are extremely costly and it is thus important to avoid overinvestment in roads where levels of service are at condition A (the best condition) for most parts of the day. See Annexure A for levels of service. This reflects a poor investment because the cost is “too high” – as depicted in the area between points O and X1 in figure 3.2. The level of development of the area may be indicative of the potential use of the road. The study area around road K8 is experiencing tremendous development pressure and it is highly probable that the provision of this road will result in sufficient usage of the road. Levels of service of between D and E are predicted by local demand modelling. Although the need for road PWV9 is not disputed (based on limited existing infrastructure) its future efficient usage is questioned. The area is not characterised by high development pressures, and it is thus assumed that most future traffic will be diverted traffic using this road as a through road.

Traffic engineers use sophisticated modelling techniques to ensure technical efficiency of the transport network, and best road alternatives. As a rule, in South Africa, technical feasibility and efficiency are not regarded as a problem. The main problem is obtaining funds to implement these road projects.

3.4.4.2 Allocative efficiency

Allocative efficiency implies optimal output at minimum cost. According to Nas (1996:14), to satisfy the allocative efficiency condition, both the exchange and the production efficiency conditions must be met. This means that the rate at which goods are produced must be equal to the rate at which consumers are willing to substitute one for the other.

This condition implies that road infrastructure investment decisions should consider all the expected outputs (or returns) and the cost implications. The two case studies serve as a comparison. In chapter 2 (secs 2.3.1 & 2.3.2) it was mentioned that the economic returns of road K8 will be higher than those of road PWV9 (the MCDC). A comparison of the project costs reveals that the PWV9 project cost is substantially more than that of road K8 – R350 million compared with R30 million. Road K16 is also less expensive (R64,25 million) than road PWV9 and the economic returns are expected to be sufficient. Given the principle of allocative efficiency of minimum cost and maximum output it is thus fair to assume that the construction of road PWV9 (high cost associated with low economic returns) will not satisfy the allocative efficiency condition when compared to the construction of roads K8 and K16 (low cost and high economic returns). This is reflected in tables 3.5 to 3.7.

3.4.5 Implications for economic development

The aforementioned discussions in section 3.4, suggest a causal relationship between road infrastructure investment and economic development because there is no guarantee that road investment will always unlock economic development. The economic returns are largely dependent on the type of road investment, and the magnitude and efficiency of investment. The economic development impacts are usually measured in terms of localised abutter impacts and wider regional impacts. Care must be taken not to invest in road infrastructure that will cause a leakage in the local economy, because of more favourable market attractions in the larger region. A theoretical model, based on the important aspects of the investment component (the type, relative size and efficient provision or consumption of the investment), is used to test the economic development potential of the three case studies in terms of the investment component.

The type of investment has two dimensions, namely that of its particular technology and that of its purpose (see sec 3.4.1). In this instance, the technology relates to the road infrastructure and the purpose to the main objectives of the projects. All the case studies are roads – hence the technology is not applicable. However, the objectives of the roads are to promote economic development. All three road projects therefore comply with the first factor. The second factor, the relative size of the investment, describes the magnitude of the road investment (refer to sec 3.4.2). From this section it was evident that road PWV9 is the most expensive (R350 million), followed by roads K8 (R30 million) and road K16 (R64,25 million) respectively. It is thus highly evident that all three roads are sufficiently sized from a cost perspective. The efficient provision and consumption of the road investment cannot be achieved by all three case studies. In this chapter (sec 3.4.3) it was indicated that the construction of road PWV9 does not seem efficient in terms of technical and allocative efficiencies (sec 3.7 & 5.5

provide more evidence in this regard). The allocative efficiency measurement implies optimal output at minimal cost. In the case of this road, this requirement is unobtainable and the cost of the road is 10 times more than that of road K8. Roads K8 and K16, however, are efficient.

Table 3.5: Economic development implications of the investment component for road K8

Factor	Compliance	Noncompliance
Type of investment	Yes	-
Size of investment	Yes	-
Efficiency of investment	Yes	-
Economic development implications	Highly probable	-

From the above discussion (see table 3.5) it is evident that road K8 will contribute to economic development based on its investment component.

Table 3.6: Economic development implications of the investment component for road K16

Factor	Compliance	Noncompliance
Type of investment	Yes	-
Size of investment	Yes	-
Efficiency of investment	Yes	-
Economic development implications	Probable	-

From table 3.6 it is also clear that road K16 complies with the factors of the investment component – hence economic development is probable. The discussions in sections 3.4.1 to 3.4.3 substantiate this qualitative assessment.

Table 3.7: Economic development implications of the investment component for road PWV9

Factor	Compliance	Noncompliance
Type of investment	Yes	-
Size of investment	Yes	-
Efficiency of investment	-	Noncompliant
Economic development implications	-	Questionable

From the above table one may infer that road PWV9's contribution to economic development is questioned because it does not comply with all the factors of the investment component. The efficiency of road PWV9 was questioned in section 3.4.3.

3.5 THE NETWORK PERFORMANCE COMPONENT

The network performance component relates to the actual performance of the transport network. It is thus a description of the ease of traffic movement, the capacity of the road network and the operating conditions. The relevance of the transport network performance to economic development needs to be investigated. From figure 3.1 (p 3-13) it is evident that network performance and accessibility are measured against determinants such as mode connectivity, origin-destination patterns, travel time and capacity. The mode connectivity impacts on the principle of intermodality which implies interaction with other transport facilities and technologies. The factors of travel time, flows and network capacity influence vehicle operating costs and accessibility. Accessibility and travel flows describe the ease of traffic movement and the extent of the road network, while the savings of vehicle operating cost are a result of improved traffic flow conditions. The overall network performance and operation describes the network effectiveness.

These determinants of the network performance component will now be discussed.

3.5.1 Accessibility and travel flows

The importance of a road network that provides good accessibility to spatial locations should not be underestimated, and will be discussed in this section. The physical accessibility that a particular urban location affords is basically determined by the form of the urban area, as well as the availability of transport infrastructure and public transport facilities. However, when considered in relation to the accessibility afforded to a household residing at that specific location, accessibility determinants are influenced by the personal characteristics of members of the household and their personal mobility. The difficulty this poses for the measurement of accessibility enjoyed by different households cannot be avoided (DOT 1996:7-6).

Accessibility impacts on travel flows, and results in specific travel patterns on the transport network. The performance of the road network is measured in terms of travel times savings or losses, by the resultant volumes on the road link and by the relative accessibility of locations (Banister & Berechman 2000:44).

Homburger, Keefer & McGrath (1992:420) consider savings in travel time as the single most important benefit, and maintain that this should be carefully evaluated because of its significant impact on the overall ranking of schemes.

