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THE ROLE OF THE ELECTRIC
TROLLEY BUS IN URBAN
TRANSPORT



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C. W. V. MOSTERT

RANDSE AFRIKAANSE UNIVERSITEIT
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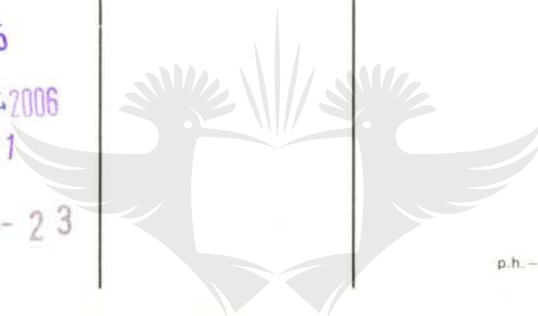
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THE ROLE OF THE ELECTRIC TROLLEY BUS
IN URBAN TRANSPORT

by

CORNEL WYNFORD VAUGHAN MOSTERT

THESIS

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SYNOPSIS

1. Die probleem

Die probleme waarmee Suid-Afrikaanse openbare pendelvervoerondernemings te kampe het word tans verder bemoeilik deur die ontwikkeling van 'n informele swartvervoersektor wat van minibusse en huurmotors gebruik maak.

Hierdie sektor kompeteer met tradisionele massasvervoerstelsels wat in Suid-Afrika uitsluitlik uit dieselbus en swaarspoordienste bestaan. Alhoewel hierdie mededinging ondersteun word deur voorstanders van die vryemarkbeginsel, wys ander waarnemers daarop dat dit tot laer standaarde, wanorde en hoër koste sal aanleiding gee.

Sou dit wenslik geag word om 'n belangrike rol vir tradisionele vervoerstelsels in Suid-Afrika te handhaaf, sal oorweging aan vervoermodusse wat aan sekere vereistes voldoen gegee moet word naamlik;

- dit moet 'n beter beeld vir openbare massapendelvervoer skep en passasiers kan lok;
- dit moet inpas met die behoeftes van derde-wêreld omstandighede;
- dit moet ekonomies wees om te bedryf.

Die rol van die trolliebus word teen hierdie agtergrond ondersoek.

2. Die doel van die studie

Die trolliebus is 'n vervoermodus wat in terme van sy kapitaalligting tussen die dieselbus en ligtespoor lê. Die gevolg is dat die trolliebus relatiewe laer grenskoste as die dieselbus aanbied. Hierdie voordeel word egter nie ten volle benut nie. In die meeste stede waar dit gebruik word, geniet die trolliebus nie die voordeel van afgesonderde bane nie en word in gewone strate gebruik waar dit deur verkeersophoping vertraag word. Boonop loop trolliebus en dieselbusroetes in baie stede oor dieselfde roetes, met die gevolg dat die oorhoofse drade en infrastruktuur 'n laer benutting geniet.

Die "ideale" rol vir trolliebusse sou stellig wees waar 'n hoë vlak van vervoerkoördinasie bestaan – d.w.s;

- trollie- en dieselroetes behoort nie te oorvleuel nie;
- oorstapperiewe tussen roetes moet voldoende wees;
- tydtafels behoort met mekaar te integreer;
- gekombineerde reisgeldstelsels moet aangebied word.

Omdat sulke omstandighede nie in Suid-Afrika bestaan nie, moet die rol van trolliebusse teen 'n minder gunstige agtergrond oorweeg word. As gevolg hiervan word 'n beperkte benadering gevolg. Die doel van die studie is om die volgende aspekte te ondersoek:

- die rol van die trolliebus in die ontwikkeling van 'n beter beeld vir openbare vervoer en om passasiers te lok;
- die anti-trolliebus argumente wat aangevoer is om hulle onttrekking te regverdig;
- die potensiële rol van die trolliebus in derde-wêreld stede;
- die ekonomiese eienskappe van trolliebusse in Suid-Afrikaanse omstandighede.

3. Die metodiek van die studie

In hoofstukke 2 tot 5 van hierdie studie word die geskiedenis van verskillende trolliebusondernemings bespreek. Die historiese verloop van sake wat tot die oorlewing van trolliebusse in sekere stede en hulle onttrekking in ander stede gelei het, word ondersoek. Die onderliggende gewildheid van trolliebusse onder die publiek word ook uitgewys. Hulle rol in ontwikkelende stede word ook kortliks geskets.

In hoofstuk 6 word die redes wat vir hulle onttrekking in sekere stede aangevoer is, ontleed en bespreek.

Hoofstuk 7 ondersoek die gewildheid van trolliebusse in dieper besonderhede en stel voor dat daar 'n verband tussen trolliebusse en hoër passasiersgetalle in dié stede waar hulle gebruik word, is.

Hoofstuk 8 sit die ekonomiese eienskappe van trolliebusse in Suid-Afrika uiteen en beskryf die omstandighede waaronder hulle regverdig kan word.

4. Die bevindinge en voorstelle van die studie

In hoofstuk 9 word die volgende bevindinge saamgevat:

- die trolliebus geniet die ondersteuning van die algemene publiek;
- daar is 'n verhouding tussen trolliebusgebruik en hoër passasiersgetalle;
- die redes aangevoer om die onttrekking van trolliebusse te regverdig is tot 'n mate oordryf;
- die trolliebus kan 'n bydrae maak in die verbetering van vervoergeriewe vir swart pendelaars in Suid-Afrika;
- die trolliebus is ekonomies regverdigbaar onder sekere omstandighede.

Daar word voorgestel dat voldoende oorweging weereens geskenk word met betrekking tot die instelling van trolliebusse in Suid-Afrikaanse stede en dat die trolliebus as alternatief tot spoorstelsels oorweeg word.



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CHAPTER 1

THE ROLE OF THE ELECTRIC TROLLEY BUS IN URBAN TRANSPORT

1.1 THE BACKGROUND TO THIS STUDY

The problems and difficulties associated with moving about in the cities of the world are apparent to all urban dwellers. Congestion, delay, noise and accidents feature daily in their lives. Urban growth has increased the demand for services, among which passenger transport forms a major part. This increase in demand is a dynamic, ongoing process and it can be expected that transport will continue to pose severe problems, in spite of academic research, investigations and commissions of inquiry.

In South Africa the transport problem is compounded by a "dualism" which reflects the mixture of first-world and third-world characteristics in the economy. One of the many results of this dualism is the emergence of an informal black transport sector using minibuses and taxis. This sector is competing with "traditional" forms of public transport, which in South Africa consist of diesel bus and heavy rail services. Although this development is strongly supported by advocates of the free-market system, other observers point out that the unchecked growth of such a sector leads to disorder, low social standards and ultimately, higher costs.

The emergence of this sector is also taking place against a background of a high level of dissatisfaction with the "traditional" forms of transport. This dissatisfaction is both physical and psychological in origin. From the physical point of view, traditional transport is regarded by many as overcrowded, inconvenient and uncomfortable. From the psychological point of view, traditional transport is perceived by many as an instrument of Government policy and is therefore regarded with a degree of resentment.

It is not the intention of this study to justify the need for traditional transport or to suggest the optimal balance between public and private transport. If, however, it is considered politically and socially desirable to

maintain a significant role for traditional forms of public transport in South Africa then proper consideration should be given to those forms of transport which satisfy the following conditions :

- they should be able to raise the image of public transport and attract passengers
- they should be suitable for third-world conditions
- they should be economical in operation

It is against this background that the potential role of the trolley bus will be considered.

1.2 THE SCOPE OF THIS STUDY

The trolley bus has been part of the urban transport scene for over 70 years. Since 1910 there have been over 700 separate trolley bus systems throughout the world at one time or another. Today there are approximately 300 cities and towns which use them.¹⁾ The part played by the trolley bus has been limited - for example in 1954 when it reached its maximum extent in North America it accounted for only 9% of all public transport mileage.²⁾ In spite of its limited role however, the trolley bus can be regarded as a form of transport of potential significance. Since 1969 it has been experiencing a modest renaissance and renewed interest is being shown in its role as a comparatively low-cost solution to the transport problems of congested third-world cities.

The trolley bus is a moderately capital-intensive form of transport - in terms of its initial cost it falls between the diesel bus on the one hand and light rail on the other. Because of its higher fixed cost, the trolley bus enjoys higher "returns to scale" than the diesel bus. It appears, however that these economies of scale are seldom exploited to the full. Whereas rail systems are usually introduced only after detailed planning and are often given the benefit of specially reserved track, the trolley bus usually shares congested streets with other traffic. In addition, diesel bus routes frequently overlap trolley bus routes, with the result that the overhead installations are under-utilised.

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- 1) MURRAY, A.G., World Trolley Bus Systems, Trolley Bus Magazine, Journal of the Trolley Bus Museum Company, London, May 1982, p. 49.
 - 2) TRANSPORTATION RESEARCH BOARD, Special Report 200, The Trolley Bus: Where It Is and Where It's Going, National Academy of Sciences, Washington, D.C., 1983, p. 25.

The "ideal" role for trolley buses would therefore seem to be in transport networks where a high degree of co-ordination exists. This implies that trolley bus routes and other routes would be separated, that adequate transfer facilities would be provided for passengers changing from one route to another, that the fare structure would feature the use of transfer tickets and that services would be frequent. Buses should also be given priority over other traffic.

Although a high level of co-ordination does exist in some first-world cities, many cities (including those in South Africa) have transport networks which are characterised by less formal planning, larger numbers of private operators, unco-ordinated services and so on. The transport planner attempting to determine the potential role of trolley buses in the South African context must take these factors into account. Since trolley buses in South Africa are likely to operate in "less-than-ideal" circumstances, their role must be evaluated against a less favourable background. As a result, only the following themes will be developed in this study:

- the role of the trolley bus in creating a positive image for public transport and in attracting passengers
- the anti-trolley bus attitudes of some transport operators
- the potential role of the trolley bus in developing cities, where "free market" transport policies seem to be in conflict with the need for co-ordinated transport systems
- the economic characteristics of trolley buses in South African conditions

This approach to the study of trolley buses is an admittedly restricted one and it is hoped that it will stimulate research into some broader aspects of the subject in due course.

1.3 THE SOURCES OF INFORMATION USED IN THIS STUDY

1.3.1 Literature

Formal academic research into trolley buses seems to be sparse and textbooks on transportation systems planning have given scant attention to the trolley bus as a potentially significant form of urban transport.

However, at least one recent academic study has been carried out – an MBA thesis by C.L. Natvig at the San Francisco State University in 1975 entitled "The Economics of the Trolley Coach". A recent textbook³⁾ has also referred to the role of the trolley bus in today's transport scene. This study will refer to these works where appropriate.

Several non-academic books have been written about trolley bus systems. They are mainly descriptive of historical events and are of limited value in a study which is orientated towards the future. This study will, however, refer to two works, both under the joint authorship of Mac Sebree and Paul Ward which give an account of the history of trolley buses in North America and which also describe their renaissance in nine North American cities.⁴⁾

Two organisations are active in the collection and distribution of information about present day trolley bus operations. They are the British-based Trolley Bus Museum Company Ltd. which publishes the bi-monthly Trolley Bus Magazine, and the North American Trackless Trolley Association Inc. based in Louisville, Kentucky, which publishes periodical bulletins known as Trolley Coach News. This study will quote from these publications.

This study will also refer to a number of official reports on trolley buses which have been prepared by various bus operators, both in South Africa and overseas and will quote from articles, letters and editorials which have appeared in newspapers and transport magazines.

