CHAPTER 7: SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The problem statement of this thesis, namely to maximise the economic returns of road infrastructure investment, was discussed in the opening sections of chapter 1. The research for this thesis focused, inter alia, on the significance of government's SDIs, and the linkage between road infrastructure and the economy and between modelling the transport economic relationships. Within this framework, the researcher endeavoured to achieve the goal of this study, namely to explore ways to maximise the economic returns associated with road infrastructure investment. To this end, it was necessary to realise the following subgoals:

- **Subgoal 1:** To analyse the relationship between road infrastructure investment and economic development

- **Subgoal 2**: To determine under what conditions road investment will maximise the economic returns of spatial locations

- **Subgoal 3:** To develop a procedure that will ensure that road investment proposals will maximise the economic returns associated therewith

- **Subgoal 4:** To develop a formula on road investment and economic development

- **Subgoal 5:** To develop an understanding of the relationship between decision making, road investment practices and actual economic returns

This study succeeded in addressing these subgoals. The causality of the relationship between road infrastructure investment and economic development was analysed in chapter 3. Chapters 2 and 3 highlighted the importance of sufficient development demand based on economies of scale and other agglomeration economies of the urban real estate market, proving prerequisites for unlocking the inherent economic potential of spatial locations through road construction. Chapter 4 outlined a procedure in terms of the modelling strategy and checklist to guide the modelling of the transport economic relationships for the analysis of road investment proposals. By analysing the direct impact of road construction activities and the subsequent operational impacts, the two perspectives of project specific methods and the wider macroeconomic analysis of road investment were bridged. Chapter 5 developed a formula on road investment and economic development, while chapter 6 analysed the relationship between decision making, road investment practices and economic returns.

The next section summarises the primary results of chapters 2 to 6.

7.2 SUMMARY

The principal findings of the previous chapters are summarised below.

7.2.1 The nature of road infrastructure

Chapter 2 assessed the nature of road infrastructure in order to determine its relation to economic development. There are two schools of thought on the influence of road infrastructure on economic development:

- The first school maintains that roads play a key role in development. It is assumed that the provision of roads will almost automatically lead to development in a region.

- The second school maintains that roads must be considered as one of the elements of a development plan, but not necessarily the most important one.

These two schools of thought invariably influence road investment decisions with different levels of success. The first school follows a supply-side approach, while the other second advocates demand-side approach. In this regard, the basic relationship between the activity system (which impacts on the urban market) and the transport network is significant. The activity system is directly related to the land-use system – hence the size, strength, economic make-up and location of the activity system determine the demand for the transport system. The supply of transport is determined by the transport system. The supply of transport impacts on the performance of the transport network. This means that the demand for transport is relative to the activity system, while the supply of transport is a function of the transport system.

In this regard, the following two investment approaches were investigated:

(1) **The balanced growth doctrine.** This so-called “big push” doctrine consumes the form of planned large-scale expansion of infrastructure. This approach focuses strongly on the supply of infrastructure to boost economic development. The MCDC (road PWV9) was used as a case study. On the basis of the findings of this study, it was concluded that the balanced approach doctrine is unsuitable for road infrastructure investment decisions.

(2) **The unbalanced growth doctrine.** This doctrine is especially relevant to situations in which limited resources are available for investment and only projects that will make the greatest contribution to development relative to their cost can be undertaken. Road K8 was used as a case study. It was found that this approach is highly relevant to road infrastructure investment decisions in South Africa, because of the low risk to financial resources and high certainty of real economic development.

It was found that transport system improvements should be typically demand led, with roads and public transport trying to keep pace with development. These findings question the existence of the first school of thought. This is further highlighted by the important characteristic of road infrastructure, namely its lumpiness, which basically means that roads are expensive, take a long time to plan and are not easily removed once in place. Other characteristics include a high minimum durability, long gestation periods and the requirement for a minimum social overhead capital industry mix.

Finally, two externalities associated with road infrastructure were identified, namely technological and pecuniary externalities. These externalities influence economic efficiency and their existence should be considered when seeking road infrastructure investment solutions.