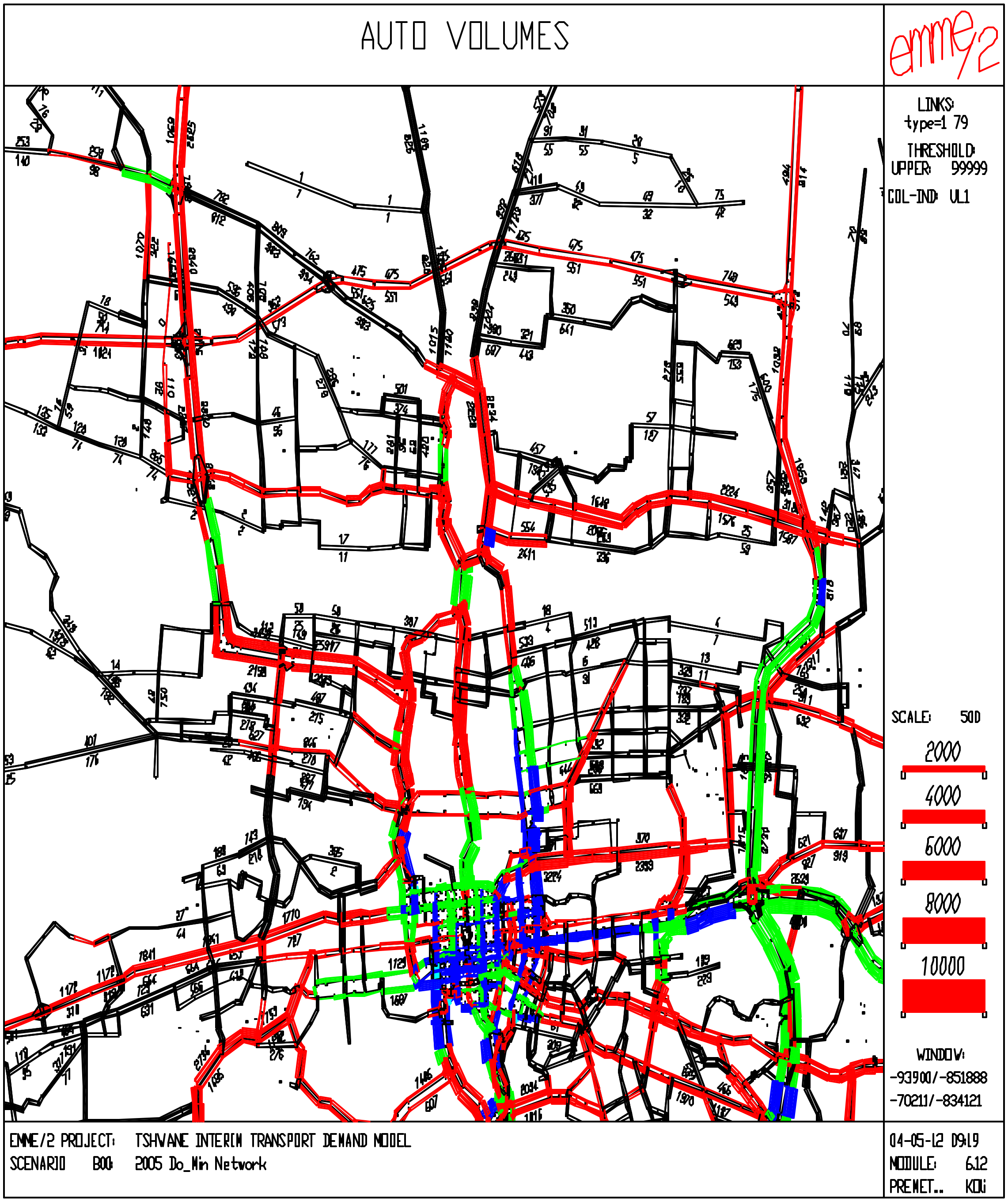
This method of network performance is used primarily for evaluating different alternatives of a specific road project. For instance, it is not advisable to compare the relative accessibility of road K8 with that of road PWV9, because of different spatial locations and network characteristics. The idea is to compare the zero-alternative (road network without road K8) with the alternative which includes road K8. The same should be done for roads K16 and PWV9. The relative accessibility of a road proposal can be measured in this way.

The EMME/2 transport model was used to determine the relative accessibility of the different road projects. The EMME/2 model is associated with a complex arrangement of mathematical formulae and algebraic algorithms intended to replicate the real situation. Certain land-use alternatives are used as input to the calibrated model, and evaluated by comparing the outputs from the model with the actual conditions of the transport system. Outputs of the model include

- trip matrixes
- transport volumes on each transport link and service
- accessibility indexes
- transfers and transfer times
- travel times, speeds and costs

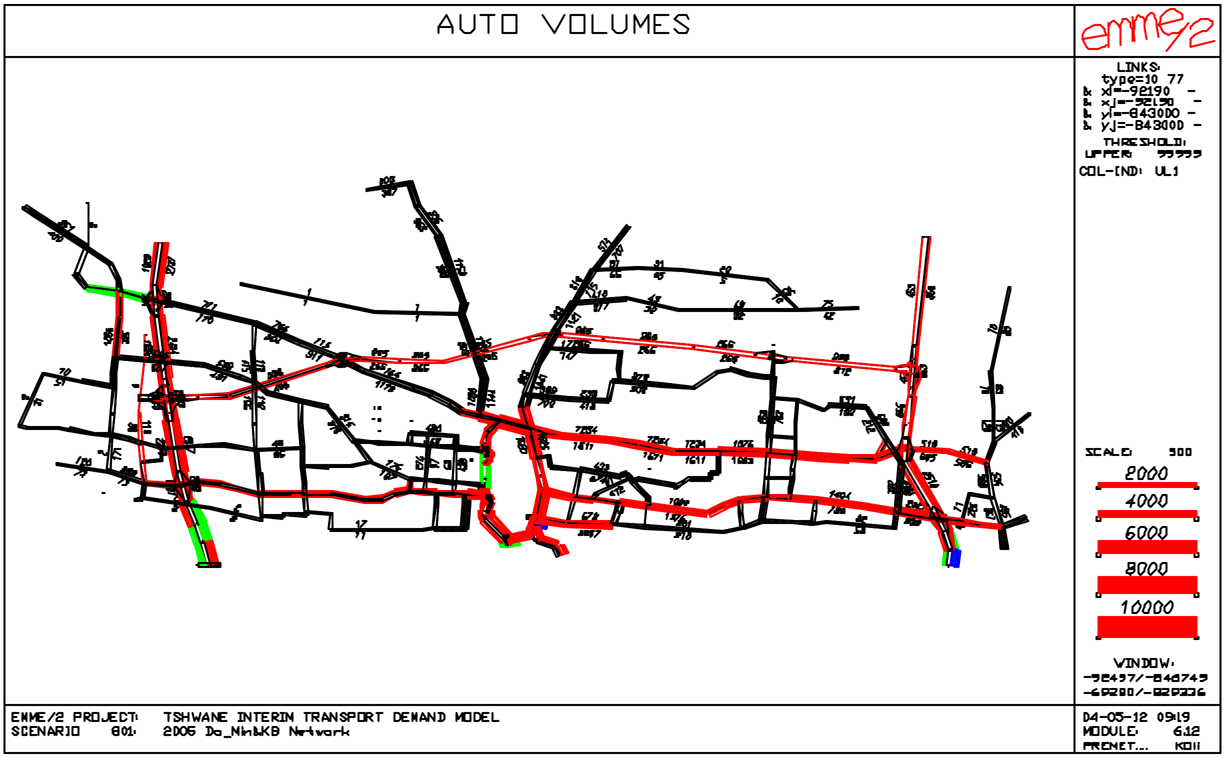
Graphs 1 to 4 depict the actual modelling results.