In August 1982 a "workshop" on trolley bus applications was held in Seattle, United States. The workshop was attended by more than 200 people representing government, transport operators, planners, consul-

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- 3) VUCHIC, V.R., Urban Public Transportation – Systems and Technology, Prentice-Hall Inc., New Jersey, 1981.
- 4) SEBREE, M. and WARD, P., Transit's Stepchild – the Trolley Coach, Interurbans, Cerritos, California, 1973, and The Trolley Coach in North America, Interurbans, Cerritos, California, 1974.

tants, researchers and citizens groups. One question it addressed was how to incorporate the trolley bus into transport plans for today and in the future. The proceedings at this workshop are summarised in a 60-page report which represents "one of relatively few comprehensive looks at the trolley bus system published in recent years."⁵⁾ Extracts from the report will be used in this study.

1.3.2 Other research

Between 1982 and 1986 a trolley bus demonstration project was carried out in Johannesburg. Seven prototype buses were tested on a route between Hillbrow and Forest Hill. During this period the author made 619 separate, documented daily visits to the test route and travelled approximately 6 000 km on the prototype buses. Some of the recommendations made in this study are based on observations made during these visits.

During August 1986 the author visited five systems in North America to gain first-hand experience of trolley bus operations there. The cities concerned were Toronto, Hamilton, Vancouver, Seattle and San Francisco. Reference will also be made to these visits where necessary.

1.4 THE CONTENTS OF THIS STUDY

This study is divided into nine chapters, commencing with an introduction in chapter 1.

Chapter 2 sketches the different stages in the history of trolley buses since 1880. It concludes with the suggestion that the large-scale abandonment of trolley buses during the period 1955-1970 was not an economic necessity.

Chapter 3 describes the modest renaissance of trolley buses since 1969 by reference to the experience of a number of individual cities. It also outlines the role which trolley buses can play in third-world conditions.

5) Transportation Research Board, op.cit.

Chapter 4 describes the abandonment of the trolley bus system in Durban against a background of public protest. It suggests reasons for the fall in passenger levels which followed the closure of the system.

Chapter 5 deals with the closure of the trolley bus system in Johannesburg (also against a background of public protest) and briefly describes the Johannesburg trolley bus demonstration project.

Chapter 6 discusses and evaluates a number of anti-trolley bus arguments which have been used to justify trolley bus abandonment.

Chapter 7 deals with public attitudes towards trolley buses and the relationship between trolley bus usage and passenger levels. It suggests a role for them on routes serving black passengers in South Africa.

Chapter 8 considers the economics of trolley buses within the context of the Johannesburg trolley bus demonstration project report.

Chapter 9 reviews the themes developed in the study and suggests areas which require further research.

CHAPTER 2

A BRIEF HISTORY OF TROLLEY BUSES

2.1 BACKGROUND TO THIS CHAPTER

The history of trolley buses can be traced through five distinct periods.

- The first period which lasted from the 1880s until approximately 1915, marked the birth of trolley bus technology and the first commercial operations.
- During the second period – which started in 1921 and ended in 1926, renewed efforts were made to establish trolley bus systems.
- The third period, during which trolley buses reached their maximum extent, began about 1930 and lasted until the mid 1950s.
- During the fourth period, which lasted from the mid-1950s until approximately 1970, trolley buses went through a period of decline.
- The fifth period – the renaissance of the trolley bus – started in the late 1960s and has continued up to the present.

(The above classification into periods does not apply to Switzerland, Russia and several Eastern bloc countries. In these countries the trolley bus has been in favour throughout the entire period since World War II)

This chapter will briefly describe the first three periods by reference to a number of trolley bus systems of the time and will outline the underlying factors which led to their introduction. The reasons for the fourth period – the decline of the trolley bus – will be discussed in this chapter but will be covered in more detail in later chapters.

The factors influencing the fifth period – the renaissance of trolley buses – will be described in more detail in chapter 3.

2.2 THE BIRTH OF THE TROLLEY BUS (1880-1915)

2.2.1 Introduction

The trolley bus is essentially a German invention. About 1882, Siemens and Halske, an electrical firm, demonstrated a "trackless trolley", an open wagon with a primitive electric motor which was connected to the overhead wires by means of a flexible cable.¹⁾ Revenue service with trolley buses commenced in Germany in 1901 between Königstein and Bad Königbrunn.²⁾ Other early demonstrations of the idea took place at about this time in both Europe and America but little effort or money was devoted to the trolley bus during this period simply because the crude roads of the time were certain to shake any motor vehicle apart very quickly.

2.2.2 Los Angeles

The first commercial use of the trolley bus in the English-speaking world was in Los Angeles – a city which ironically enough was to become famous in later years for its devotion to the private car. By 1910, a number of communities were springing up in the hills overlooking Hollywood. The operator of the city's trams, Los Angeles Pacific, was not prepared to extend its tracks up the steep and winding roads, so a local property development company took the initiative in providing a feeder transport service between the tram terminus and the developing area. Two 16-passenger Oldsmobile motor buses were converted to trolley buses by having their petrol engines removed and replaced with 15-horsepower electric motors. Los Angeles Pacific linesmen erected the overhead wires and on September 11 1910 the trolley buses (trolley taxis?) began revenue service.³⁾ For five years they operated without major incident. By 1915 however, they had worn out and were replaced by a new Stanley Steamer – one of the few instances in the history of transport where electricity gave way to steam!

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- 1) SEBREE, M. and WARD, P., *Transit's Stepchild – the Trolley Coach*, op. cit., p. 11.
 - 2) TRANSPORTATION RESEARCH BOARD, op. cit., p. 1.
 - 3) SEBREE, M. and WARD, P., op. cit., p. 13.

2.2.3 Boksburg

South African operators were not far behind the United States in introducing the "trackless tram". In March 1911, the Town Council of Boksburg considered a report on a proposed trolley bus route between Boksburg North and East Rand railway station, a distance of 5,4 km. The council accepted the report, with some modifications, and on March 25 1914 six 20-seater trolley buses entered service. The buses carried half-a-million passengers a year – but by 1925 they were worn out and on October 1 of that year they were replaced by motor buses.⁴⁾

2.2.4 Germiston

Nearby Germiston ordered 10 trolley buses which entered service on August 19 1914. The route ran from Victoria Lake to the Johannesburg boundary, where the trolley buses connected with the Johannesburg Municipality's Malvern tram route. The system was not a success and four years later the decision was taken to abandon it.⁵⁾

2.2.5 Bloemfontein

The third "first-generation" South African operator was Bloemfontein. The residents had been promised a tramway once the town had grown sufficiently, but it became obvious that a tramway was going to be a costly form of transport for a town with a population of only 15 000. As a compromise, the "trackless tram" was chosen for Bloemfontein, and on December 16 1915 the first trolley buses trundled through what is now Hoffman Square. By 1922 their condition had deteriorated to such an extent that eight replacement trolley buses were ordered, followed by

4) SHIELDS, G.B., South Africa's Trolley Buses, S.A. Transport, September 1975, p. 562.

5) SHIELDS, G.B., op. cit., p. 563.

another three in 1927. A solitary double-decker – South Africa's first – arrived in 1930. By now, Bloemfontein was the only trolley bus operator in South Africa, although the larger cities, such as Johannesburg, Cape Town and Durban were becoming aware of the potential benefits of this new type of transport. By 1934 it had become necessary to consider the long-term future of the Bloemfontein system, as the equipment had become due for renewal.

Heavy capital expenditure was required if the system was to be renewed, and because of Bloemfontein's sparse population it was decided to abandon the system. The trolley buses made their last journeys in October 1937.⁶⁾

2.2.6 Shanghai

Before moving on to the "second period" of trolley buses, mention should be made of the world's longest-serving trolley bus system in Shanghai, China, where trolley bus operation commenced in November 1914. The initial fleet consisted of seven Railless trolley bus chassis fitted with locally-built bodies. These buses were designed for two-class travel – 20 third-class passengers sat in the front of the bus while 8 first-class passengers travelled in a separate compartment at the rear. In 1924 the system was expanded and 100 trolley buses were ordered. Today, Shanghai's system is one of the largest in the world, making use of over 800 articulated trolley buses.⁷⁾

2.2.7 Summary

The story of the "first-generation" trolley bus systems appears to be similar throughout the world. Most systems had short lives, caused mainly by bad roads. Furthermore the incentive to develop alternative forms of transport to the tram was not sufficiently strong at the time.

6) SHIELDS, G.B., op. cit., pp. 564 – 565.

7) Trolley Bus Magazine, July – August 1984, p. 95.

2.3 NEW EFFORTS TO ESTABLISH TROLLEY BUS SERVICES (1921-1926)

2.3.1 Introduction

In spite of the indifferent performance of the early trolley bus systems, some far-sighted tram operators had already realised the potential of the trolley bus as a feeder to the tram networks of the day and as a low-cost form of transport to serve developing areas. Two such operators were based in Toronto and Philadelphia.

2.3.2 Toronto

Public transport in Toronto is operated by the Toronto Transportation Commission, which was established in 1921 to consolidate a network of tramcar lines previously operated by three separate companies.

The TTC was willing to experiment with trolley buses and almost immediately ordered four of them to serve a developing area beyond an existing tram route. The trolley buses entered service on June 19 1922 and proved to be successful. Their success actually shortened their lives – passenger response was sufficiently strong to justify the extension of the tram route within a short period and on August 31 1925 the trolley buses were withdrawn.⁸⁾ Trolley buses did not run again in Toronto until 1947. (The Toronto system will be referred to again in chapter 3).

2.3.3 Philadelphia

October 14 1923 was a significant date in the history of the trolley bus. On that day the Philadelphia Rapid Transit Company placed ten trolley buses in service on the Oregon Avenue route, an important feeder to various existing tram lines. This route was to be no trial installation. Since 1923, trolley buses have operated continuously in Philadelphia up to the present – the longest unbroken period of service for trolley buses in the English-speaking world. The original buses lasted until 1935 when they were replaced by improved units, and the Oregon Avenue line was to disappear in 1961 – but by then the trolley bus had firmly established itself on other routes in Philadelphia.⁹⁾

8) SEBREE, M and WARD, P., *The Trolley Coach in North America*, op. cit., p. 326.

9) Ibid., p. 210.

2.3.4 Summary

By the late 1920s, trolley buses were being used mainly to feed existing tram lines or to serve routes which did not warrant the investment in tram facilities. At this stage neither the trolley bus or the motor bus had started to take over from the tram, but the social forces which were to bring about its ultimate downfall were destined to make themselves felt within a few years.

2.4 THE MAXIMUM EXTENT OF TROLLEY BUSES (1930 - 1955)

2.4.1 Introduction

The third period of the trolley bus was characterised by significant improvements in trolley bus design and performance. An American observer writes :

"When the trolley bus first came on the scene in significant numbers in the 1930s, city streets had improved, automotive technology had advanced, and the street railway saw the trolley bus as a means of obtaining modern but cheap vehicles while retaining the same electric propulsion technology with its attendant infrastructure with which everyone was familiar and that had proved so reliable.

At that time, the capital cost for converting to trolley bus was not too great. It generally required only the addition of a second trolley wire, some special work, and turnback loops. Existing line crews could do the work. Trolley buses, themselves, were cheaper than streetcars and at that time only slightly more expensive than motor buses.

There were immediate payoffs on the small capital investment. Then, as now, trolley bus maintenance was considerably less than for motor buses. The cost differential was considerably marked because the motor buses in use then were powered by petrol engines, which are more expensive to fuel and maintain than the diesel bus."¹⁰⁾

10) TRANSPORTATION RESEARCH BOARD, op.cit., p. 25.

Another observer puts it this way :

"The inflexibility of the tramway, initially caused by cost factors and in some cases a rather monopolistic "take-it-or-leave it" attitude, led to bus operators being granted permission to feed to the trams from new areas and sometimes to link new areas with the central area. By doing so, the death-knell was sounded for the expansion of tramway routes.