7.2.1.1 Conclusions

The characteristics of road infrastructure complicate road investment decisions. This is especially problematic for developing economies such as South Africa, which lack the resources to make inappropriate investment decisions.

Road infrastructure is expensive and cannot be easily replaced – the so-called "lumpy" characteristic. It is argued that the demand-side approach to road infrastructure investment is more appropriate because demand indicators identify a need for the road.

The characteristic of high minimum durability implies that roads have a long economic life. It is thus essential to ensure that road investment decisions are based on an optimum usage for their entire economic life. Wrong investment decisions lead to inefficiency. This suggests that the demand-side approach to road infrastructure investment seems more appropriate.

Another characteristic of road infrastructure is its long gestation period. Proponents of the supply-side approach overemphasise this characteristic. They argue that the initial low traffic volumes and concurrent economic development will ultimately result in higher traffic volumes and long-run development. This argument cannot hold water in countries with limited financial resources. The demand-side approach implies that the gestation period for roads should not be unnecessarily long. Excessively long gestation periods also tend to mask incorrect investment decisions.

The last characteristic, namely the requirement of a minimum social overhead capital industry mix, implies that certain market demand characteristics are a precondition for road investment decisions.

The conclusion drawn is that the first school of thought is not appropriate for South Africa, but that road infrastructure investment decisions should rather be based on the second school of thought. A demand-side approach towards road infrastructure investment clearly provides optimum investment solutions, given the nature of roads.

7.2.2 The relationship between road infrastructure investment and economic development

Chapter 3 analysed the relationship between road infrastructure investment and economic development.

To determine this relationship, the economic impacts of road projects had to be measured and expressed as the level of economic activity in an area. These impacts were viewed in terms of business output (or sales volume); value added (or gross regional product); wealth creation (including property values); personal income (including wages); and job creation. Three types of economic impacts are prevalent:

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

From the above, one may infer that in the analysis of the impact of road infrastructure investment on economic development it is necessary to consider the local economy, market and other conditions and other factors that influence the economy. Four premises are of significance here:

(1) The investment must be effective in the sense that it improves the performance of the transport network.
(2) The causal linkage between road infrastructure investment and economic growth must manifest in changes in transport economic behaviour.
(3) Transport improvements that influence travel behaviour must ultimately be transformed into measurable economic benefits.
(4) The performance of the network that is in place must not be ignored.

These results are now summarised.

(1) **The investment component**. Road infrastructure investment decisions need to be carefully considered. The following factors merit consideration:

- **The type of investment.** The type of the investment relates to the technology (ie a road) and to the purpose of the investment. In this instance, the purpose of road infrastructure is to maximise economic development stemming from road construction programmes.

- **The magnitude of the investment.** The magnitude of the investment reflects its relative size – hence the economic effects of the road investment also need to be considered. This is done by analysing the localised abutter impacts associated with shifts in traffic flow patterns and routes, and the regional business attraction impacts of road improvements. The first aspect is measured by analysing travel cost effects, logistic cost effects as well as accessibility and scale economy effects. The regional business impacts are measured by analysing the cost of doing business in a region, the region's market potential and natural business attraction.

- **The efficient provision and consumption of the investment.** The efficiency of road infrastructure investment is measured by analysing the technical efficiency, the allocative efficiency and the social optimum. Technical efficiency basically means that the investment's output (road space provided) must meet the demand (extra traffic) for the facility. Allocative efficiency implies optimum output at

minimum cost. The social optimum requires the consideration of all the social costs and benefits.

(2) **The network performance component**. There are four principal determinants of the network performance, namely:

- accessibility and travel flows
- savings on vehicle operating costs
- network effectiveness
- intermodality

(3) **Transport economic behaviour.** Transport economic behaviour comprises a number of elements:

- **Location and real effects.** Location effects comprise convenience, favourable exposure and unfavourable exposure. In addition, it is important to note that real estate markets have certain characteristics, which include the highly localised nature of the market; the slow adjustment of supply and demand to new market conditions; durability and fixed location; and gestation period. These factors play a vital role in the economic returns associated with road infrastructure investment.