Graph 1: Modelling of the road network without roads K8, K16 and PWV9 (2005 traffic volumes)

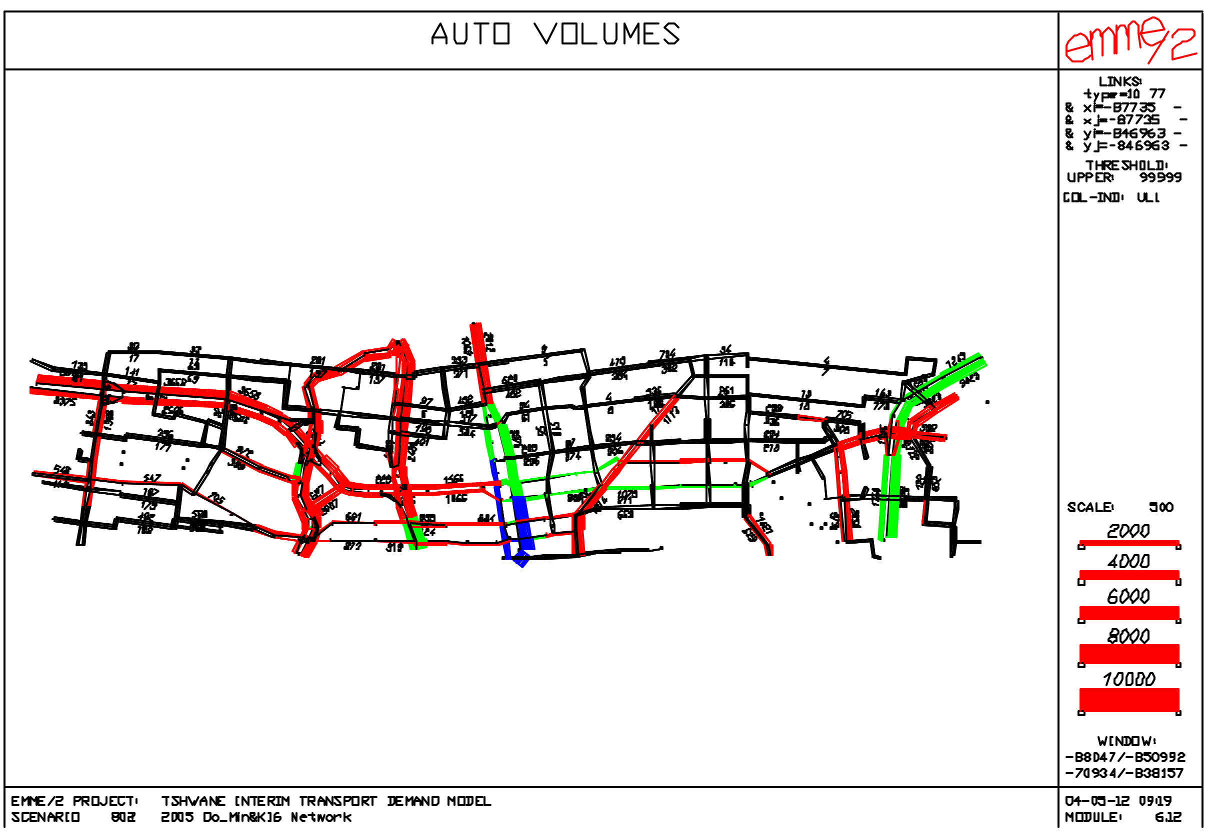


Graph 1 shows the expected 2005 traffic volumes prior to the construction of roads K8, K16 and PWV9. Graphs 2 to 4 indicate the traffic volumes after the construction of the said road projects. The implications of the modelling results are provided in graph 4.

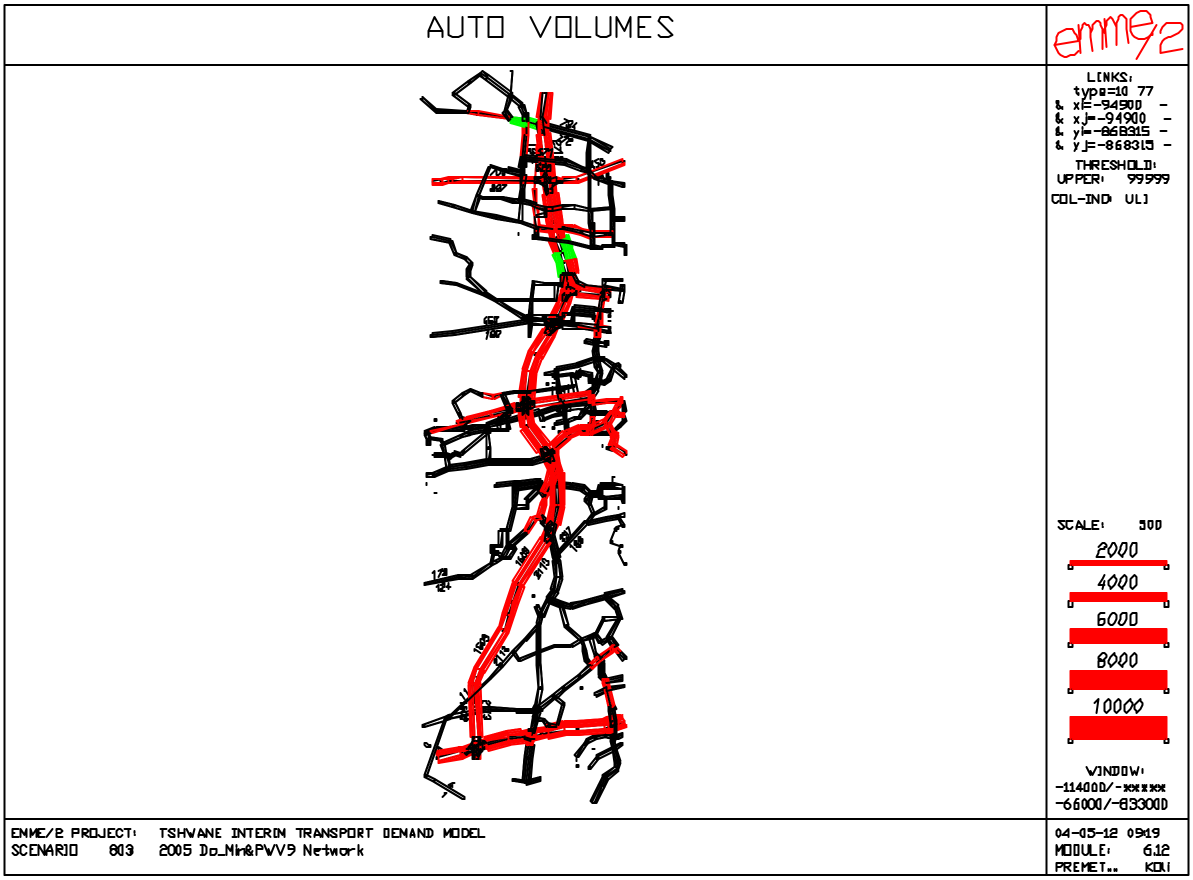
Graph 2: Modelling of the road network including road K8 (2005 traffic volumes)



Graph 3: Modelling of the road network including road K16 (2005 traffic volumes)



Graph 4: Modelling of the road network including road PWV9 (2005 traffic volumes)



Modelling results (based on the EMME/2 modelling) indicate improvements to the network if the respective roads are constructed. The actual construction of the roads shows an improvement in terms of lane kilometres, vehicle kilometres and average network speed. These are shown in table 3.8.

Table 3.8: Accessibility and travel flows for roads K8, K16 and PWV9

Road	Lane km	Vehicle km	Speed (km/h)
Without K8	618,9	344 775	55,6
With K8	653,8	344 949	57,7
Without K16	449,9	275 321	36,1
With K16	482,6	289 517	40,7
Without PWV9	663,2	323 708	54,3
With PWV9	786,5	432 809	61,1

The above information shows that the number of vehicles using the road network has increased for all three roads, if the vehicle kilometres of the network are considered. This is indicative of network efficiency and improved accessibility. The improvement of average speeds also indicates travel flow improvements. Travel flows will thus be improved with the construction of all three roads, which supports the qualitative assessment in tables 3.11 to 3.13.

3.5.2 Savings in vehicle operating costs

Savings in vehicle operating costs are also a measure of network efficiency. According to the CB-Roads Users' Manual (1992), vehicle operating costs comprise

- the fuel used in travelling over the road
- the oil used in travelling over the road
- the tyres used in travelling over the road
- vehicle depreciation due to the use of the road
- the vehicle maintenance cost

According to Homburger et al (1992:420), the quantification of vehicle operating cost savings is relatively straightforward. These are direct savings for the road user. These savings are relevant to the economic evaluation of road alternatives in order to select the optimum alternative. These cost calculations require detailed information on the vehicle mix and modal choices because they have different vehicle operating costs. However, this is not relevant to the study. The modelling results provide sufficient information to determine travel time reductions and hence operating cost reductions. The table 3.9 provides information on the contribution to cost reduction from the case studies, which was obtained from the modelling discussed in section 3.5.1.