Thus it was that the tramway operators, municipal and company, cast around for an alternative with some basic essential specifications :

- modernity
- flexibility
- lower capital cost than tramways
- passenger capacity at least equal to a tram

The trolley bus was the answer. It would continue to use electricity and this meant in theory at least, that existing tramway electrical installations could be utilised. One of the primary features of this was, in many cases the continued use of municipal power using locally-produced coal."¹¹⁾

2.4.2 Chicago

Credit for the "coming of age" of the modern trolley bus must go to Chicago, the second-largest city in the United States. During the 1920s Chicago was served by a huge network of tram routes totalling 1 200 miles, using more than 3 000 trams operated by Chicago Surface Lines

11) SHIELDS, G.B., op.cit., (May 1976), p.234.

(CSL). In 1928 the Chicago Motor Coach Company, a competitor to CSL, obtained a State of Illinois franchise to serve newly-developing residential areas with motor buses. CSL opposed the decision, arguing that it would be more logical to use its own buses feeding its own tram lines. The courts overruled the Illinois decision and awarded the feeder franchises to CSL. At the time, CSL, in addition to its 3 000 trams, was operating about 12 motor buses on a single route, with limited success. CSL realised that it was going to have to become far more involved in the bus business, so it decided to stay with what it already knew well – electricity. During 1930–31, CSL introduced 114 trolley buses on seven routes covering 26 route miles.¹²⁾

The main factor influencing CSL in favour of trolley buses was the expectation that most of the feeder routes would eventually be converted to tram operation, and the poles, wires and cables would already be in place. Six of the seven routes were feeder lines, but the remaining route, no. 85–Central was a heavy cross-town route, handling 50 000 passengers a day with trolley buses on headways only 45 seconds apart during the rush hour. Although the ridership on this route was high enough to justify tram operation in normal circumstances, the route included a long bridge over railway lines that was not strong enough to carry trams.¹³⁾ The Central route was probably the most severe test that trolley buses had to deal with up to that time and it seems that they coped adequately – Chicago went on to become the largest operator of trolley buses in the United States.

In 1950, Chicago placed an order for 349 trolley buses – as far as is known, the largest single order for them ever placed. These were, however, the last trolley buses to be ordered by Chicago. After the system closed in 1973, 124 of these buses were sold to the new Mexican system in Guadalajara where they remained in service until 1985.¹⁴⁾

2.4.3 Newark

Another large United States operator of the pre–World War II period was the Public Service Coordinated Transport Company of New Jersey (PSNJ) which operated services in the city of Newark.

12) SEBREE, M and WARD, P., op.cit., p.51.

13) Ibid., p.53.

14) Trolley Bus Magazine, May – June 1986, p.70.

Between 1934 and 1938 PSNJ perfected a unique dual-powered bus known as the All-Service Vehicle (ASV). The ASV was a conventional trolley bus with trolley poles and an electric motor, but in addition the ASV was fitted with a petrol engine connected to an electric generator to allow the bus to operate at normal speeds away from the wires. PSNJ used the All-Service Vehicle in substantial numbers – it bought 357 new units and converted 226 other buses to ASVs – making up a grand total of 583 dual-mode buses.¹⁵⁾ The use of this type of bus gave the operating department the flexibility to run its fleet of trolley buses wherever it liked, both underneath and away from the wires. By 1938 however the "straight" diesel had come into its own and over the next ten years the PSNJ replaced its entire ASV fleet with diesels.

The idea of the ASV was unique to Newark. No other bus operator of the period made any attempt to imitate the concept except for Baltimore, which experimented with a solitary dual-mode bus.¹⁶⁾

2.4.4 South Africa

When discussing the extent of "third period" trolley bus developments in South Africa, it should be remembered that South Africa's transport systems of the time were closely based on British operating practice. Experiments with trolley buses in Britain had already taken place as early as 1909 when a prototype bus built by the Railless Electric Traction Co. Ltd. was demonstrated to delegates attending the conference of the Municipal Tramways Association. The first British trolley bus routes opened simultaneously in Leeds and Bradford on June 20 1911, and for several years thereafter trolley bus experiments and demonstrations continued to take place in London. It was only in 1926 that Wolverhampton placed several six-wheel pneumatic-tyred Guy trolley buses in service. This design was to mark the shape of most of Britain's (and South Africa's) trolley buses for many years to come.

15) SEBREE, M. and WARD, P., op. cit., p.196.

16) Ibid., p.197.

In 1930, Sydney Guy, whose factory had produced the buses, decided to send one of his vehicles to South Africa to test the market. The bus arrived in Cape Town on August 25 1930, and demonstrations were carried out in Cape Town, Durban and Johannesburg during the remaining months of that year.¹⁷⁾ The demonstrator trolley bus used existing tramway routes – the positive trolley taking power from the overhead and a metal skate being dragged in the tram rail for the return current. The tests were considered to be successful and in fact caused a clamour in the press for the immediate elimination of trams. No immediate orders for trolley buses were placed but the seed had been sown and late in 1933 Durban led the way with an order for 22 trolley buses, half of the order going to the Sunbeam Trolley Bus Company and the other half going to Leyland. Cape Town followed soon after with an order for 50 buses while Johannesburg and Pretoria joined the ranks of South African trolley bus operators in 1936 and 1938 respectively. By 1940, there were 262 trolley buses in service on the four South African systems.¹⁸⁾ Although many more trolley buses were on order at the time, the war put a stop to imports of new vehicles and it was only in 1948 that new buses started to arrive once more. In 1950 South African trolley bus operations reached a high-water mark, with 426 trolley buses carrying 127 million passengers. (In 1961 there were 436 trolley buses, but by then the total passenger figure had fallen to 110 million).¹⁹⁾

2.5 THE DECLINE OF THE TROLLEY BUS (1955–1970)

2.5.1 Social and economic factors

The "fourth stage" of the history of the trolley bus covers the period from the mid 1950s to approximately 1970 and is characterised by the closure of most of the North American and British trolley bus systems, as well as many systems under North American or British influence, such as those in South Africa, Canada and Australia. The downfall of the trolley bus coincided with an accelerating trend away from public transport and towards the private car. This change was accompanied by a mood of pessimism on the part of the transport industry and a resulting lack of incentive to make improvements.

17) SHIELDS, G.B., op. cit., (May 1976), p.235.

18) Ibid., p.236.

19) Ibid., (December 1976), p.733.

Carl Natvig's analysis of the decline of the trolley bus in North America is illuminating.

"In North America, the trolley bus "boom" peaked in 1954 with 9% of all mileage (tram, trolley bus and diesel bus) operated by trolley buses. By the late 1950s trolley bus systems began to disappear. Factors other than purely economic ones appear clearly to have been at work as evidenced by the fact that the average life of trolley buses was only about 15 years – well below the 25 to 30 years possible. Two basic underlying problems appear to have been at work – the financial weakness of a declining transit industry and the dominance of the motor industry.

In a declining, financially strapped industry, there was naturally little interest in long-term investment in new wires to serve new, expanding low density suburbs or in new and now more expensive vehicles, however long lived, regardless of the long-term economies.

The best evidence that trolley bus abandonment was not an economic necessity can be found in the Dayton system. This was a 70 percent trolley bus transit system that remained profitable in a medium-sized city long after most other such systems had gone out of business and sold out to municipalities. This contention is also supported by our experience at MUNI in San Francisco. Except for brief periods when diesel fleets were new, at no time over the past 43 years has it been cheaper to operate diesel buses than trolleys."²⁰⁾

2.5.2 Some questions on trolley bus abandonment

Natvig's observation that "trolley bus abandonment was not an economic necessity" introduces a new perspective which will be examined in greater detail in the next four chapters.

20) TRANSPORTATION RESEARCH BOARD, op. cit., p. 25.

In spite of the swing away from public transport and the "industry trend" towards diesel buses, certain cities continued to operate trolley buses and renewed their fleets. This prompts two questions :

- What were the factors which led to the survival of a few trolley bus systems, particularly in those countries where the pressure to abandon them was strong?
- Where trolley buses were abandoned, what justification was put forward and can such justification be regarded as acceptable?

The first question will be considered in the next chapter which will examine the circumstances which led to the retention of trolley buses in a number of cities. It will show that the decisions to retain trolley buses were in some cases accompanied by disputes and controversy.

The second question will be considered in chapters 4 and 5 which examine the decline and abandonment of trolley buses in the South African cities of Durban and Johannesburg respectively. The controversial nature of the decisions to eliminate trolley buses in these cities will also be highlighted.

CHAPTER 3

TROLLEY BUS RETENTION AND EXPANSION SINCE 1967

3.1 BACKGROUND TO THIS CHAPTER

In early 1986 there were slightly over 300 trolley bus systems in the world, of which approximately 200 were in Eastern bloc or Communist countries.¹⁾ Of the 100 systems in the West, ten were to be found in English-speaking cities.

This chapter is divided into the following sections :

- A record of the events leading up to the retention of trolley buses in four of the ten English-speaking cities. The cities concerned are Toronto, Seattle, Dayton and San Francisco.
- A description of the introduction of trolley buses in Guadalajara, Mexico in 1975-77.
- A discussion of the renaissance of trolley buses in Brazil in recent years.
- A brief note on the trolley bus proposals for Leeds and Bradford.

It is the purpose of this chapter

- to show that while the retention of trolley buses was a controversial issue in several cities, such retention was supported by the public.
- to show, by reference to Seattle, Guadalajara and Bradford that trolley buses can be used in a "pre-metro" role. (This is relevant both to Johannesburg, where an underground railway has been proposed, and to other South African cities, where light rail systems and busways are being considered).

1) Trolley Bus Magazine, May 1982, pp. 49 - 53.

- to show that trolley buses can play a part in the transport systems of developing countries, such as Brazil. (This may be of significance to those areas of South Africa, where social conditions may be similar to those of Brazil).

3.2 THE RETENTION OF TROLLEY BUSES

3.2.1 Toronto

3.2.1.1 Introduction

Toronto is credited with having one of the best transport systems in the world. In a recent analysis of Toronto Transit Commission (TTC) policy, an observer writes :

"The frequency and reliability of its services, its modern and well-maintained fleets, the level of electrification, the competence and patience of its drivers, its cleanliness; all these excellences are rarely equalled elsewhere. The simplicity of its fare system and its routings and the interlocking of surface and subway routes, make the TTC very user-friendly."²⁾

Although the role of trolley buses in the overall Toronto picture is small,³⁾ it can be said that Toronto led the way in the revival of the trolley bus in the West. Toronto's early experience with trolley buses between 1921 and 1925 has already been described. Trolley buses did not reappear in Toronto until 1947, when 85 of them were bought to replace trams on lines which would otherwise have required extensive relaying. Further trolley bus expansion took place in 1954 when forty more buses were bought. By 1963 the fleet had grown to 152 units as a result of purchases of second-hand buses from Ottawa, Cleveland and Cincinnati.⁴⁾

2) WEBB, P., The Direction of TTC planning in the 1980's, Modern Tramway, Journal of the Light Railway Transport League, London, October 1983, p. 326.

3) In 1981 they carried 4,9% of total TTC passengers and covered 3,7% of the total TTC mileage. TRANSPORTATION RESEARCH BOARD, op. cit., p. 12.

4) Trolley Bus Magazine, January - February 1984, p. 15.

3.2.1.2 The rebuilding of trolley bus 9020

Trolley bus systems were closing throughout North America and Canada in the late sixties. By 1967, only seventeen North American cities still operated trolley buses and several had already announced ultimate closure plans. It was a surprise, therefore when the TTC decided on May 2 1967 to rebuild two of its trolley buses as a feasibility test. At that stage, the trolley bus fleet was showing signs of body wear but the electrical equipment showed almost no deterioration. A preliminary investigation had shown that a new body could be manufactured for about \$35 000 per unit as against a price of over \$50 000 for entirely new units by European manufacturers.