- **Social equity and the environment.** The principle of social justice merits attention. People should be afforded the opportunity for self-improvement. Road infrastructure investment achieves this by providing greater mobility in townships, employment opportunities during road construction and the promotion of local economic development (LED) initiatives as part of road infrastructure

investment projects. From an environmental perspective, however, roads impact negatively on the environment in terms of visual impacts, noise and vibration, disturbance of ecosystems, atmospheric emissions, and severance impacts. These impacts have negative economic consequences.

(4) **The economic development component**. Four factors are considered here:

- **The multiplier effect and road infrastructure.** The definition of the multiplier is the ratio of the change in national income to the change in spending which involves the change in national income. The increase in spending is thus the investment in the new road. This shows that the multiplier associated with road investment can have a significant effect on the economy of an area. The higher the initial investment, the higher the multiplier effect will be.

- **Productivity implications of road infrastructure.** This concerns the way in which infrastructure investment impacts on the productivity of the private sector. It was found that investment in infrastructure, particularly transport infrastructure, may have significant effects on economic productivity.

- **Economic effects of government provision of road infrastructure.** Government provision of road infrastructure is not always adequate – the so-called "failure of omission". This failure results in the deterioration of transport facilities which raises the costs of many private sector activities. It is argued that services provided by public infrastructures enter directly and indirectly into the private production process, and thus affect the productivity of the private economy.

- **Urban market competition and economic development.** Road infrastructure improvements allow the integration of urban markets, thus also introducing more competition. Interurban and intraurban markets are encountered. In instances of imperfect market conditions, improved transport may lead to unfair competition and reduced parity between regions. The existence of scale economies is the major factor that changes the expected outcomes of perfect conditions because firms with the ability to exploit such economies will be able both to overcome higher transport costs more easily and take advantage of reductions in such costs. The role of scale economies is thus compounded by the existence of vertical linkages in a region. The finding here was that scale economies impact on firms' decisions to reduce transport costs in a local market, because this may act as a barrier to competition. In certain instances, a reduction in transport costs will increase competition.

7.2.2.1 Conclusion

In the investment component, it was found that 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.

The implications for economic development based on the transport network performance are clear – an effective transport network will support economic development, while an ineffective one will constrain economic development. A transport network that functions properly will allow movement of people and

goods, resulting in increased flows and interaction in the market, thus assisting economic development. A poor network, however, will restrict market interaction and thus curb economic development.

The transport economic component reaffirmed the importance of a suitable location and associated real estate development. Good locations reduce transport costs and ensure access to markets. In addition, it was emphasised that social and environmental issues may no longer be ignored during road infrastructure investment decisions. Strict environmental controls and associated mitigating actions will effectively increase the costs of road infrastructure. The negative environmental externalities are then internalised as part of the overall project. This will enable decision makers to achieve a social optimum because all costs are discounted. It was further found that application of the principle of social justice will promote local economic development.

The economic development component highlighted the role of the multiplier effect in road infrastructure investment as well as the productivity implications of road infrastructure. Lastly, it was found that imperfect market conditions transport improvements may result in a redistribution of firms locating in the area (thus no wider economic impacts).

7.2.3 Economic modelling and case studies

Chapter 4 provided a framework for modelling transport economic studies. It also assessed local and international case studies. The modelling strategy proposed a model structure for road infrastructure investment analysis. In order to achieve sufficiently accurate modelling results it is necessary to focus on the following factors:

- definition of the study area
- market and real estate analysis
- the impacts of road infrastructure improvements
- regional and business attraction impacts
- economic modelling and impact analysis
- economic impacts list

In this thesis, a checklist was developed for the purposes of conducting transport economic modelling. This was used to assess local and international case studies.