Table 3.9: Travel time reductions for roads K8, K16 and PWV9

Road	Time (minutes)
Without road K8	370 310
With road K8	358 111
Without road K16	457 686
With road K16	426 887
Without road PWV9	357 385
With road PWV9	424 947

From the above it is clear that use of roads K8 and K16 (see also tables 3.11 & 3.12) led to a significant reduction in travel time on the road network, while that of road PWV9 shows an increase in cost because of an increase in travel time (see table 3.13). The increase in travel time for road PWV9 can probably be ascribed to new (diverted) traffic using this road.

3.5.3 Network effectiveness

According to Banister and Berechman (2000:44), the following three factors define network effectiveness:

(1) positive network externalities
(2) network connectivity
(3) network efficiency

Positive network externalities relate to technological externalities caused by road network improvements. Road links that are constructed add to the accessibility of the network, thereby increasing route choices. An example of this externality is that of the effect of the expansion of road capacity in a network with congested traffic. If the scheme results in the diversion of traffic from other congested roads to the improved road, then existing users of the improved road, as well as nonusers (ie the new users as well as those using the other roads) will benefit. This principle is illustrated by graphs 1 to 4 in section 3.5.1. These graphs show the diversion of traffic from the road network excluding roads K8, K16 and PWV9 to the road network that includes the respective roads. This traffic assignment was done with the aid of an EMME/2 transport model.

Network connectivity is defined as the number of alternative routes available to road users wishing to reach a given destination given their location (Banister & Berechman 2000:44). Steyn and Barnard (1984:111) support this definition in that they describe connectivity as the linkage of networks. From this it is evident that the existing network is a function of connectivity, and the larger the number of alternative routes, the greater the connectivity of the network will be. The above figures which include roads K8, K16 and PWV9 in the road network, serve as an example of improved network connectivity. The increases in the lane kilometres of the three case studies discussed in section 3.5.2 show improved network connectivity.

Network efficiency is defined as the capability of a transport network to process the area's volume of daily traffic in terms of the relative length of the peak period, or the percentage of total traffic processed during that period (Banister & Berechman 2000:44). Transport network efficiency has the potential to impact adversely on the functioning of urban economies. Highly congested urban areas increase transport costs and hamper trade flow. In his study on urban transport sustainability, Kim (2001:13) found that cities like Seoul and Inchon were 9 to 15 times more congested than, say, the city of Toronto. Clearly poor network performance could impact on economic activity and transport cost. The network efficiency is usually determined by complex transport models, such as EMME/2. As shown in section 3.5.1, the three case study roads, roads K8, K16 and PWV9, were modelled to determine their respective efficiencies using the aforementioned model. These results describe the respective performance improvements effected by actually building the roads (the performance improvements were compared with a road network excluding these roads). The results are shown in table 3.10 below (see also graphs 1 – 4).

The information in table 3.10 indicate that from a transport point of view, all three roads will improve traffic flow conditions, and hence the network performance. For instance, all the road proposals will reduce travel for the vehicles within the study area, while also improving the average speed of traffic.

Table 3.10: Network efficiency for roads K8, K16 and PWV9 (morning peak hour, 2005).

Road	Lane-km	Vehicle-km	Time (min)	Speed (km/h)
Without K8	618,9	344 775	370 310	55,86
With K8	653,8	344 949	358 111	57,74
Without K16	449,9	275 321	457 686	36,09
With K16	482,6	289 517	426 887	40,69
Without PWV9	663,2	323 708	357 385	54,34
With PWV9	786,5	432 809	424 947	61,11

Road K8 improves the average speed from 55,86 km/h to 57,74km/h, while road PWV9 improves it from 54,34km/h to 61,11km/h. Road PWV9 has the most significant improvement in terms of speed, and this is largely ascribed to the freeway standard (limited access) of the road. The other roads will be urban roads with intersections and accesses. This also shows that road PWV9 may have a mobility function as a primary function. One should be careful not to compare these roads with each other because various other factors such as construction costs must be collated prior to making any meaningful comparison. The purpose of the above table is to indicate the impact of the road on network performance.

3.5.4 Interaction with other transport facilities

The road network links various transport facilities. The performance of the network can also be measured according to the way in which this interaction actually occurs. This interaction follows an integrated approach by allowing road users various choices in terms of mode and facility. The specific characteristics of the network will be indicative of the interaction possibilities.

3.5.5 Implications for economic development

From the above discussion one may infer that various determinants impact on the performance of the road network. These determinants should be considered as part of the initial feasibility studies for individual road projects. This will help decision makers to identify optimum road network improvements for individual road projects. Once road priorities, based on network performance, have been determined, the economic development potential of individual projects can be used to identify investment priorities.

The implications for economic development according to transport network performance are based on the premise that an effective transport network will support economic development, while a poor performing transport network will constrain it. An effective transport network will allow movement of people and goods, resulting in increased flows and interaction within the market thus assisting economic development. A poor network, however, will restrict market interaction and thus inhibit economic development. The function of the road also needs to be carefully considered. For instance, a road may have a mobility function – hence contributing little to economic development except for travel cost savings.

Sections 3.5.1 to 3.5.4 used the travel flows, savings in vehicle operating costs, network effectiveness and intermodality as determinants to measure the network performance component of the respective roads. Tables 3.8 to 3.10 provided details on how the road projects impacted on the network performance. The case studies were evaluated against these factors, and any improvement in the specific determinant was regarded as compliance with network performance. One should also bear in mind the causality requirement, namely that all determinants must comply with the network performance component in order to contribute to economic development. The results are as follows:

Table 3.11: Economic development and network performance for road K8

Factor	Compliance	Noncompliance
Travel flows	Yes	-
Vehicle operating costs	Yes	-
Network efficiency	Yes	-
Intermodality	Yes	-
Economic development implications	Highly probable	-

In sections 3.5.1 to 3.5.4 it was shown that road K8 complied with all the factors related to the network performance component (positive improvements following the construction of road) – hence highly probable economic returns.

Table 3.12: Economic development and network performance for road K16

Factor	Compliance	Noncompliance
Travel flows	Yes	-
Vehicle operating costs	Yes	-
Network efficiency	Yes	-
Inter-modality	Yes	-
Economic development implications	Highly probable	-

Road K16, like road K8, is compliant with the factors of the network performance component (see sec 3.5.1 – 3.5.4).

Table 3.13: Economic development and network performance for road PWV9

Factor	Compliance	Noncompliance
Travel flows	Yes	-
Vehicle operating costs	-	Noncompliant
Network efficiency	Yes	-
Intermodality	Yes	-
Economic development implications	-	Questionable

In the discussions in sections 3.5.1 to 3.5.4 it was shown that road PWV9 made positive contributions to most of the network performance components, except for that of vehicle operating costs where an increase was modelled in the travel time (see table 3.9). This negative factor thus places a question mark next to the role of road PWV9 in the economic development of the study area, when assessed in terms of the network performance component. Hence road PWV9 does not comply with the causality requirements between road investment and economic development. However, one should note that from a purely road perspective, this road will lead to improvements in the average travel speed and network efficiency.

3.6 TRANSPORT ECONOMIC BEHAVIOUR

Transport has opened vast tracts of land to economic development which has been to the advantage of factors of production like capital goods, raw materials, intermediate inputs, labour and consumer goods (DOT 1984:72). Transport economic behaviour comprises a number of elements, namely the principal elements of locational and real effects, as well as secondary elements relating to social equity and the environment (see fig 3.1).

3.6.1 Locational and real effects

Chapter 2 (sec 2.2) the intricate relationship between the transport system and the activity system, which includes the real estate and land-use system, was highlighted. The structure and performance of the transport system creates a response from the activity system, which is influenced by changes to transport markets relative to their spatial location and consumption and production decisions. In order to understand the role of roads in the location of the real estate market, it is necessary to assess the characteristics of the real estate market and the relationship between roads and location.