The two buses selected for rebuilding were numbers 9020 and 9144. Bus number 9020, which had been built in 1948 by the Canadian Car and Foundry Company was sent to Winnipeg for rebuilding by the Western Flyer Coach Ltd, while 9144 was sent to England to be overhauled by a British firm, Robin-Nodwell. This firm was unable to undertake the work and the British project was eventually abandoned.⁵⁾

Western Flyer, meanwhile, rebuilt 9020 and on July 22 1968, the TTC took delivery of its first "new" trolley bus.

Although there were a number of initial problems with 9020, it covered 27 000 miles during its first year of service (contrasted with an estimated average of 32 500 for the rest of the fleet) and comment from the operating staff and passengers was favourable.

"Talks with repairmen who had worked on 9020 produced few comments though most liked it. Some felt that not enough thought had gone into the design and positioning of internal accessories as well as criticism of the appearance of hasty assembling in some areas. A general thought of many, was the opinion that the original design work had not evolved enough before the building stage had

5) SEBREE, M. and WARD, P., *The Trolley Coach in North America*, op. cit., p. 329.

been reached. But as I and many of the other mechanics noted, this is a prototype and most of these faults are common with this first-of-a-kind vehicle."⁶⁾

With the trials with 9020 were in progress, the TTC was proceeding with an economic evaluation of its trolley bus fleet. By November 1969, the investigation was complete and a report⁷⁾ which recommended that the fleet of trolley buses be modernised, was tabled at the TTC meeting on November 11 1969.

On that day, the TTC decided to rebuild the entire fleet to general conformance with the standards of the prototype test unit, 9020. The total cost of the rebuilding of the units was \$5,24 million, or \$34 700 each. By August 1970, the first bus had been completed and all rebuilt trolley buses were in service by August 1972.

3.2.1.3 Subsequent developments in Toronto

During the period 1974 - 1976, further extensions were made to trolley bus routes in Toronto to increase the utilisation of surplus trolley buses. An article in the local press read as follows :

"35 TROLLEY BUSES IDLE, TTC URGED TO USE THEM

The Toronto Transit Commission was asked yesterday to investigate replacing some of its diesel buses with 35 now idle trolley buses. Toronto's City Council's Public Works Commission earlier had recommended the use of the trolleys on Bay St. Ward 4 Alderman George Ben said "it's time we got those polluting diesel buses off Bay St." Ben called Bay St. "a chasm of pollution" and

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- 6) PRENTICE, C.H., Report on prototype 9020 - a short history of the unit, North American Trackless Trolley Association, Trolley Bus Bulletin No. 103, February 1970, pp. 20-21.
- 7) TORONTO TRANSIT COMMISSION, Report No. 5 of 1969, Comparison of Trolley Coach Modernization and Diesel Bus Replacement.

said the use of trolley buses would not need extra looping facilities. Most of the committee members agreed with Ward 7 Alderman Karl Jaffary, who said, "the important thing is that we dislike the idea of 35 non-polluting buses sitting unused in a shed." The TTC has 138 trolleys ready for service, but only 103 are in use."⁸⁾

In 1981, a TTC report advocated a two-step trolley bus expansion programme for the 1980's. The rationale behind the recommendation was as follows :

- "1. There are surplus trolley buses available in rush-hour periods. The current surplus exists because replacement of streetcar lines with trolley bus operation never materialised, due to the renaissance of streetcars in Toronto.
2. In terms of motive power costs, there is an operating cost differential on the cents-per-mile basis favouring trolley bus operation. The 1982 TTC operating budget used 18,42 cents/mile for trolley bus operation, and 33,20 cents/mile for diesel bus operation.
3. There is an increased awareness of the role that public transit can play in achieving an energy-efficient urban transportation system."⁹⁾

The TTC, however, referred this proposal back to management with a request to do a more thorough-going analysis of surface vehicle requirements. The result was the "Vehicle Fleet Mix Study" which was published early in 1983.¹⁰⁾ The study represented a change of attitude towards trolley buses. It held that they were significantly more expensive to operate than diesels and that they suffered from "inflexibility". It recommended that when the rebuilt fleet wears out around 1990 it should be replaced by diesels. Philip Webb's criticism of the Fleet Mix Study Report is scathing :

8) Toronto Star, September 5 1973.

9) TORONTO TRANSIT COMMISSION, Report No. 3, Possible conversion of diesel bus routes to trolley coach operation, 4 March 1981.

10) WEBB, P., Toronto's Vehicle Fleet Mix Study, Trolley Bus Magazine, November 1983, pp. 138-140.

"The Fleet Mix Study, insofar as it applies to trolley buses, is an appallingly bad piece of work, and betrays a scarcely hidden prejudice against the technology. Indeed it is not difficult to see in the study a desire by one or two men in the upper middle levels of TTC management to eliminate all surface electric vehicles, if they could get away with it. They know that it would be politically impossible to attack the tram system, and have compromised by falling on the trolley buses. It is scarcely credible that an organisation as well established as the TTC could approve such an irresponsible and prejudiced piece of work."¹¹⁾

The "Streetcars for Toronto" Committee (a local citizens organisation) was revived to tackle this issue and submitted a brief to the TTC refuting in detail its claims against the trolley bus system. In June 1986 it was announced that the TTC was to keep its trolley buses and that it was "studying a number of options to determine the most effective use of the trolley bus fleet"¹²⁾

3.2.1.4 Summary

The Toronto experience illustrates that the attitude of transport management towards trolley buses can change from positive to negative and back again in a short space of time. Although a trolley bus system may be justified on both economic and technical grounds, the final decision to retain, extend or abandon trolley bus operations may ultimately depend on other factors such as political pressures, the style of local transport management, and the general city philosophy. The following city which will be discussed, Seattle, demonstrates this point in clearer terms.

3.2.2 Seattle

3.2.2.1 Introduction

Seattle has many steep hills and an abundant source of hydro-electric power – features which should allow trolley buses to operate to best

11) WEBB, P., op. cit., pp. 138-139.

12) Passenger Transport, American Transit Association, Washington, D.C., June 23 1986, p. 9.

advantage. Few cities have experienced as much municipal controversy over their trolley bus systems as Seattle, however.

Trolley buses were introduced in Seattle in 1940 as replacements for its wornout trams. The trolley bus system grew quickly – by 1942 there were 235 buses operating on 28 routes. At that stage Seattle had become a major centre in the Pacific war effort and the US government approved further trolley bus orders to carry passengers to the Harbor Island shipyards. In 1944 there were 307 buses in the fleet – it was not unusual for all of them to be running at one time, so heavy was the ridership.¹³⁾

3.2.2.2 The retention of the system

The system remained basically unchanged until 1959 when the operator, Seattle Transit System, announced plans to abandon trolley buses by 1961. This announcement was the first stage of a long-drawn-out wrangle to save the trolley bus system. The saga was destined to last eighteen years, during which time the trolley bus fleet dwindled from 305 to 53 buses. From 1963 onwards, it seemed that the trolley bus system was "constantly poised under the blade of the guillotine."¹⁴⁾ The story of the controversy is worth recording in some detail:

In December 1959 the Seattle Transit System (STS) announced plans to eliminate trolley buses. However, the Seattle Transit Commission (STC), a controlling body formed in 1939 to separate transport from politics, voted to buy only 40 diesel buses instead of the 200 that STS wanted. In May 1960 STS released the first in a series of reports showing that trolley bus costs were rapidly rising relative to diesel bus costs. This led to the formation of a private citizens group called the Committee on Modernisation of Electric Transport (COMET) to oppose STS's decision to abandon trolley buses.

13) SEBREE, M. and WARD, P., op. cit., p. 264.

14) Ibid., p. 264.

In June 1963, STS withdrew trolley buses from six routes, and reduced the fleet from 305 to 132.

"COMET began to collect signatures on a petition to restore all pre-1963 routes and to require STS to keep TBs predominant in the fleet. STS countered with an extensive ad campaign showing that TBs were more expensive, including the phrase that even if (electric) power were free the TB would cost more to run. The ad campaign was charged to TB running expenses. In 1963 STS ledgers went into the red to stay."¹⁵⁾

By 1967 the Washington Society of Professional Engineers (WSPE) had joined the battle with a long report on the whole trolley bus situation. In 1968, a local agency responsible for sewers and water control, named METRO, made a bid to take over Seattle's transport system. It had enabling powers to do so, subject to public approval in a referendum but failed to obtain sufficient public support at that stage.

In January 1970 two more trolley bus routes were abandoned and the fleet was reduced from 132 to 57 trolley buses. Four months later, COMET announced plans to seek the abolition of the STC and started collecting signatures in support of its intention. In October 1970 the STS authorised a study to compare the trolley bus and diesel bus to "once and for all" settle the question. The study was released in March 1971. It favoured the diesel bus, based on a comparison between a 30 year old trolley bus and a three year old diesel bus. The WSPE responded to this by claiming that the trolley bus had been tampered with to lower its performance.¹⁶⁾

In 1972 METRO finally obtained sufficient support to take over the Seattle bus service. In its contract acquiring STS, METRO agreed to seriously consider expanding the trolley bus system. By now the system consisted of only 53 trolley buses. A year later METRO obtained an Urban Mass Transportation Administration grant for 605 new diesel and trolley buses. In November 1974 an articulated trolley bus was leased

15) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Trolley Bus Bulletin No. 110, October 1976, p. 3.

16) Ibid., p. 4.

"The bending trolley buses purchased from M.A.N. will be an important element of the new circulation system that will operate in downtown Seattle after the tunnel is completed."¹⁹⁾

George E Benson, a member of the Seattle City Council and one-time chairman of its transportation committee, explains Seattle's attitude towards trolley buses in this way :

"Public transportation is more than just a matter of getting from point A to point B. What happens in between is just as important as getting to the destination.

It is a question of style, and the mode of public transportation a community prefers can reveal more about its character than dry statistics about passengers per mile or peak-hour capacity.

The people of Seattle love trolley buses. What does that say about the people of Seattle? It speaks of this community's fascination with science and technology and to its sophistication in weighing technological alternatives.

Of course, new technology creates new problems, and we had our share. Lightning wreaked havoc in the first year, and the rectifiers turned the overhead wires into the world's largest radio antenna.

We have solved the lightning problem and we are working on the radio interference. One thing had no problem with, however, was community acceptance. When my office polled 45,000 citizens along proposed trolley routes, more than 87 percent said that they wanted the service. Seattle's trolleys are going to be around for a long time to come. But it is not just a matter of efficiency or economics. Trolleys are not just a part of Seattle's public transit system, they are part of the soul of the city."²⁰⁾

19) Ibid., p. 48.

20) TRANSPORTATION RESEARCH BOARD, op. cit., pp. 9-10.

3.2.2.4 Summary

According to Benson, the principal reasons for the system's success in attracting riders and in overall operations are related to :

- the public support for the expansion and retention of trolley buses
- the involvement of community and professional organisations
- the support of the political infrastructure obtained through education and information dissemination efforts and
- the public relations campaign promoting the advantages of the trolley bus.²¹⁾

Benson did not specifically mention one other factor – the attitude of transport management towards trolley buses. In Seattle, the positive attitude of METRO was in sharp contrast to the negative attitude of the previous management (STS/STC). Without a positive approach, it seems unlikely that the support of the political infrastructure can be obtained or that public relations campaigns will succeed.

3.2.3 Dayton

3.2.3.1 Introduction

One example of a city where the positive attitude of management towards trolley buses has played a key role in their survival is Dayton. In chapter 2 it was noted that "the best evidence that trolley bus abandonment was not an economic necessity can be found in the Dayton system. This was a 70 per cent trolley bus transit system that remained profitable in a medium-sized city long after most other systems had gone out of business and sold out to municipalities."²²⁾

Dayton's transport history has been described as "incredibly complex."²³⁾ For a brief period in 1940–41 there were five private companies

21) TRANSPORTATION RESEARCH BOARD, op. cit., p. 6.