The key findings of these case studies were as follows:

- A detailled description of the direct and indirect study area is of primary importance, because this promotes a better understanding of the project findings. It further seems logical to link direct transport improvement to the direct study area, while the wider economic effects are linked to the indirect or secondary study areas. Some of the case studies did not define the study area and this complicated the analysis of the study and project benefits.

- Measurement of the direct transport impacts or improvements is equally important. Studies that do not include this component lack a vital component of transport economic analysis. These improvements include, inter alia, transport cost savings, travel time savings and increases in travel speed. Different transport modelling techniques are used to measure these improvements. The extent of the study will determine what modelling technique should be used.

- Different economic modelling techniques are used to model the wider economic impact of road projects. It is useful to subdivide the assessment

into two phases, namely the construction phase and the operational phase. The key indicators used are jobs created, value added and consumption increases.

- The spatial disaggregation component of the studies was the most problematic. Only the studies that used complex macroeconomic modelling adequately addressed zonal disaggregation. Furthermore, an analysis of the real estate market is necessary. It is also meaningful to conduct a proper study of the real estate market.

- All the benefits of the project should be indicated in an integrated benefit matrix. These benefits should include direct transport benefits, economic impacts and nonmodelled benefits. Some studies did not summarise the benefits into a matrix which would complicate matters for decision makers. It is also vital to clearly justify that the potential problem of double-counting has been adequately addressed.

The key findings of the case studies underline the importance of a good modelling strategy.

From the case studies it was evident that two models were mostly used for economic studies, namely:

(1) input-output accounting models
(2) general equilibrium simulation models

A modelling methodology was developed to ensure the standardisation of transport economic modelling in South Africa. It is proposed that any transport economic study should include four stages, namely:

(1) project assessment
(2) transport impact analysis
(3) indirect economic impacts
(4) integrated benefit matrix

The process was depicted in figure 4.1.

7.2.3.1 Conclusion

It was proposed that any transport economic study should basically follow project stages, namely project assessment, transport impact analysis, indirect economic impacts and an integrated benefit matrix. This approach will ensure that a correct transport economic study is conducted, and that all the benefits of any road project are considered.

7.2.4 The formula of road investment and economic development

Chapter 5 developed a formula of road investment and economic development. The economic returns of road investment decisions are primarily influenced by various factors. In section 5.2, these factors were collated into four markets:

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

The **real estate market** is characterised by four elements. The scoring method used for each characteristic is provided by either a table or a figure. These characteristics are

(1) vacancy rates (scoring derived from fig 5.1)
(2) rental rates (scoring derived from figs 5.2 & 5.3)
(3) real estate demand (scoring derived from fig 5.5)
(4) building plans (scoring derived from fig 5.6)

The land development market has four characteristics, namely:

(1) development stimulus (scoring based on qualitative assessment)
(2) development applications (scoring derived from fig 5.7)
(3) development activity (scoring derived from fig 5.8)
(4) illegal land-uses (scoring derived from fig 5.9)

The urban economic market comprises four characteristics, namely:

(1) business attraction (scoring derived from table 5.3)
(2) agglomeration economies (scoring derived from fig 5.10)
(3) maturity of market (scoring derived from table 5.4 & figs 5.11)
(4) market exposure (scoring based on descriptive assessment)

The road and other infrastructure market also has four characteristics, namely:

(1) infrastructure provision (scoring derived from table 5.6)
(2) traffic demand (scoring derived from table 5.7)
(3) economic leakage or inflow (scoring derived from fig 5.12)
(4) transport costs (scoring derived from fig 5.13)

These factors impact on the causal relationship between road infrastructure and economic development, which manifests itself in economic returns.

The following formula was proposed:

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

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

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

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

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

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

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

Interpretation of ER values:

- ER < 50% = Poor economic returns expected with a high investment risk. Carefully reconsider this project and abandon if necessary.

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

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

7.2.4.1 Conclusion

This formula is a vital first-order system for analysing the economic development potential related to road infrastructure investment.