Real estate markets have certain characteristics, which need to be considered when evaluating road infrastructure investment proposals. Shenkel (1980:146) identifies the following unique characteristics:

- Supply and demand are slow to adjust to new market conditions.
- Real estate markets are highly localised.
- Real estate is durable and fixed in a location.
- Legal restrictions prevent orderly market adjustments.
- Credit availability and its cost affect supply and demand.

- The gestation time – the time between project planning and project completion – makes real estate markets sluggish and slow to respond to changing markets.

These market characteristics are of crucial importance when trying to stimulate real estate development and economic growth through road infrastructure investment proposals. Road infrastructure investment in areas of an undeveloped market will not attract any significant retail development. The fact that the retail market is slow to respond to new market conditions reinforces this point. An undeveloped market will cause the real estate market to be even more sluggish to relocate. This market is characterised by a wait-and-see approach. Owing to the high costs of relocating businesses, relocation decisions will only be based on favourable market conditions with clear supply and demand characteristics. The durability of real estate at specific locations also restricts relocation decisions to favourable market locations. This is because the business must have some hope of long-term sustainability. Furthermore, the legal restrictions on town planning schemes prevent relocation decisions. For example, although a specific location may be desirable for, say, a shopping centre, there is no guarantee that the site will be zoned for such purposes. The rezoning of applications is a lengthy process, and open to objections by interested parties and those affected by rezoning.

Given the above information, one can infer that the MCDC (road PWV9) project was based on the wrong assumptions. As stated previously, there was no significant market demand for real estate development, and it was hoped that the provision of the road PWV9 would stimulate the local market. Section 2.3.1 showed that road PWV9 is located in an area of poor real estate market and that the construction of this road is supposed to stimulate the local real estate market. See chapter 2 for an additional discussion on the issue of market demand, directly productive activities and the provision of road infrastructure. The fact that the real estate market is slow to adjust to changing market conditions reinforces the failure of the approach followed in the investment of road PWV9. The assessment of real estate compliance is reflected in table 3.16. However, the market conditions for real estate development were favourable in the vicinity of road K8. Information obtained from the local authority indicates that applications for developments in excess of 500 000 m² were received. In addition to these estimations (UE 2000:42), the construction of road K8 will ensure the opening up of an additional 240 shops, 550 offices and 905 industries compared with the nonconstruction of this road. This is evidence of a substantial real estate market with a favourable location (see table 3.14). The construction of road K16 will increase the demand for real estate (residential and nonresidential) by approximately 1,2 million m² (UE 2001:50) when compared with the nonconstruction of the road. This indicates a fairly significant real estate demand, which is reflected in the assessment in table 3.15. Road infrastructure can play a meaningful role in making certain real estate locations more favourable.

Rogerson (1997:21) concluded in his study on the locational influences of high technology activities that a key requirement for locating in a specific area is a good road infrastructure. The relationship between a sound road infrastructure and decisions on location was thus emphasised. Earlier discussions in sections 3.4.2 and 3.5.2 also highlighted the importance of transport cost to location decisions. However, transport cost is not the only location decision. This argument is supported by Balchin (1981:16) who states that "… rarely is an activity's location determined by a single locational requirement, a mixture of interacting influences usually explains each location decision". Be that as it may, transport costs are still of paramount importance. Brown (1999:2) concurs with this argument and contends that according to location theory, transport costs are one of the key determinants of industrial site choice.

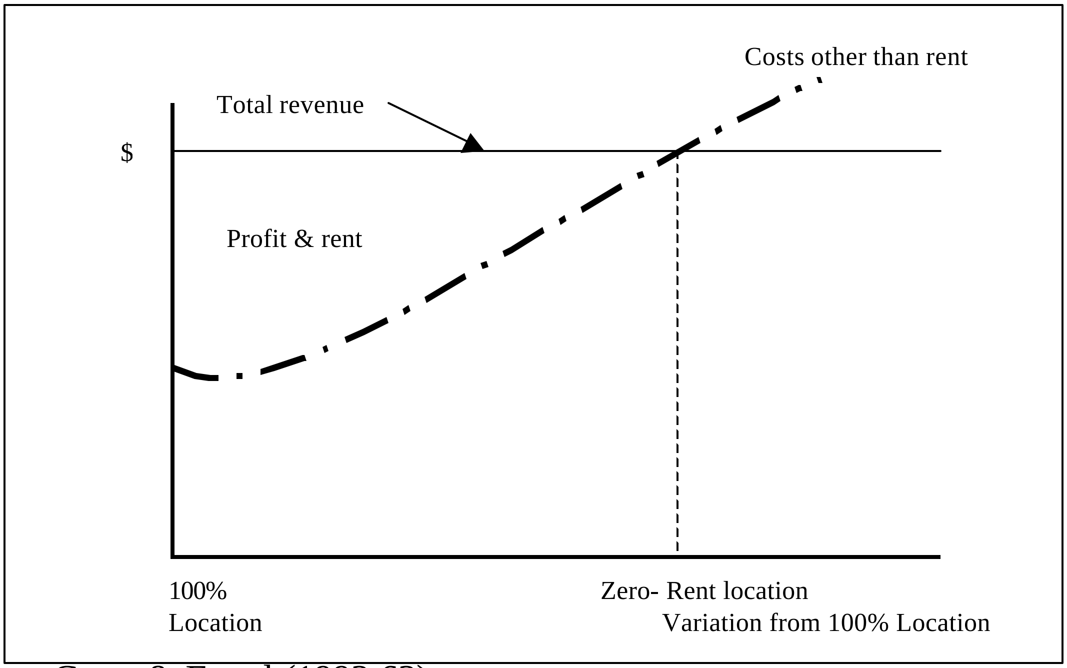
Transport is affected by accessibility. From a road user's perspective it is evident that accessibility subsequently influences convenience. For instance, direct access is convenient to users, while indirect access is not. Clearly, accessibility will impact on location choice. This statement is underscored by Ratcliff (1979:224) who maintains that for many land uses, convenience to the greatest number of people is a primary requisite. He adds that land at the focal point of transportation routes is greatly sought after and commands a high economic rent. Graaskamp (1970:76-79) supports these arguments and designates dynamic property attributes as follows:

- transportation access
- exposure of site and structure
- tributary area analysis

Graaskamp (1970:76) regards transportation access as the critical factor because it impacts on transport costs. In this regard, Greer and Farrel (1993:62) argue that the best location is the one that minimises all costs.

Indirect access has explicit cost implications because of longer travel distances and time spent on the road. Figure 3.3 illustrates the principle of best location.

Figure 3.3: Industrial location decisions



Source: Greer & Farrel (1993:63)

Brown (1999:2) explains the importance of lower transport costs. Such costs encourage economic activities and people to locate further away from population centres and highways have the potential to open up underdeveloped regions for economic development. This is the impact that roads K8 and K16 are expected to have because they will reduce transport costs. This is not the case with road PWV9, because it will lead to increases in vehicle operating costs. A well-developed and efficient transport network will thus result in reduced transport costs and time savings. Section 3.5.5 has shown that roads K8 and K16 will lead to reductions in travel time, while the opposite will be true of road PWV9. The surrounding areas of road K8 are fairly underdeveloped, with huge land development potential and pressure. The construction of road K8 will result in land development – and hence economic development. Such road infrastructure can lead to improved linkages in the study area. Linkage refers to the functional relationships between establishments that result in the movement of people and goods. Suffice it to say, that linkage is caused by the transport system, with road infrastructure playing a major role. Insufficient linkages in an area will deter certain establishments from locating in that area. The study area of road PWV9 is poorly served with road infrastructure, while those of roads K8 and K16 are well developed with a road network.