22) Ibid., p. 25.

23) SEBREE, M. and WARD, P., op. cit., p. 91.

running trolley buses in Dayton. In 1941 the first consolidation between companies took place and by 1956 all street transport in Dayton was in the hands of one company – City Transit Company (CTC).²⁴⁾

3.2.3.2 The retention of the system

While other trolley bus operators closed their systems during the 1960's Dayton's system survived. In 1967 one route was closed because of freeway construction but two others were extended into neighbouring towns. The trolley bus fleet was also strengthened by the purchase of 15 used trolley buses from Cincinnati in 1965, and 32 from Columbus in 1967.²⁵⁾

Nevertheless, the psychological pressures to abandon trolley bus operation, as well as economic pressures caused mainly by the universal decline in bus passengers, were building up. By 1972, CTC had been losing money for some time. By then it was the only privately-owned trolley bus operator in North America and negotiations had commenced to sell the undertaking to a regional authority, the Miami Valley Regional Transit Authority (MVRTA). The voters of Dayton duly approved a levy to activate the MVRTA which announced plans to buy out CTC and take over all transport services within its jurisdiction.²⁶⁾

The president of CTC was W.W. Owen, who had been a firm protagonist of trolley buses for many years. The survival of the system until then was attributed largely to his efforts. "Year after year, pressures to convert were resisted subtly or vociferously, as the occasion demanded."²⁷⁾ When Dayton changed over to one-way streets – a change which might have caused other cities to abandon trolley buses – CTC erected new overhead lines. When freeways were built, CTC arranged detours and revised routes. When "the city sprawled ... the wires crept out to follow."²⁸⁾

24) SEBREE, M. and WARD, P., op. cit., p. 94.

25) Ibid., p. 102.

26) SEBREE, M. and WARD, P., Transit's Stepchild – The Trolley Coach, op. cit., p. 70.

27) SEBREE, M. and WARD, P., The Trolley Coach in North America, op. cit., p. 97.

28) Ibid., p. 97

In 1970, following the Toronto rebuilding program, Owen ordered one new trolley bus body from Western Flyer Company and had it fitted with motors and controls from a withdrawn trolley bus. Owen's intention was to prove that a new trolley bus could be a success. It entered service in April 1971 and Owen obtained maximum publicity value from the new bus, which had the letters "1971 Trolley Bus" emblazoned in letters a foot high on the roof.

It was the first new trolley bus in the United States for sixteen years. Owen was undoubtedly trying to apply pressure on the MVRTA (which had not yet taken over from the CTC) to continue trolley bus operation.

For the next eighteen months, controversy raged in Dayton over the bus operating policy to be followed by the MVRTA. At the outset, MVRTA was non-committal about its policy towards trolley buses and/or diesel buses.

"Charles V. Simms, vice president of the MVRTA, refused last night to answer whether the authority had made the decision to switch from electric trolley buses to diesels. But the Journal Herald has learned that the transit authority has made the decision to switch to diesels. And the question of the type of bus to be used is crucial to arriving at a negotiated price the transit authority will pay for the City Transit Co."²⁹⁾

On May 26 1972, an employee of the MVRTA, Joseph Entress, was suspended without pay for "conduct unbecoming an employee." Entress had been involved in comparing costs of operating electric trolley and diesel buses and had stated to newsmen that he had been ordered to halt the study.

"Suspended planner Joseph W. Entress claimed today the Miami Valley Regional Transit Authority might face \$400 000 a year more in operating costs by replacing the electric trolley fleet with diesel-powered buses.

29) Dayton Journal Herald, May 23 1972.

Entress said he is convinced the authority already has decided to scrap the electric trolleys. Authority trustees deny they have made the decision. Entress said the material he tried to forward to the transit authority and the TCC task force working on transit was a comparative cost study based on the Toronto Transit Commission's experience. Entress said he believes switching to the diesel system and operating at a higher cost will be more of a financial burden than the authority can handle. He said the authority would have to borrow extra money from the Dayton and Oakwood governments, and cut service and raise fares."³⁰⁾

These developments were embarrassing to the MVRTA, whose attorneys had stated in a letter that :

"the difficulty, as you know, lies in the MVRTA's opinion that City Transit's car barn, headquarters and electric buses are obsolete and that new diesel buses are the only practicable solution of the transit problems of Dayton and Oakwood."³¹⁾

Various letters to the editor of this period were also pro-trolley bus or generally critical of the MVRTA. It was announced in the Journal Herald of February 7 1973 that a decision would be taken on April 3 1973 as to what type of bus would be bought.

On March 13 1973 the MVRTA held a public meeting on the trolley/diesel question. The following day's newspaper reported :

"It wasn't a hearing. It was a love-in. A love-in for trolleys."³²⁾

The strong pro-trolley sentiments expressed at that public meeting presumably played a part in the decision of the MVRTA board on April 3 1973 to purchase 25 new buses for Dayton. This order was later increased to 64 buses. Flyer Industries (who had rebuilt the Toronto buses)

30) Dayton Daily News, June 8 1972.

31) Dayton Journal Herald, May 25 1972.

32) Ibid., March 14 1973.

were awarded the contract and delivered the buses during 1976/77. In 1984 it was announced that 12 more trolley buses were to be bought to replace the oldest buses, dating from 1951.

3.2.3.3 Summary

The Dayton experience shows that pro-trolley bus feelings in a community can be strong enough to influence the bus- buying policy of the transport operator. Speaking at a 1982 symposium on trolley buses, Fred C. Dyer, General Manager of the MVRTA conceded that "several citizen groups came out in favour of (trolley bus) retention and that there had been "overwhelming support in favour of trolleys."³³⁾ W.W. Owen's views underline this :

"I have no financial or job interest in the type of transit equipment which will continue to be used in Dayton. But I have civic concern for the continuation of a fine transit system based on the retention of mainline trolley bus operation, supplemented by circumferential and feeder operation by diesel buses. The people of Dayton care about their city, and about the quality of their environment, and they were with us in our judgement to retain electric transit."³⁴⁾

3.2.4 San Francisco

3.2.4.1 Introduction

According to Sebree and Ward, the decision in San Francisco to retain trolley bus operations was based "almost entirely on ecological grounds, with a dash of that city's anti-auto sentiment and mystique for quaintness thrown in."³⁵⁾ Perhaps Sebree and Ward are being a little unfair to San Francisco. It will be shown in this section and in chapter 7 that San Francisco does more than most cities to justify its use of trolley buses.

33) TRANSPORTATION RESEARCH BOARD, op. cit., p. 10.

34) SEBREE, M. and WARD, P., Transit's Stepchild - the Trolley Coach, op. cit., p. 120.

35) Ibid., p. 70.

San Francisco has a long and fascinating public transport history. Just about "every conceivable type of transit motive power has been successfully applied"³⁶⁾ there and today it is well-known for its public transport mix of cable cars, trams, trolley buses, diesel buses and the controversial Bay Area Rapid Transit (BART) system.

Trolley buses came to the city in 1935. At that time there were two competing transport enterprises, the privately- owned Market Street Railway Company (MSR) and the city-owned Municipal Railway (MUNI). MSR introduced trolley buses first, on a "hilly and twisty line which fought both topography and traffic."³⁷⁾ MUNI introduced its own trolley bus service in 1941, but trolley buses played a minor role until after the war, when large-scale expansion started to take place. By this time all operations were under the control of MUNI, and the most heavily patronised tram lines were converted to trolley bus while the lighter lines went to diesel buses.

3.2.4.2 The retention of the system

By 1952 the number of trolley buses in the fleet had grown to 389, and the system thereafter remained basically unchanged for many years. The system was not spared the pressures to convert to motor bus, however :

"The MUNI's trolley bus system did not go unthreatened. In 1966, the Northern California Transit Demonstration Project Report, prepared by Simpson-Curtin, recommended that trolley bus lines operating on or crossing Market Street should be converted to diesel bus in order to facilitate BART construction."³⁸⁾

(The advent of BART foreshadowed a large-scale restructuring of the surface system. Trolley buses would then be relegated to a few routes in the hilly area north of Market Street).

36) SEBREE, M. and WARD, P., *The Trolley Coach in North America*, op. cit., p. 249.

37) Ibid., p. 253

38) SAN FRANCISCO MUNICIPAL RAILWAY - Issue Paper 3, Five year plan 1977-1982, The Environmental and Economic Feasibility of Trolley Coach Expansion, July 1978, p. 3.

"It was at this point that MUNI ran headlong into the ecology movement. Just as they had risen to battle for the retention of cable cars two decades previously, citizens groups sprang into action in behalf of trolley buses. "Cut Smog and Noise ... Keep our Trolley Buses" bumper stickers appeared. Ever sensitive to pressure groups, MUNI's management had second thoughts. Encouraged by the County Board of Supervisors, MUNI in late 1969 declared that the trolley coach would have a permanent place in the local transit firmament, and set in motion plans which culminated in the ordering, in 1974 of 345 new trolley buses from Flyer Industries Inc. of Canada to completely replace the electric bus fleet."³⁹⁾

3.2.4.3 Subsequent developments in San Francisco

Despite its "mystique for quaintness", San Francisco seems to adopt a very formal approach towards its public transport planning. There is a five year transport plan which is updated each year.⁴⁰⁾ (The 1985-1990 plan is a 237-page volume complete with foldout maps). San Francisco's trolley bus policy which is set out in detail in its 1979-84 five year plan consists of four elements :

- A master plan for new trolley bus routes
- A Transit Equipment Program
- A Trolley Bus Overhead Program
- A Power Improvement Program⁴¹⁾

The first element involves the conversion of some diesel bus routes to trolley operation. The second involves tests with auxiliary power systems as well as an investigation into the use of articulated trolley buses. The third involves the renewal of poles, wire and switches at a cost of \$12 million. (Most of the overhead line system is over 30 years old). The fourth involves the replacement of old power conversion equipment with

39) SEBREE, M. and WARD, P., The Trolley Coach in North America, op. cit., p. 258.

40) SAN FRANCISCO MUNICIPAL RAILWAY, Short-range transit plan 1985-1990, June 1985.

41) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Trolley Coach News No. 50, 1980, p. 120.

new solid state silicon rectifiers. (The power supply network was originally installed between 1902 and 1926). 78 articulated trolley buses are to be purchased between 1987-89 at a cost of \$27 million.⁴²⁾

3.3 THE INTRODUCTION OF TROLLEY BUSES IN GUADALAJARA, MEXICO

3.3.1 Introduction

Early in 1974 it was announced that Guadalajara, the second largest city in Mexico, was planning to introduce a metro rail system. In the central area, the metro would run underground and rise to the surface in the outer areas, thereby combining feeder and trunk operations into one. Unfortunately finance was a major problem - the metro was estimated to cost the equivalent of \$244 million and there appeared to be no way of raising the necessary money.⁴³⁾ A novel compromise was decided upon - the central-area tunnel would be built as planned but trolley buses would be used instead. Eventually when money was available and patronage high enough the trunk line would go over to rail and the trolley bus lines would then act as feeders to the metro.

3.3.2 The development of the system

By 1976 the tunnels had been completed and some of the stations had been built. Guadalajara had purchased 124 used trolley buses from Chicago (which as noted in chapter 2 had closed its operations in 1973) and was refurbishing them. These buses had at that stage already covered over one million kilometres each in Chicago.⁴⁴⁾

The modifications to the buses were mainly to the bodywork. The front windshields were replaced and a new fibreglass front panel was added.

42) SAN FRANCISCO MUNICIPAL RAILWAY, Capital Improvement Program 1985-1990, June 1985, p. 44.

43) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Trolley Coach News No. 27, 1974, p. 48.

44) Chicago Sun-Times, February 15 1973.

Rusty sheet metal was replaced. New seats were fitted and the interiors were generally spruced up. A new coat of paint was applied. Two visitors to Guadalajara during the rebuilding program noted that :

"attention is also given to the springs and underframe but, generally, little is being done to the mechanical components or suspension. Of course, having no overhead, the undertaking has been unable to road-test any of the rebuilt vehicles at the present time but the general impression created is that they have a team of intelligent, conscientious mechanics who are doing a good job in rather primitive facilities."⁴⁵⁾

The visitors felt that the system appeared to be quite workable, avoiding sophisticated technology, which would be impossible to support in Mexico.

The trolley bus system opened on January 9 1977. In 1983 it was announced that two new trolley bus routes were to be introduced and that the subway trolley bus route was to be extended southwards. An order for sixty new SOMEX/MASA trolley buses was placed to operate the additional routes. The buses were delivered and the extensions were opened in August 1984.⁴⁶⁾ By March 1986, however, all the ex. Chicago trolley buses had been placed in store and diesel bus substitution had taken place on one route.⁴⁷⁾

3.3.3 Summary

It is significant that both Seattle (an example of a "sophisticated" economy) and Guadalajara (a "third world" economy) have seen fit to include trolley buses in their plans for new underground transport

45) AURELIUS, J. and SCALZO, S., Mexico's new subway trolley bus system, Trolley Bus Magazine, May 1976, p. 65.

46) Trolley Bus Magazine, January-February 1985, p. 21.

47) Ibid., May-June 1986, p. 70.

systems. It has become customary to regard underground systems as being suitable for rail vehicles only. This is not necessarily the case, as Seattle and Guadalajara have shown. The potential of the trolley bus as an underground as well as a surface vehicle should be investigated by a city such as Johannesburg (which has been considering underground systems for many years).

3.4 THE RENAISSANCE OF TROLLEY BUSES IN BRAZIL

3.4.1 Introduction

This section will briefly consider developments in Brazil, where trolley bus systems are being expanded and new systems are being introduced.

Brazil is one of the most bus-orientated countries in the world, for both inter-city and commuter transport.

"(Inter-city) frequencies are quite staggering. At peak times, coaches depart at 2 1/2 minute intervals from Rio for the 250 mile journey to Sao Paulo. The inter-city coach terminal is a central feature of all Brazilian cities. Quite an amazing one is the Tiete terminal in Sao Paulo. There are ... about 4 000 bus movements per day. On Christmas Eve 1982 212 881 passengers were handled on 6 122 buses."⁴⁸⁾

In commuter transport, the role of the bus is equally impressive – in Rio de Janeiro, (diesel) buses account for 88% of all public transport carryings. Most buses are privately operated and competition between buses and taxis is intense.⁴⁹⁾

The role played by trolley buses in the Brazilian scene has in many respects followed the trends identified elsewhere. The first Brazilian trolley bus installation was in Sao Paulo in 1949. Between 1953 and 1967, another ten Brazilian cities introduced trolley bus systems. As in many other cities, the principal objective was tramway replacement. From the 1960's onwards however, pressures started to build up that

48) HELLEWELL, D.S., Buses in Brazil – the current scene, Buses Magazine, May 1984, p. 201.

49) Ibid., p. 198.

were to discourage trolley bus expansion. These pressures included the "lack of spare parts for imported buses, absence of a real program for local manufacture of components ... plus the false impression that individual transport would be substituted for transit systems."⁵⁰⁾ So, by 1973, only Sao Paulo, Recife, Araraquara and Santos still operated trolley buses.

3.4.2 The retention of trolley buses in Brazil

The 1973 oil crisis was a sobering experience for Brazil which imports 80 to 85% of its oil, and studies were launched to determine the best course of action. The runaway inflation that had gripped Brazil had led to the postponement of a number of light-rail projects. In 1975 the federal government formed a special agency, the EMTU (Empresa Metropolitana de Transportes Urbanos) to promote public transport (particularly electric transport) and to distribute funds from the government to the cities for various projects. By 1976 the EMTU had decided to advocate trolley buses instead of the more costly methods of electric transport (commuter rail, trams etc.) and it was decided to draw up specifications for a Brazilian standard trolley bus.⁵¹⁾ To achieve this, the EMTU approached the largest operator of trolley buses in Brazil, Sao Paulo, to perform studies and to act as a testing ground for new ideas. (The municipal operator in Sao Paulo is known as Companhia Municipal de Transportes Colectivos - CMTC)

Trolley bus operation in Sao Paulo began on April 22 1949 when 16 buses first replaced a number of ageing trams. The fleet grew to a peak of 233 units in 1969 but dwindled thereafter.⁵²⁾ By the time EMTU requested CMTC to conduct experiments, the fleet consisted of 192 buses. In 1978 an ambitious program of trolley bus expansion and rebuilding was announced, involving 1280 new trolley buses and 400 km of new routes. Runaway inflation since then has caused a cutback in Government programs however, and only 230 new trolley buses had been delivered up to 1985. The fleet then stood at 418 serviceable buses. Current expansion plans include the electrification of twelve routes which will require 263 additional trolley buses.⁵³⁾

50) TRANSPORTATION RESEARCH BOARD, op. cit., p. 20.

51) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Trolley Coach News No. 49, 1980, p. 43.

52) Ibid., p. 55.

53) Trolley Bus Magazine, September - October 1985, p. 110.

As in the case of Toronto the role of trolley buses in Sao Paulo is small. (CMTC also operates over 2 000 diesel buses while private operators own another 6 800 buses. Bus passenger levels in the city amount to 5 million a day.) The policy in Brazil however is to use trolley buses on the busiest routes where their higher capacity can be used to best effect.

"The trolley buses will have exclusive bus-only lanes in the centre of dual-carriageway roads with stations every km. In effect, this is "trolley bus-rapid-transit" very much in the pattern of the train or LRT in Europe. There will be trolley/diesel interchange with through ticketing, and other diesel bus routes will connect at points in corridors."⁵⁴⁾

It has been suggested that :

"as service demands grow on the new routes, restrictions will be placed on all other forms of transport along these routes until everything, including motor buses, is removed to side streets. In this manner such a trolley bus route could be capable of 20 000 passengers per hour at an average speed of 20 km/hr."⁵⁵⁾

These flows, which seem to be within the bounds of feasibility, match those of light rail systems and can be achieved at lower capital cost. This is confirmed by the following extract :

"Brazil's solutions are tailored to Brazilian conditions and while those conditions may not provide a carbon copy for other nations, there is sufficient overlap for everyone to learn a lesson or two.

In the medium-capacity range, rail advocates would favour light rail development but at Sao Paulo's prestigious Engineering Institute's conference on urban transit recently, IRJ's regional editor, Theodor A. Gevert, was told by several speakers that so far as Brazil was concerned, light rail was out.

54) HELLEWELL, D.S., op. cit., p. 200.

55) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Trolley Coach News, September 1983, p. 63.

The reasoning is that articulated trolley buses, running in exclusive buslanes can carry as many passengers as light rail but cost only a fraction of LRT to introduce."⁵⁶⁾

The first of Sao Paulo's articulated trolley buses was introduced to the public on September 18 1985 (At what rate they will enter service is as yet uncertain). Apart from the expansion of the existing Brazilian systems, new trolley bus systems are planned for the cities of Campinas, Rio Claro, Goiana, Belo Horizonte and Belem among others.⁵⁷⁾

3.5 A BRIEF NOTE ON THE TROLLEY BUS PROPOSALS FOR LEEDS AND BRADFORD

Leeds and Bradford were the first trolley bus systems to open in Britain, on June 20 1911, and Bradford's system was the last to close, in 1972. In 1984 the West Yorkshire Passenger Transport Executive (WYPTE), which operates bus services in the area, announced plans to re-introduce trolley buses on a 76 km network linking the two cities. In anticipation of this project, a demonstration trolley bus has been built and is being tested on a short route in Doncaster.

The trolley bus is being marketed by the WYPTE as "Electro Bus" and is described as a forerunner to the longer-term "Electro Line" (or light rail). As such it is an example of a possible pre-metro role for the trolley bus.

In spite of the WYPTE's efforts, the British Department of Transport announced on May 7 1986 that it could not at this stage accept the WYPTE's application for a grant because of the impending deregulation of bus services, and it appears that the project will now be deferred for a year or two.⁵⁸⁾

3.6 CONCLUSION

This chapter has demonstrated that trolley bus retention and expansion has been the result of a number of factors. These include :

56) International Railway Journal, May 1983, pp. 18-19.

57) Trolley Bus Magazine, March - April 1985, p37.

58) Ibid., May - June 1986, p. 67.

- Economics. The lower cost of operation of trolley buses in comparison with other modes has been a factor in places such as Toronto, San Francisco and Brazil.
- Public preference. Some operators have shown a responsiveness to public preference for trolley buses – eg Dayton, Seattle and San Francisco.
- A willingness to experiment with the rebuilding of old buses – eg Toronto and Guadalajara.
- A new realisation of the role trolley buses can play in the development of underground and rapid transit systems – eg Guadalajara and Brazil.
- A forward-looking city philosophy – eg Seattle and San Francisco.

In the two chapters which follow, the experience of two South African cities where citizen action on the trolley bus issue and public preference for them has been disregarded will be examined.

CHAPTER 4

THE DECLINE OF THE TROLLEY BUS IN DURBAN

4.1 BACKGROUND TO THIS CHAPTER

The previous chapter has introduced some themes which will be developed further in this study. One of these themes is the popularity and public appeal of trolley buses and the influence of the trolley bus on passenger levels.

This chapter deals with the decline of the trolley bus system in Durban. By reference to press articles, public statements and official reports, it will be shown :

- that trolley buses were a popular form of transport in Durban
- that there was a negative attitude towards them on the part of the municipality
- that their abandonment was criticised by bus passengers and the general public
- that public requests to retain the system were disregarded by the City Council
- that the economic justification for their abandonment was not clear-cut but was based on conflicting financial reports.

This chapter is divided into the following sections :

- a brief account of the events leading up to the introduction of trolley buses in Durban in 1935 and the growth of the system thereafter
- a review of the decline of the system from 1952 until its final closure in 1968, with particular reference to the public efforts which were made to save the trolley bus service
- a review of events since 1968 with particular reference to the 1974 trolley bus investigation
- a note on the reasons for the decline in white passengers since 1967.

Electric street transport – trams and trolley buses – served Durban for nearly 66 years and played an important role in the development of what are now the inner-city suburbs of the Beach, the Berea and Umbilo.

Electric trams commenced operation on May 1 1902. The system grew until 1917 when the fleet reached its maximum strength of 120 trams including 30 large double-deckers which could carry 115 passengers each.¹⁾

By 1930, the tram system was starting to show its age and on June 16 of that year the City Council of Durban was requested to take a policy decision on its future. Trolley buses were being used in Bloemfontein at that stage and South African tram operators were well aware of their potential as a replacement for trams. The Council's decision was in principle not to buy any more trams but to replace them gradually with trolley buses.

On October 14 1930 representatives of the Guy Motor Company arrived in Durban with their Guy trolley bus, which was demonstrated to the Durban City Council along the Marine Parade route. No proper trolley bus wires were erected along the route; the bus operated with its positive trolley pole connected to the tram overhead while a sliding skate in the tram rail provided the negative return.

Three years passed before the City Council, on the advice of the General Manager, Mr J.A. Bromley, finally approved the replacement of trams. During November 1933 tenders were invited for the supply and delivery of 22 two-axle double-deck trolley buses to Council specification.