7.2.5 Road investment practices and maximised economic returns

Chapter 6 investigated the relationship between policy making, investment decision and economic returns. The main findings are summarised below.

Four factors are important in examining the relationship between transportation and economic development, namely:

(1) the relevant type of transport investment
(2) the data necessary to analyse the economic effect of the investment

(3) appropriate methodology to analyse the economic effect

(4) the proper dissemination of the results and education of professionals regarding the economic effects of transportation investment

These four factors are necessary to measure road investment projects in terms of inputs, outputs, outcomes and impacts for the purpose of maximising economic returns. These terms are explained below:

- **Inputs.** Inputs are the resources and capacity that are mobilised to implement the road project. Inputs thus relate to the cost of the project as well as other activities involved in the road investment process.

- **Outputs.** The output is the specific project that directly results from the inputs, namely the actual road that is constructed.

- **Outcomes.** Outcomes refer to the direct consequences or results emanating from an output. The outcome is thus the change in conditions that occurs once the road has been constructed. Outcomes are the direct results of the project and may include diversion of traffic to the new road.

- **Impacts.** Impacts reflect the wider economic implications of the project. These impacts may relate to a growth in business sales or income or job creation as a result of the road project. They also occur over a longer period than the actual implementation time.

The relationship between inputs, outputs, outcomes and impacts of road projects is a key indicator of the accuracy of policy and the correctness of political decision making on road investment decisions. The relationship between input and

outcomes measures efficiency, and that between inputs and outcomes effectiveness.

Current road investment practices are not focused to ensure maximised economic returns. This conclusion is based on the following:

- Uncertainty about the important relationship between road infrastructure investment and economic development has led to inappropriate policy decisions.
- Limited understanding of the nature of road infrastructure often results in ineffective investment decisions with poor economic returns.
- A lack of understanding of the relationship between road infrastructure investment and economic development, culminates in limited economic growth.
- Improper modelling techniques or inadequate economic studies lead to poor investment advice.
- There is no theory on road investment – hence road investment priorities was not based on the maximised economic returns associated with these investments.
- A faulty relationship between policy making and investment decisions results in poor economic returns.

The following road infrastructure investment reforms are required to ensure the optimum economic returns associated with road infrastructure investment decisions:

- creating greater efficiency in road infrastructure investment decisions
- rethinking road prioritisation
- depoliticising road infrastructure investment decisions

- institutional reforms

7.2.5.1 Conclusion

It was shown that decision making and policy making play a crucial role in influencing and strengthening the impact of road investment on economic development. Policy making includes decision making by the political organ and politicians. It is thus evident that policy making and the decisions involved, which affect both economic returns and road investment, are the predominant factor in realising the economic development benefits from road infrastructure investment. It was shown that the relationship between these factors does not support maximisation of the economic returns of these road investments. The relationship between policy making and road investment decisions is such that high economic returns cannot be expected. This will lead to either over- or underinvestment of road projects in South Africa.

In order to maximise the economic returns associated with road infrastructure investment it is necessary to optimise the interplay between decision making, economic returns and road investment. The policy reforms proposed in this chapter should promote this goal.

7.3 FINDINGS

The problem statement of this thesis was to maximise the economic returns of road infrastructure investment. The aim of the study conducted was to test the purpose of the thesis, namely to explore ways to maximise the economic returns of road investment. To achieve this end it was necessary to comply with the subgoals of the study. These subgoals will now be discussed.

7.3.1 Subgoal 1: To analyse the relationship between road infrastructure investment and economic development

As stated previously, chapter 3 analysed the relationship between road infrastructure investment and economic development, while chapter 6 assessed the cost implications of deficient road infrastructure.

The relationship between road infrastructure investment and economic development is measured by three types of economic impacts, namely the direct impacts, the indirect economic effects and the induced effects. These impacts are dependent on the magnitude of the road infrastructure investment, but also on other locational and market considerations. On the basis of the research conducted it was found that this relationship depends on four important conditions.