However, highways can also have negative development consequences – they may provide conduits for economic activity to leave underdeveloped regions (Brown 1999:2). These conduits are the so-called "leakage effects" caused by road infrastructure. Whenever a local resident or business shops, trades or invests outside the community, money flows out, thus creating economic leakage (NBI 1998:35). These leakages usually occur with the construction of new roads that link underdeveloped areas with better urban markets. Flows out of the region to these new markets will result. The construction of PWV9 is expected to result in this anomaly.

From the above discussion it is evident that road infrastructure plays a vital role in the relationship between locational and real effects. Inappropriate road investment may actually deter the locational decisions of real estate developments, while the provision of appropriate road investment may promote real estate investment in certain locations.

3.6.2 Social equity and the environment

The provision of road infrastructure impacts on society and the environment. Although the purpose of this thesis is to maximise the economic returns of road infrastructure investment, social and environmental factors also merit attention. These factors have cost implications that may impact on the economic returns of roads. Section 1.2 indicated that social and environmental factors are inextricably linked to the economic outcomes of roads.

3.6.2.1 Social equity

Equity is a vital social issue. Not all members of society have equal access to transport. Provision has to be made for those without transport, and governments have tried to provide opportunities in remote and peripheral areas, often through transport investment. In this regard, the World Bank (1994) advocates that poverty reduction should be an integral part of national, provincial and local transport strategies (DOT 1995:37). Social strategies related to transport investment are the following:

- reducing barriers to informal supply of transport, subject to enforceable levels of safety
- developing efficient subsidy schemes for "social service" public transport (eg transport for people with disabilities, the elderly and scholars)

Some proponents argue that transport should not only provide social equity, but also opportunities for social justice to be improved through transport investment. The term "social justice" provides a far more comprehensive analytical base than equity. According to Bailey (1995:274), social justice refers not only to equity but also to need, entitlement and merit. Social justice requires that institutional and market structures be adapted to break down barriers that prevent people from being afforded the opportunity for self-improvement.

The improvement of road infrastructure provides certain social equity gains. These gains are usually measurable in terms of cost savings that will have a positive impact on the economy of the area in which the new road is constructed. These impacts, except for reductions in vehicle operating costs, are generally induced economic impacts that will occur in the longer run. As discussed in section 3.2.3, economic impacts are effects on the level of economic activity as a result of the road project and include increases in personal income. According to the DOT (1992:3-11), these increases result in reduced household and medical costs which are some of the benefits of roads in disadvantaged areas.

- less time and money spent on household cleaning tasks (floors, windows, walls, carpets, curtains and laundry)
- improved health and lower medical costs because of less dust (fewer respiratory illnesses), no stagnant water in potholes affecting the health of children who play in them, and less risk of injury on or near poorly surfaced, stony roads, which became muddy and slippery after rains
- greater personal mobility in the township. (It will be easier to walk to transport, schools, shops, etc. Also public transport could move around in the township and drop people near their homes, which would be safer, without risk to vehicles, and certainly with lower vehicle operating costs. Transport fees should therefore be lower.)

It is thus evident that road infrastructure investment in disadvantaged areas promotes social equity.

Social justice includes the above advantages and more. Roads connecting disadvantaged areas to larger markets where the community can sell their local products are but one of the advantages. Local residents can also be employed during road construction activities, while local economic development (LED) initiatives should form part of road infrastructure investment projects. These LED initiatives may include the following:

- small, medium and micro enterprise (SMME) development
- provision of incubators – places where local entrepreneurs are provided with work space, administration support, training and other assistance

- the creation of public-private partnerships during the project
- tourism development, because of improved access
- business retention, expansion and attraction initiatives

These are some of the initiatives that could ensure social justice during road infrastructure investment project. Clearly, social justice issues can only be addressed at project level. All three road proposals are expected to make a positive contribution to social equity (the assessments are shown in tables 3.14 – 3.16). This is supported by the proposal that projects associated with the MCDC (including road PWV9) include small business support programmes, entrepreneurial training programmes and human development support centres. Road K8 promotes social equity because of major job creation, while the expectation is that this road will be constructed by means of a public-private partnership. The construction of road K16 will promote social justice by stimulating small to medium business development in the study area.

3.6.2.2 Transport and the environment

Transport infrastructure impacts on the environment in a number of ways. Rong (2001:13) concurs, and adds that the effects of transport on the environment include energy depletion, land occupation, air pollution, noise, accidents, congestion, soil erosion and the unbalance of the biological environment. According to Farrington (1992:53-62) the most obvious impacts include the following:

- **Visual impacts.** Road infrastructure clearly has the potential for large-scale visual impacts. Consider, for example, the visual impact that a tunnel for a road link has on the mountain through which the cutting is made.

- **Noise and vibration impacts.** Noise on roads is a function of many factors including vehicle mix, vehicle speed, traffic control devices or signage, horizontal and vertical alignment of the road, road surface material and condition. These vibrations on roads are primarily a function of the vehicle mix. Roads with high percentages of heavy vehicles will have larger vibration impacts compared with roads with lower percentages.
- **Atmospheric emissions.** These are the emissions caused by vehicles using the road, and are also referred to as negative environmental externalities.
- **Severance, displacement and demolition impacts.** Most road projects have one or more of these impacts. For example, during public participation exercises the public complained that road K8 would split the area into two. Pedestrians would thus have difficulty moving freely between these two areas. This road will also lead to expropriation of houses that need to be demolished because they are in conflict with the road alignment.

Road investment projects (including the stages of planning, design and construction) in South Africa are compelled, by various environmental Acts (eg the National Environmental Management Act), to limit the environmental impacts. These are controlled by environmental impact studies that also make recommendations on the mitigation of expected negative outcomes. The environmental impacts of the three case studies have not yet been determined. One should note, however, that the mitigating measures of road projects may have significant cost implications that could influence the positive economic returns associated with road projects.

3.6.3 Implications for economic development

The economic impact of a good location and associated real estate development was dealt with earlier. Positive locations reduce transport costs and ensure access to markets. Real estate development has many positive economic impacts – from the construction activities to the operational impacts of businesses.

The above discussions highlighted the fact that social and environmental issues may impact on the economic returns associated with road infrastructure investment. It was shown in section 3.6.2 that environmental considerations may have costly impacts on the construction costs owing to the mitigating measures required. The strict environmental controls and associated mitigating actions will effectively increase the cost of road infrastructure. The environmental costs must thus be internalised as part of the cost benefit analysis of the road project. This will ensure that all costs are discounted.

It would seem that the application of the principle of social justice will promote local economic development. Section 3.6.2 highlighted the actions needed to promote social justice. This should have a positive impact on economic development.

A stated previously, the following factors are important when analysing the transport economic behaviour component:

- location and real effects
- social equity
- environment

Compliance of the different case studies with these factors is shown below. Note that the environmental factor will not be considered for the analysis in the tables below, because the environmental impact assessments for the respective road projects were not available during the compilation of this thesis. Detailed environmental impact assessments are required to properly measure the environmental impact of roads. These reports can be used to complete tables 3.14 to 3.16.

Table 3.14: Economic development and transport economic behaviour for road K8

Factor	Compliance	Noncompliance
Real effects	Yes	-
Social equity	Yes	-
Environment	Not applicable	-
Economic development implications	Compliant	-

Section 3.6.1 indicated the magnitude of real estate development applications, as well as the locational advantages of road K8. In section 2.6.2, it was shown that road K8 will promote social justice by means of the public-private-partnership proposal to construct the road and the advantages stemming from job creation. The above shows that road K8 should contribute to economic development because of its compliance with the transport economic behaviour component.