The successful tenderers were the Sunbeam Trolley Bus Company and Leyland Motors. Each firm was to supply eleven buses at a cost of £4 000 each, making a grand total of £88 000.²⁾

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- 1) FANN, J.A., The Tramways of Durban, Electric Traction, Australian Electric Traction Association, Sydney, March 1972, p.5.
 - 2) FANN, J.A., Durban's double deck trolley buses, Trolley Bus Magazine, November 1971, p.109.

By November 1934 the buses had been delivered but had to be placed in the Alice Street tram shed to await the erection of the overhead.

On Sunday, February 24 1935, a crowd gathered to watch Durban's first trolley bus service being officially opened by the Mayor of Durban, Mr Fleming-Johnson. The fleet of 22 buses was lined up on the north side of West Street from Church Street to Aliwal Street, facing east and in numerical order. They were painted in the official Corporation livery of grey with cream stripes, white wheels and silver roof and were numbered 1 to 11 (Sunbeams) and 12 to 22 (Leylands).

In 1937, tenders were invited for 42 three-axle double-deck trolley buses. The tender was awarded to three companies. Sunbeam were to supply twelve buses, A.E.C. thirteen and Leyland seventeen buses. These buses, which arrived between 1939 and 1942 were the last to be delivered during the war as the risk of enemy action was too great to allow the shipping of further vehicles.³⁾

The war years were busy for Durban's trolley buses and trams, many of which worked 22 hours a day. The diesel and petrol buses of which Durban had 118, were hampered by a shortage of fuel and spare parts. By 1945 a decline in passengers allowed the tram fleet to be reduced from 40 to 28. Their numbers continued to fall thereafter and on August 1 1949, the last tram operated to Musgrave Road.

Towards the end of the war, tenders were invited for fifty-two double-deck, three-axle trolley buses. Sunbeam was awarded the tender in July 1945, and delivery commenced in March 1948.

These were to be the last trolley buses ordered by Durban. The fleet now numbered 116 buses at which level it remained until 1950, when the 22 original trolley buses were withdrawn.⁴⁾

4.3 THE DECLINE OF TROLLEY BUSES 1952 - 1968

In 1952 the City Council, which had until that time been in direct control of the transport department, decided, on the advice of the Scott Baldwin

3) FANN, J.A., op. cit., p.111.

4) Ibid., p.112.

Commission, to create a semi-autonomous body, known as the Durban Transport Management Board (DTMB) to assume control of the department. The broad intention was to remove transport from the arena of "municipal politics" without, however, relinquishing complete control. To safeguard its interests, the City Council decided to appoint two city councillors to the DTMB and to make the DTMB responsible to the Trading Undertakings Committee of the Council.

(The DTMB, which still exists today, was destined to feature prominently in the subsequent history of Durban's trolley buses. Whether it succeeded in removing Durban's transport system from the sphere of municipal politics is doubtful, as the subsequent record of events, extending over a period of many years, will show)

In 1955, the 13 A.E.C. trolley buses were scrapped due to a structural defect in the roof stanchions. This reduced the fleet to 81 trolley buses.

The first indication that the trolley bus in Durban was under official disapproval came in 1957. In that year, a traffic plan was prepared in which the following extract appeared :

"From the traffic aspect it is regretted that this latter vehicle (trolley vehicle) has found its way on to the city streets, for there are several objections to the vehicle. There may be certain advantages that the trolley bus enjoys over the motor bus in other directions, but there are no real advantages from the traffic aspect. Their manoeuvrability is limited by overhead power cables, particularly at street intersections, they are unable to overtake each other, or "leap-frog" with the result that several of these vehicles are forced to follow each other closely along busy streets; they cannot be re-routed easily when street repairs or other works are in progress, and in the event of a power failure the whole fleet must perforce come to a standstill to the obstruction of all other traffic."⁵⁾

5) CITY COUNCIL OF DURBAN, A traffic plan for Durban, City Engineers Department, May 1957, p.59.

In November 1958 the Umgeni and Mayville Hill trolley bus routes were closed as a result of the re-settlement of residents in these areas, which had caused a slump in traffic. This led to the sidelining of about 15 trolley buses. At that stage the average age of the fleet was only 14 years, and withdrawal was probably considered unwarranted. It was announced that the Musgrave - Marriott circular route was to be electrified to absorb the spare buses. On May 1 1960, trolley buses took over on the route - the last conversion of a route to trolley buses in Durban, and probably the last in South Africa.

In 1961 the axe started to fall on Durban's system. Trolley buses were withdrawn on all routes after 6 pm, and eight buses were scrapped, reducing the fleet to 73. The official reason for the withdrawal of the trolley buses was that they were operated by two men whereas the latest single-deck diesel buses were designed for one man operation and were therefore cheaper to run. (Purchases of single deck diesel buses had begun in earnest in 1959).

(During the financial year 1961-62, Durban's 73 trolley buses carried 21 589 903 passengers, an average of 810 passengers per bus per day.)⁶⁾

In August 1964, single-deck diesel buses took over the afternoon services on four trolley bus routes - once again in the name of staff savings. The trolley bus fleet remained at 73 however, because most of the buses were still needed to work the routes in the morning peak.

By late 1964, the "letters to the editor" columns of Durban's two daily newspapers (the morning paper being the Natal Mercury and the afternoon paper, the Daily News) were carrying regular complaints from the public about the new single deck diesel buses. Most correspondents were in favour of trolley buses. The following four letters are typical of the views expressed at the time :

6) DURBAN TRANSPORT MANAGEMENT BOARD, Annual report for the financial year ended July 31 1962.

"TROLLEY BUS ADVANTAGES

I agree with previous writers, that it would be much better to have trolley buses in our city, and to do away with the one-man operated diesel buses."

"A BUS PASSENGER" 7)

"TROLLEY BUSES PREFERRED?

The other morning I was travelling in a procession of three buses going down Berea Road during the rush hour. First were two single-decker diesels and then a trolley, but though the leading buses were only half full it was noticeable how virtually everyone made a bee-line for the trolley, even though it was forced to stop well short of the bus stops because of the presence of the other two.

I wonder why this was - perhaps because the trolleys are more comfortable, quieter and less troubled by noxious fumes?"

"NUFF SAID" 8)

"ALL FLOCK TO THE TROLLEY BUS

For many months it was my pleasure to witness the same phenomenon that "Nuff Said" wrote about. The 7.21 am trolley bus to Marriott Road was accompanied by a diesel bus on the same route, possibly through some slip when the timetable was drawn up. At whatever stop both buses happened to come to a halt, three out of every four people boarded the trolley even if it was standing far behind the single-decker.

The trolley bus is, simply, a better bus, and electric street transport, even with its occasional power failures, is just the thing for Durban."

"MORE SAID" 9)

7) Daily News, November 5 1964.

8) Ibid., November 11 1964.

9) Ibid., December 15 1964.

"TROLLEY BUSES PREFERRED

... no-one could possibly think that the diesel buses are more comfortable, safer or cleaner. May we ask what it will cost to discard the trolley buses which are still perfectly good, and install these noisy uncomfortable and smoky buses? If we must have new buses why not gradually get more up-to-date trolley buses? ..."

"RATEPAYER FOR MANY YEARS" ¹⁰⁾

In a lengthy article in the Natal Mercury, the DTMB defended its position. Sensitive to criticism of diesel buses and public support for trolley buses, the statement included the following :

"The Board operates 379 diesel buses and 73 trolley vehicles. The (diesel) buses can operate on any route while the trolley vehicles are, for obvious reasons, restricted to a certain few routes only. The ideal service must allow for the free interchange of all vehicles between all routes.

Contrary to popular belief, the trolley vehicles are more expensive to operate than the diesel omnibus and this fact, coupled with its restrictiveness, and following an economic study, has forced the Board to decide on a policy aimed at standardisation on diesel omnibuses.

They are not readily available on the world market. Estimates for the purchase of new trolley vehicles indicate that they will cost twice as much as a new diesel omnibus."¹¹⁾

A few weeks earlier, the following article had appeared in the Daily News :

"TROLLEY BUSES MUST GO, SAYS TRANSPORT CHIEF

The antipathy of minority groups who want Durban to retain trolley buses cannot be allowed to influence any decision on replacing them, according to the Transport Department's general manager, Mr H.H. Robertson-Cumming.

10) Natal Mercury, December 21 1964.

11) Ibid., December 11 1964.

In a report to the Town Clerk, he said that the Transport Management Board was still firmly convinced that the trolley buses should go.

The board made its decision in the light of the estimated savings of well over R800,000 over the next 10 years," he says. Further advantages included greater flexibility in fixing routes; the minimising of traffic congestion; the overcoming of spare part and power failure difficulties, and the savings arising from common garaging and servicing."¹²⁾

Two points are significant :

Firstly, the general manager refers to "minority groups". While it is true that those actively engaged in civic action may be few in number, they may represent a larger body of citizens – the "hidden majority" who express their opinions by staying away from the buses altogether. As will be seen, this is what happened in Durban.

Secondly, the Board estimated that R800 000 would be saved over ten years by scrapping trolley buses. Bearing this expected saving in mind the following article must have proved embarrassing to the DTMB.

"TROLLEY BUS REPORT

The heads of three municipal departments have come to the conclusion that there is no justification for the immediate replacement of the two-man operated trolley buses with one-man trolley or motor buses.

The report by Mr O. Gorven, City Treasurer, Mr R.M.O. Simpson, City Electrical Engineer, and Acting General Manager of the Transport Department, Mr P. Amm, will be considered at a joint meeting of the Finance and Trading Undertakings Committees on January 29.

The conclusions arrived at by the three heads of departments, after a detailed investigation into all aspects of the change-over, indicate that the annual saving of R81 515 in wages by operating

12) Daily News, November 3 1964.

one-man buses would be more than offset by the extra average annual capital charges on new vehicles of R120 250.

"It would therefore appear to be to the Council's advantage to run the existing fleet of 73 debt-free double decker two-man trolley vehicles for as long as possible," the report states." 13)

There are two significant aspects to the above report. Firstly, it contradicts the expected savings figure quoted by the General manager in the previous article. Secondly, the "joint" report was linked with name of the Acting General Manager, Mr. P. Amm and not the General Manager, Mr Robertson-Cumming. It seems reasonable to suppose that there may have been some disagreement between the members of top management of the transport department over the trolley bus issue because Mr Amm resigned from his post as Deputy General Manager a few months later, in May 1965. "It is understood that he has clashed with members of the DTMB over the running of the Department and bus service." 14)

The three-department report on trolley buses was duly tabled at the meeting of the Trading Undertakings Committee on January 29 1965. The TUC's recommendation was to retain trolley buses "until they become unserviceable; there is no justification for their immediate replacement by one-man operated motor buses." 15)

In a letter to the editor the TUC's decision was praised :

"HOW TROLLEY BUS SERVICE COULD BE IMPROVED

It is indeed a pleasant surprise to see that the value of our trolley buses has been recognised by the departmental heads concerned. For some years now, trolley buses have been blamed for a great deal of our transport troubles.

A lot of the criticism has been unwarranted and has been almost entirely due to the apparent unwillingness of the Transport Department itself to maintain and operate trolley buses properly.

13) Daily News, January 19 1965.

14) Ibid., May 6 1965.

15) Ibid., January 30 1965.

There are scores of places on the routes where dewirements occur, but I see nothing being done about it. It is the method of pull-off on corners which is incorrect but whenever a bad dewirement occurs the wiring is merely restored to its original poor condition."

VAUGHAN MOSTERT¹⁶⁾

(According to a DTMB report, dewirements were the biggest single cause of trolley bus breakdowns in Durban, causing 33% of all incidents on the system.¹⁷⁾ The report suggested a number of improvements, which were never acted upon.)

A few days later, the discrepancy between the DTMB's figures and those of the "joint" report was again highlighted in a letter to the editor :

"TRANSPORT : RADICAL NEW APPROACH IS NEEDED

According to the chairman of the Transport Board, Mr G.B. Law, a sum of R770 554 is going to be saved during the 10 years commencing on the year of trolleybus replacement.