Firstly, the investment in road infrastructure must be effective. This implies that the performance of the transport network must be improved. The investment component demands that the aim of the investment should be clear, the magnitude thereof should have measurable impacts, and the road infrastructure provided should be efficiently used. **Secondly**, the road network performance must be improved. These improvements are usually measured by means of travel flows, savings in vehicle operating costs and other network efficiencies. **Thirdly**, transport economic behaviour is of utmost importance. This behaviour is influenced by the location of the road infrastructure and the real estate market in that location. Some locations are more favourable than others, and this manifests in the real estate market conditions prevalent at those locations. Certain social equity and environmental impacts also influence the transport economic location. **Lastly**, the economic development component is influenced by the urban market competition, as well as the efficiency of government provision of road

infrastructure. In imperfect market conditions, road investment may impact either positively or negatively on economic development.

From the above, one may infer that the relationship between road infrastructure investment and economic development is not always causal. All of the above four conditions must be met before this relationship is causal. For instance, road infrastructure improvements that lead to improved traffic flows and network performance do not always result in economic development. Road improvements in mature residential areas with congestion improvements will not contribute to real economic development. Similarly, it must be clear that any economic development was in fact caused by the road infrastructure.

Given the evidence produced in this thesis it is clear that the first school of thought, namely that the provision of road will almost automatically lead to economic development, is not true. The evidence suggests that the second school of thought has been supported, namely that roads must be considered as a vital element of any economic development plan. The conditions described above must be met before the provision of roads can be linked to economic development.

This study thus adequately addressed subgoal 1.

7.3.2 Subgoal 2: To determine under what conditions road investment will maximise the economic returns of spatial locations

Chapters 2 and 3 dealt with this important goal. A lucid explanation of this subgoal is necessary.

Subgoal 2 refers to the basic relationship between the transport system and the activity system. The activity system is directly related to the land-use and real

estate system. It was argued that the size, strength, economic make-up and location of the activity system determine the demand for transport. The flows that result from the interaction between the transport and activity systems, impact on economic development. The inherent economic potential is determined by the existence of directly productive activities (DPAs), the elasticity of development demand, the profitability of firms, the maturity of the urban market, the real estate market activities and other agglomeration economies in the region. These factors are part and parcel of the critical success factors required to maximise the economic returns of road infrastructure investment. Many negatives reduce the inherent economic potential of areas. The characteristics of real estate markets also need to be clearly understood. These characteristics were discussed in section 3.6.1. The important characteristics relate to the slowness of supply and demand to react to new market conditions caused by road infrastructure investment, or the durability of real estate in a fixed location.

For instance, the economic potential of a large vacant area with insignificant development demand (immature location), will not be triggered by road investment – the slowness of the supply and demand of the real estate market to respond to new market conditions, as well as the highly localised nature of existing real estate markets in competing intra-urban markets fulfilling a major role. Similarly, road improvements in a well-established area (mature location) will not lead to major economic development because the economic potential of the area may already be fully exploited. Road provision in such areas may even cause economic leakages by linking these areas to more favourable locations with better agglomeration and scale economies.

As stated, many factors such as the following, determine the inherent economic potential of an area:

- the extent of development applications
- the remoteness of the location
- the maturity of the location
- distance from competing intra-urban markets
- real estate market conditions
- the strength of the total urban market

Many other factors also impact on the inherent economic potential of an area. The need for road infrastructure in that location will thus influence the actual economic potential of an area. In chapter 6 it was shown that poor investment decisions have high economic and other costs. Chapter 5 proposed a theory to measure the expected economic returns of road infrastructure investment proposals. This theory will also guide investment decision making in order to maximise the economic returns associated with roads. Subgoal 2 was thus met.

7.3.3 Subgoal 3: To develop a procedure to ensure that road investment proposals will maximise the economic returns associated with road investment

Chapter 4 addressed this subgoal. The purpose of the modelling strategy, together with the process depicted in figure 4.15, was to ensure that current modelling theories and supporting methodologies are correctly used to help transport economists assess the potential economic impacts of road investments, and to assist with the design of specific transport economic modelling studies. Transport economic modelling must be done with a clear acknowledgement that of the complexity of the relationship between road investment and actual economic returns will be simulated in the modelling exercise.