Table 3.15: Economic development and transport economic behaviour for road K16

Factor	Compliance	Noncompliance
Real effects	Yes	-
Social equity	Yes	-
Environment	Not applicable	-
Economic development implications	Compliant	-

Road K16 is similar to road K8 – hence economic development contributions are expected. The real estate development demand associated with road K16 is substantial and exceeded the 1,2 million m² floor area mark. Section 3.6.2 provided information on the compliance of road K16 in terms of social justice principles.

From table 3.16 it is obvious that road PWV9's contribution to economic development in terms of the transport economic behaviour component is questionable.

Table 3.16: Economic development and transport economic behaviour for road PWV9

Factor	Compliance	Noncompliance
Real effects	-	Noncompliant
Social equity	Yes	-
Environment	Not applicable	-
Economic development implications	-	Questionable

Section 3.6.1 indicated that the construction of road PWV9 will have limited real estate effects because of the absence of a substantial real estate market in the study area. However, section 3.6.2 has shown that this road will promote social justice through the strategic projects related to small business development and support programmes.

3.7 THE ECONOMIC DEVELOPMENT COMPONENT

This section discusses the economic development resulting from road infrastructure investment. Certain elements will focus on the macroenvironment, namely the cumulative impact of total national infrastructure investment on the economy, while others will examine the economic impacts of individual road projects. Figure 3.1 listed certain impacts that are measured to determine the contribution of transport investment to economic development. These are:

- output per capita
- employment

- private investment

Other criteria which were discussed in section 3.2.3, are also applicable. The contribution of road investment to economic development is usually manifested in growth. This is known as the multiplier effect. According to Banister and Berechman (2000:48), the significant feature of infrastructure projects is their investment multiplier effect which stimulates local use of factors and the demand for goods. This is a function of the size as opposed to the type of investment. This section will thus assess the multiplier effect of road investment, employment creation, and lastly, discuss urban market competition and economic development.

3.7.1 The multiplier effect and road infrastructure investment

The relevance of multipliers is that capital investment in roads at urban and regional level influences the local economy with a substantial amount of funds (depending on project size). These funds, in turn, stimulate the economy in terms of demand for labour (ie construction workers) and the demand for goods (construction materials) and services. These increased demands further stimulate economic activity. This is known as the multiplier effect. Weisbrod and Weisbrod (1997:7) state that the indirect and induced business impacts of a project are often referred to as the multiplier effects (see also the discussions on indirect and induced economic impacts earlier in this chapter). DOT (1993:5-1) contends that a basic principle of the national income theory is that an increase in spending will lead to an increase in national income which will be greater than the initial increase in spending.

Naude (1998:14) provides a lucid explanation of the dynamics of multiplier analysis:

> Each transaction that takes place adds value to the total economy – for example, the housewife's purchase of a loaf of bread adds, say, R1 to the gross domestic product (GDP). But because of the linkages, it is important to locate where the income was actually generated. To produce the bread, the baker had to buy flour and the farmer had to buy fertilizer, and to produce each commodity requires labour and capital and land. These commodities could be acquired from all over the economy. These (expressed in terms of labour and capital's remuneration) can be added together to show the total economic effect of the housewife's action on the GDP, for instance.

The same principle applies to the construction of a road project. Land needs to be obtained (or expropriated) for the location of the road. Labour must be used to construct the road and construction materials are also required. All these actions impact on the economy of the area and the region.

Hence the multiplier associated with investment in road infrastructure can have a significant impact on the economy of an area. The higher the initial investment, the higher the multiplier effect is expected to be. Although the multiplier effects will differ from one industry to the next, research has shown that local multipliers are low if they are below 1,5 and high if they are above 2,0 (Weisbrod & Weisbrod 1997; UE 2000). This will now be evaluated in terms of the case studies.

From a purely construction cost perspective, it would seem that road PWV9 should have a larger multiplier effect than that of road K8. The investment of R350 million in the economy is certain to have a larger multiplier effect, than a R30 million project. The same argument applies to the comparison between road PWV9 and road K16. The assessment rating in tables 3.17 to 3.19 therefore highlights the principle that the construction costs of all three roads are of sufficient magnitude to have measurable multiplier effects. One should bear in mind, however, that this is the initial investment – the so-called "construction phase". This initial direct investment also leads to further property development which forms part of the construction phase. The next phase, the operation phase, may be larger than the construction phase in terms of multiplier effects. The propensity to import goods and services from other regions impacts on the extent of the multiplier in the study area. It was stated previously that road PWV9 will cause a leakage in the economy, thus resulting in a high propensity to import goods and services from outside areas. This suggests that the multiplier effect will be small during the operational stage, subsequent to lower construction activities due to unstable real estate conditions. Thus the high initial investment in the area will be lost to other areas. From a national perspective, the multiplier effect should still be high, but low local area multipliers are expected (less than 1,5).

In the case of roads K8 and K16, the propensity to import goods and services is low, which is indicative of favourable market conditions in the said study areas – hence a resultant high local area multiplier effect. As stated previously, the real estate market is also extremely active in the case of road K8, which contributes to the construction phase of the economy. This results in calculated values that indicate that the contribution of the construction phase is larger than that of the operational phase, R6,097 billion versus R5,325 billion on the gross geographic product (GGP) of Pretoria during the assessment period (UE 2000:3). This is indicative of a significant multiplier (higher than 2,0). For road K16, the Urban-Econ study (UE 2001) predicts R758 166 695 during the construction phase as the contribution to the GDP during the construction phase, and R7 960 million during the operational phase. These contributions, although significant, are much lower than the GDP contributions for road K8. Unfortunately, a similar assessment was not done for the MCDC (road PWV9) to allow direct comparisons.

From the above discussion it is also patently clear that the multiplier effect of road infrastructure spending plays a significant role in economic development. This effect is thus of major importance to the study because it provides a realistic indication of whether the proposed road investment will in fact realise economic returns.

3.7.2 Employment creation

Road construction programmes invariably have an impact on employment creation. These are generally the direct jobs created by the construction activities during the construction phase of the project. However, long-term jobs are also created during the operational phases of such projects. The three case studies are a case in point. The predicted job creation for road PWV9 is 77 200 jobs (GPMC 1997:67). Unfortunately, this was not divided into the construction and operational phases. For road K16, the expected job creation is 18 769 and 32 883 jobs respectively (UE 2001). The figures for road K8 are 38 000 jobs (UE 2000:42) during the construction and operational phases. All three road projects have significant job creation prospects – hence their potential to contribute to economic development (see tables 3.17 – 3.19).

The importance of job creation to the economic returns associated with road investment is thus evident. The next section will evaluate the relationship between urban market competition and economic development.

3.7.3 Urban market competition and economic development

Transport infrastructure improvements allow the integration of urban markets, hence also introducing more competition. The effectiveness and efficiency of the market location play a vital role in the competitiveness of that urban location.

According to Du Pisani (2002:322), effectiveness and efficiency are not only required for the industry producing the goods and the services sold in the market, but for the entire value chain. The value chain includes all the activities of the product or service through to delivery to the end-user – hence transport forms part of the value chain. From this one can infer that the state of the transport system may impact on the competitiveness of an urban location. The principle of so-called “inter-corridor” competitiveness thus comes into play. Competition between the three case studies comes to mind here.

Essentially, two economic factors influence the competitiveness of urban locations, namely:

(1) economies of scale
(2) agglomeration economies

Economies of scale predominantly apply to individual firms and involve the reduction of unit costs as production increases. Each firm also benefits from agglomeration economies that result from the presence of many other firms, because a wide range of necessary inputs and other services become available (Gillis et al 1996:487). The provision of an effective transport infrastructure may also promote agglomeration economies. The agglomeration of a number of firms at one location may be indicative of the competitiveness of that area. In this regard, it is fair assume that the urban location of road PWV9 has agglomeration economies present as a result of its close proximity to the Rosslyn industrial area. This area is seen as a hub for the automotive industry such as BMW and Nissan. The urban location of the road K8 also has fairly significant agglomeration economies with the grouping of a large number of retail outlets including the Montana shopping centre. The urban location of road K16 has limited agglomeration economies because of the dispersed nature of business activities along this road (see assessment rating in tables 3.17 – 3.19).