Thus in order to achieve sufficiently accurate modelling results, it is necessary to focus on the following factors when developing a strategy for transport economic models:

- definition of study area
- market and real estate (spatial) analysis
- impacts of road infrastructure improvements
- regional and business attraction impacts
- economic modelling and impact analysis

Some of the work done in chapter 3 also ensured compliance with this subgoal. This was achieved by analysing the localised abutter commercial business impacts as a result of transport improvements, and the regional business attraction impacts. The aforementioned impacts were measured by assessing the travel cost effects, logistic cost effects and accessibility. The regional business attraction impacts are a function of the size of the region's consumer and labour markets, the cost of doing business in the market and the natural attraction for business in the region. Regarding the project-specific economic impacts, the construction phase assessment was done to determine the direct economic impacts of the road construction, while the wider indirect economic impacts were measured in the operational phase.

In conclusion it can be stated that the study and modelling process depicted in figure 4.1 proposed a study and modelling methodology to be used for transport economic studies – hence developing a procedure to ensure that road investment proposals will maximise the economic returns associated with road investment.

7.3.4 Subgoal 4: To develop a formula of road investment and economic development

Chapter 5 developed this formula. The economic returns of road investment decisions are primarily influenced by various factors. In section 5.2 these factors were collated into four markets, each with its own scoring system, namely:

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

The following formula was proposed:

ER = f (D; R; U; T)
(**Note:** Section 7.2.4 summarised the main aspects of this formula.)

This formula of road investment and economic development was tested against the three case studies. The empirical findings of the theory correlated with the theoretical findings of the previous chapters namely, the maximum economic returns associated with road K8 versus the low economic returns associated with the investment of road PWV9. The above discussion shows that this subgoal was achieved.

7.3.5 Subgoal 5: To develop an understanding of the relationship between decision making, road investment practices and actual economic returns

Chapter 6 analysed the relationship between decision making, road investment practices and economic returns. It was found that decision making and policy

making play a crucial role in influencing and strengthening the impact of road investment on economic development. To maximise the economic returns associated with road infrastructure investment it is necessary to comprehend the interplay between decision making, economic returns and road investment. Figure 6.1 depicts the interplay between policy making and road investment in achieving maximised economic returns.

The interplay between the above three factors is important. The road investment factor refers to the road proposal being considered for investment and may be viewed in terms of the nature of investment, and its scope and its location. The factor of economic returns relates to the expected economic returns associated with the road project. These economic returns are only theoretical if these road projects are not approved and investments made in them according to their economic potential. This indicates the significance of the third factor, namely policy and decision making. Policy making refers to noneconomic factors that influence economic growth. Most importantly, this includes decision making by the political organ and politicians. From this relationship it is evident that policy making and the decisions emanating from it, which affect both economic returns and road investment, are the predominant factor in realising economic development benefits from road infrastructure investment.

Correct decision making is influenced by the budget constraints in terms of available funds for new road projects. This scarcity problem thus emphasises the opportunity cost related to road investment, namely that limited funding used for the construction of one road project implies that the construction of another road will be doomed. Poor investment decisions thus means a high opportunity cost and low returns for the country. This discussion again highlights the prominence given to road PWV9 and the MCDC which is expected to have low economic returns. It was also stated that road PWV9 forms part of this policy statement, while roads K8

(high economic returns) and K16 are of minimal significance from a policy perspective. It is thus obvious that road PWV9 will be the project with the highest priority, and probability for favourable decision making. This is all wrong, because it was shown in this thesis that this project has the lowest potential for economic returns. Hence improper decision making may have long-term opportunity cost implications.

The relationship between the inputs, outputs, outcomes and impacts of road projects affects decision making. This relationship is an indicator of the accuracy of policy and the correctness of political decision making on road investment. The above discussion shows that subgoal 5 was achieved.