Vickerman (2001:5) contends that the impact of changes in transport costs depends both on the initial level of transport cost and the amount with which these costs change, since transport cost affects both the costs of firms and the degree of competition they face. Hence from a high level of transport costs, which implies a fairly low level of economic activity, a reduction to a medium level may result in a substantial increase in concentration towards a region that can exploit most agglomeration economies. However, any further reduction in transport costs may lead to de-concentration from that region since extremely low levels of transport costs reduce the competitive advantage of larger agglomeration economies. In the case of road PWV9 it was shown (see sec 3.5.2) that the construction of this road actually led to increases in travel time with a subsequent increase in transport costs. This supports the contention that this transport improvement will result in the deconcentration of the area to other more favourable locations. This is not the case with roads K8 and K16, where transport improvements will ensure economic concentration in those areas.

From this discussion may infer that the urban market competition that is influenced essentially by agglomeration economies plays a prominent role in determining the potential economic returns associated with road investment.

3.7.4 Implications for economic development

Regarding the economic development component, it was indicated in sections 3.7.1 to 3.7.3 that the following factors are important:

- multiplier effects

- employment creation
- urban competition

In section 3.7.1, it was shown that all three case studies will have some multiplier implications rising from the extent of construction spending and operational implications. Section 3.7.2 indicated that roads K8, K16 and PWV9 will involve significant employment creation with positive economic returns. However, with regard to urban competition, it was evident that the location of road K16 has relatively dispersed economic activities to ensure proper agglomeration economies. In the case of road PWV9, road improvements may actually lead to the deconcentration of the economic activity of the area (see sec 3.7.3). These impacts are depicted in the tables below:

Table 3.17: The economic development component of road K8

Factor	Compliance	Noncompliance
Employment	Yes	-
Multiplier effect	Yes	-
Urban competition	Yes	-
Economic development implications	Compliant	-

According to the discussion in sections 3.7.1 to 3.7.3, road K8 complies with the requirements of all three criteria which impact on economic development and will thus have positive economic development implications.

Table 3.18: The economic development component of road K16

Factor	Compliance	Noncompliance
Employment	Yes	-
Multiplier effect	Yes	-
Urban competition	-	Noncompliant
Economic development implications	-	Questionable

As stated above, road K16 does not have the advantage of agglomeration economies and the economic development implications associated with the investment in this road are thus questionable. The discussion in section 3.7.3 emphasised the possibility that the construction of road PWV9 may actually lead to a deconcentration of economic activity in the study area. This road does therefore not comply with all the criteria to ensure economic development.

Table 3.19: The economic development component of road PWV9

Factor	Compliance	Noncompliance
Employment	Yes	-
Multiplier effect	Yes	-
Urban competition	-	Noncompliant
Economic development implications	-	Questionable

From these three tables it is obvious that only road K8 is compliant with all three factors – hence economic development linked to the construction of road K8 is highly probable. Hence roads K16 and PWV9 were noncompliant with the urban competition factor, their economic development potential is questionable.

3.8 SUMMARY

3.8.1 Economic impacts

Three types of economic impacts are found, namely:

(1) direct impacts
(2) indirect economic effects
(3) induced effects

The relationship between these impacts and road infrastructure investment were analysed.

3.8.2 The interrelationship between road infrastructure investment and economic development

It was shown that several conditions must be complied with to prove a causal relationship between road infrastructure investment and economic development. These are as follows:

- The investment in road infrastructure must be effective in the sense that it improves the performance of the transport network.
- The linkage between road infrastructure investment and economic growth must manifest in transport economic behaviour.
- Road improvements that influence travel behaviour must ultimately be transformed into measurable economic benefits.
- The performance of the network in place must not be ignored.

Each of these components has different implications for economic development and these were discussed in depth in this chapter.

3.8.3 The investment component

Regarding this component, the economic returns are largely dependent on the type of road investment and the magnitude and the efficiency of investment. The economic development impacts are usually measured in terms of localised abutter impacts and wider regional impacts. Care must be taken not to invest in road infrastructure that will cause a leakage in the local economy, because of more favourable market attractions in the larger region.

The type of investment has two dimensions, namely that of its particular technology and that of its purpose. In this regard, the technology relates to the road infrastructure and the purpose to the main objectives of the projects. Since all the case studies are roads, technology is not applicable. However, the objectives of the roads are to promote economic development. All three road projects therefore comply with this first factor. The second factor, the relative size of the investment, describes the magnitude of the road investment. From this section it was evident that road PWV9 is the most expensive road (R350 million) followed by roads K8 (R30 million) and K16 (R64,25 million) respectively. This shows that all three roads are sufficiently sized from a cost perspective. The efficient provision and consumption of the road investment cannot be achieved by all three case studies. This chapter indicated that the construction of road PWV9 does not seem efficient in terms of technical and allocative efficiencies. The allocative efficiency measurement implies optimal output at minimal cost. In the case of road PWV9, this requirement is unobtainable and the cost of the road is 10 times higher than that of road K8. However, roads K8 and K16 are efficient.

3.8.4 The network performance component

The implications for economic development based on transport network performance rest on the premise that an effective transport network will support economic development, while a poorly performing transport network will constrain economic development. An efficient transport network will allow movement of people and goods, resulting in increased flows and interaction within the market, thus assisting economic development. A poor network, however, will restrict market interaction and thus inhibit economic development. Travel flows, savings in vehicle operating costs, network effectiveness and intermodality are determinants to measure the network performance component of the respective roads. The case studies were evaluated against these factors, and any improvement in the specific determinant is considered to show compliance with network performance.

3.8.5 The transport economic behaviour component

The following factors are significant in an analysis of the transport economic behaviour component:

- location and real effects
- social equity
- environment

The economic impact of a good location and associated real estate development was indicated earlier in this thesis. Effective locations reduce transport costs and ensure access to markets. Real estate development has many positive economic impacts – from the construction activities to the operational impacts of businesses. Social and environmental issues may also impact on the economic returns associated with road infrastructure investment. It was shown that environmental considerations may have costly impacts on the construction costs because of the mitigating measures required.

3.8.6 The economic development component

The following factors are important in the economic development component:

- multiplier effects
- employment creation
- urban competition

It was shown that all three case studies will have some multiplier implications as a result of the extent of construction spending and operational implications. Roads K8, K16 and PWV9 will contribute significantly to employment creation with positive economic returns. However, regarding urban competition, it was evident that the location of road K16 had relatively dispersed economic activities to ensure proper agglomeration economies. As far as road PWV9 is concerned, the road improvements may actually lead to the deconcentration of the economic activity of the area.

3.9 CONCLUSION

From this chapter it is evident that certain critical success factors need to be in place to ensure that the maximum economic returns will be obtained during road investment programmes. These factors are related to the urban market and real estate conditions in the area of road investment. This chapter also showed that economies of scale in the study area are required. This is basically measured by sizeable production facilities of firms. In addition, certain agglomeration economies must be evident, as seen by the occurrence of directly productive activities. The area must be characterised by a natural developmental stimuli. These stimuli are measured by the extent of land development applications, the number of queries for land-use changes and the number of illegal land uses. The real estate market is also assessed by certain demand and supply conditions such as rental rates, vacancies and different land-use types.

Intra-urban market competition also plays a role in the economic returns that can be expected when investing in road infrastructure. The potential of the road to cause an economic leakage can be determined by analysing the size of the cumulative market, the region's natural attraction for business, the maturity of the market as well as its location and exposure.

In conclusion, it is also necessary to weigh the size of the investment against that of the expected economic returns based on the critical success factors described. This will balance the problem of the multiplier effect which mainly considers the size of the initial investment.