The above discussions are proof of the fact that the subgoals formulated for this thesis were in fact achieved. Hence, one may conclude that this study did explore ways to maximise the economic returns of road infrastructure investment. The main goal of this study was realised.

7.4 CONCLUSIONS

The primary conclusions to be drawn from this study are as follows:

(1) The characteristics of road infrastructure (ie lumpiness, high minimum durability, long gestation period and requirement for a minimum social overhead capital industry mix) complicate investment decisions. The demand-side approach to investment is thus more appropriate for the following reasons:

- Demand indicators identify a need for the road.

- Sufficient demand will ensure that roads will experience an optimum usage for their entire economic life.
- Sufficient demand ensures that the gestation period for roads should not be unnecessarily long.
- Certain market demand characteristics are a precondition for road investment decisions.

A demand-side approach towards road infrastructure investment thus provides optimum investment solutions.

(2) The relationship between road infrastructure investment and economic development is not always causal. The degree of causality will be determined by the following components:

- The investment component – economic returns are largely dependent on the type, magnitude and efficiency of the investment.
- Transport network performance – an efficient transport network will support economic development, while an ineffective one will constrain it.
- Transport economic behaviour – a good location, with associated real estate development, will mean a reduction in transport costs and improved access to markets.
- The economic development component – the impact of the multiplier effect will be of primary importance.

(3) Transport economic studies should essentially follow four project stages, namely project assessment, transport impact analysis, wider economic impact analysis, and finally, the preparation of an integrated benefit matrix.

(4) No evidence was found that the first school of thought is applicable to roads. It is therefore assumed that roads do not play a leading role in development. The second school of thought is thus applicable, but only if there is a causal relationship between road investment and economic development.

(5) The formula of road investment and economic development as proposed in this thesis provides an effective method to ensure the probability of maximised economic returns of road investment projects.

(6) The relationship between road investment, decision making and economic returns in this country is such that road investment projects will not maximise economic returns. This is largely because of poor policy making. The improvements proposed in chapter 6 should enhance this relationship.

7.5 RECOMMENDATIONS

Based on the conclusions and findings of this study, the following recommendations are made:

(1) The demand-side approach, based on the principles of the unbalanced growth doctrine, should be followed for road infrastructure investment decisions.

(2) The economic impact checklist, as shown in annexure A, should be used to conduct transport economic studies.

(3) The four-stage modelling process depicted in figure 4.1 should be followed to conduct transport economic studies.

(4) The reforms for a road investment framework should be implemented in order to improve the relationship between decision making, road investment and maximised economic returns.

(5) The formula of road investment and economic development should be accepted and used as an early indicator of expected economic returns for road infrastructure investment decisions.

7.6 FUTURE RESEARCH

This thesis raises the following two crucial issues that should be addressed in future research:

(1) **The formula of road investment and economic development.** The formula comprises four markets each of which is characterised by four subelements. Compliance with these subelements is based on a scoring system. The scoring system forms the basis of the practical application of this theory. The case studies used in this thesis were all located in the Pretoria metropolitan area. The data used were thus limited to the geographical constraints of the case studies. It is therefore necessary to obtain and refine the data requirements for a scoring system that would be applicable to the whole of South Africa.

(2) **Spatial development initiatives (SDIs) and development corridors.** As stated previously, the SDI programme is part of government's macroeconomic strategy. It is a government initiative to promote development in specific areas – or more specifically, it is a short-term investment strategy aimed at unlocking inherent economic potential in specific spatial locations in South Africa. Development corridors form part

of these SDIs. Unfortunately, no specific guidelines are provided to ensure successful implementation. Proponents of the development corridor concept argue that these corridors have significant political value. However, this thesis highlighted the potential inefficiencies related to political influences in transport investment. The research required should focus on the formulation of proper guidelines to ensure successful development corridors that will actively ensure the unlocking of inherent economic potential. The research findings in this thesis should therefore be used as the basis for future research in this field.