This figure seems to have been arrived at without taking into consideration the R906 400 required to buy the 80 diesel bus replacements.

How this omission came about is a matter for suspicion but if this figure of R906 400 is included, the saving of R770 554 becomes a loss of R135 846, spread over the next 10 years.

In 1975, when we are still "in the red" as a result of our extravagance in 1965 (or in whatever year the trolley buses are replaced) the diesel buses will in their turn require replacement, meaning that further large sums of money will be required.

It therefore looks as if we are in for a state of perpetual loss in terms of vehicle-life alone."

VAUGHAN MOSTERT¹⁸⁾

16) Daily News, January 30 1965.

17) COMLEY, E.P., Methods Officer, Durban Transport Management Board, Report on Trolley Vehicle Maintenance, June 1961, p.4.

18) Natal Mercury, February 9 1965.

There was no response from the transport department to the points raised in this letter and as far as is known, no further financial investigation was carried out in support or otherwise of the elimination of trolley buses in Durban.

The columns of the local press continued to carry letters critical of the transport department. A City Councillor, Bill Medwin, suggested that a referendum be held to test public opinion ¹⁹⁾ but this idea was never followed up.

Civic associations also became involved. On March 4 1965, both the Umbilo Burgesses' Committee and the Central Citizens Association called for the retention and renewal of the trolley service. "We are under the impression that the only European routes which pay their way are mainly operated by trolley buses" said Mr Morris, chairman of the CCA. ²⁰⁾

The trolley bus issue was not the only problem facing the transport department at the time. Breakdowns of buses and low morale among transport department employees were also causing headaches for transport management.

The announcement on April 6 1965 that the Administrator of Natal, Mr T.J.A. Gerdener had decided to appoint a Commission of Inquiry into the affairs of the DTMB, therefore came as no surprise. The Commission was to be under the chairmanship of Mr Justice Henochsberg with Mr R.S.J. Geraghty and Mr J.M. Schutte (general manager of the Pretoria transport department) as commissioners. ²¹⁾

The terms of reference of the Commission were wide, and did not specifically relate to trolley buses. Nevertheless an organisation called the Anti-Diesel Pollution Society (ADPS) decided to submit evidence to the commission on the trolley bus question. The Commission sat throughout 1965 and the early part of 1966 and its findings will be discussed below.

19) Natal Mercury, February 15 1965.

20) Daily News, March 4 1965.

21) PROVINCE OF NATAL. Provincial Notice no. 149 of 1965.

Meanwhile in May 1965, the following headline appeared in the Natal Mercury :

"TROLLEY BUSES OUT" EXPERT ADVISES" ²²⁾

The "expert" was Mr J.H. Herdman, then chief engineer of Bus Bodies (S.A.) Ltd who advised the DTMB not to buy any more trolley buses. He said the trend throughout the world was away from trolley buses and towards diesel buses. Trolley buses cost more to buy and were no longer being built in Britain. Trolley buses were tied to particular routes. This was the prime factor behind the decisions to replace trolley buses with diesel buses in Cape Town.

A few days later a reader responded :

"The electric bus must be anathema to certain manufacturing companies due to its fantastic long life - a fact which seems strangely absent from Mr Herdman's report. Some of our electric buses are 26 years old and to all appearances, seem perfectly capable of a further 10 years' service. Certain vested interests obviously view this amazing life with deep concern, for it simply means that they may have to look a little further for more work."²³⁾

The trolley bus issue continued to simmer throughout 1965 and 1966. In April 1966 it was announced that construction of the Western Freeway was to commence in 1967 and that trolley buses using Berea Road would give way to diesel buses because the wires could not be moved. Despite this, the Finance Committee of the City Council decided, in May 1966 to invite tenders for 40 new trolley buses.²⁴⁾ Nothing came of this inquiry however - perhaps it was a publicity measure to draw attention away from the fact that the Council had already approved the purchase of 107 new single deck diesel buses which would make the elimination of all trolley bus operation possible.

In August 1966, the Commission of Inquiry presented its report to the Administrator. (Both Messrs Justice Henochsberg and Geraghty had since died and the Commission of Inquiry completed its work under the chairmanship of Mr A.A. Elffers.) The report of the Commission amounted to

22) Natal Mercury, May 14 1965.

23) Ibid., May 18 1965.

24) Ibid., May 15 1966.

45 pages plus annexures and although its main theme was on matters other than trolley buses, its recommendations on the trolley bus question are set out below :

"TROLLEY BUS VERSUS MOTOR BUS :

Your Commission heard considerable evidence about the advantages and disadvantages of trolley buses.

The future of the trolley buses is a matter which must be given priority.

The Management Board should prepare a well-motivated report with recommendations for the consideration of the City Council. If trolley buses are to be retained then there must be an improvement programme, if not, then a conversion period and replacement programme must be stipulated. In general the trolley bus routes are high passenger density routes and could be profitable.

If the trolley buses must go, the public should be provided with the same acceptable, or even better, service and this a motor bus system is well able to do. ...

... The Anti-Diesel Pollution Society requested, and was permitted, to give evidence regarding air-pollution and it inundated your Commission with memoranda, pamphlets, circular letters and arguments, in support of the retention of trolley buses. This matter did not fall within the scope of the terms of reference, but your Commission's attention was drawn to reports which the Council had considered on the question of the scrapping of trolley buses. These reports indicated to your Commission that a certain amount of re-evaluation of the trolley bus position is necessary and although the end result may be the same, a more thorough analysis and motivation is required.

The future of trolley buses must be based on economic considerations."²⁵⁾

25) PROVINCE OF NATAL. Report of the Commission Appointed in terms of Provincial Notice 149 of 1965 to Enquire into Matters concerning the DTMB, pp. 34-45.

Under the circumstances it can be said that the findings of the Commission as far as trolley buses are concerned, were reasonable. There was insufficient evidence for the Commission to express a definite opinion on the economics of trolley buses. The recommendation that "a more thorough analysis ... is required" was, however never followed up.

Meanwhile, the ADPS was continuing the fight for trolley buses. In terms of the provisions of a local ordinance a public meeting on a civic matter could be called if a minimum number of signatures was obtained and a public meeting was duly called to discuss the trolley bus issue.

The meeting was held on March 1 1967 in the Jubilee Room of the Durban City Hall. The meeting was chaired by the then Mayor of Durban, Mrs Margaret Maytom and was addressed by the secretary of the ADPS, Mr H. Kemp and the chairman of the DTMB, Mr G.B. Law. This meeting is probably the only "official" public meeting ever held in South Africa on the trolley bus issue. The Daily News reported as follows:

"TRANSPORT CHIEF LOSES TROLLEY BUS BATTLE

The eight-member strong Durban Anti-Diesel Pollution Society last night gained huge support at a public meeting in the City Hall for a resolution calling on the City Council to provide a trolley bus service throughout the city.

It was a tremendous personal success for Mr Hugh Kemp. Mr Kemp's resolution will now be forwarded to the Town Clerk and then run the gamut of the various Council committees."²⁶⁾

The Natal Mercury reported:

"ELECTRIC BUSES ARE FAVOURED

At a heated meeting in Durban last night a motion that "the Durban City Council be called upon to provide a electrically-operated bus service throughout the city," was carried by an overwhelming majority."²⁷⁾

26) Daily News, March 2 1967.

27) Natal Mercury, March 2 1967.

In spite of these developments the ADPS was informed by the Town Clerk one month later that trolley buses were to be scrapped.

By May 1967 the number of trolley buses had fallen to 56. Work on the Western Freeway was due to start on August 1 1967 so on July 31, trolley buses operated for the last time on the routes serving the northern Berea. The fleet was then reduced to 30, and the only routes still operated were those to Marine Parade, South Beach, Point, Umbilo and Glenwood.

The Durban trolley bus saga is a story of surprises, however. On October 16 1967 the Council once again referred the future of the system back for further discussion.

"TROLLEY BUSES GET REPRIEVE

The fate of Durban's trolley buses is still undecided and has been referred back to a Council meeting in committee.

Mr S.J. Smith spoke against a Finance Committee resolution, which sought authority to dismantle the trolley vehicle overhead equipment. To many residents, he said, the trolley bus was the most popular mode of public transport in the city. He doubted very much the belief of those who wished to see the end of the service, that by scrapping it the city would save a lot of money."²⁸⁾

The overhead wires on the abandoned Berea routes were removed late in 1967. According to the DTMB the wires had become a "danger to public safety".²⁹⁾

At least one citizen was unimpressed with this reason :

"THE DANGER OVERHEAD

I cannot agree with the Durban Transport Management Board report that the trolley-bus overhead equipment is a danger to public safety.

28) Daily News, October 17 1967.

29) Ibid., November 2 1967.

I have been a resident of Durban for 48 years. I have never heard of anybody being killed through an electric shock, not even on the trams!

In my opinion, the Board has no right to remove the wires when the matter has been referred back to a Council-in-Committee meeting which has still to be held!"

J.B. MARSHALL ³⁰⁾

By January 1968 the trolley bus fleet had dwindled to ten, and it was announced that the final day of operation would be April 11.

At 8.30 am on April 11 1968, trolley bus 2040 left the Post Office for Marine Parade on Durban's last trolley bus run. There were no ceremonies. At the corner of Albert Street and Beatrice Street, the two last passengers got off 2040 and asked the driver to pause to allow a final photograph to be taken. With traffic hooting impatiently behind, the driver, Mr Gracie, obliged. Five minutes later, 2040 slipped into the gloom of Durban's Alice Street shed for the last time. The poles were pulled down and the saga of Durban's trolley buses seemed to be over.

4.4

EVENTS SUBSEQUENT TO 1968

If the DTMB had hoped that the withdrawal of trolley buses would end the controversy, it was soon disappointed. Throughout the remaining months of 1968, letters to the editor continued to appear, although less frequently than before. In October 1968 the Daily News carried the following snippet:

"FINAL SIGNS OF TROLLEY BUSES GO

The final remnants of Durban's trolley bus era are being removed, as city council workmen take down the last of the overhead wires.

Mr N.E. Flanagan, general manager of Durban's Municipal Transport Department, said today that although many people still bring up the "trolley bus versus diesel" dispute, trolley buses are out.

"The trolley bus was the ideal means of transport in its time, but has now served its purpose," he said."³¹⁾

30) Daily News, November 15 1967.

31) Ibid., October 9 1968.

Meanwhile, services had been slashed at the time trolley buses were removed from service. These service cuts, coupled with fare increases and increases in the annual loss, ensured a supply of material for critics of the transport department. In October 1968, the DTMB requested the City Council to subsidise the transport undertaking to the extent of R1 315 430 for the year – an increase of R351 210 on the previous year.³²⁾ Critics of the DTMB were not slow to seize on this development – one correspondent's view was that "it is high time the councillors inquired into the Transport Department, as its revenue is absolutely nil now that trolley buses are gone."³³⁾ This comment is obviously an exaggeration, but it may have been pertinent to ask what had become of the savings which had been predicted as a result of trolley bus withdrawals.

In September 1970, the following letter appeared in the Natal Mercury :

"DIESELISATION" HAS LOST BUSES MANY PASSENGERS

What the DTMB does not admit is that through the introduction of a thoroughly uneconomical one-man single deck diesel bus fleet, it has chased thousands of passengers away from the bus service.

In 1967, 33 million passengers were carried, while today only 25 million are being carried. This is a decline of 8 million passengers over a period of three years."

J.A. FANN ³⁴⁾

The drop in White passengers to which the above letter refers had resulted in continuing cuts in service frequencies. By 1972 the level of passengers on Durban's white bus service had fallen still further – to 22 million passengers. This time the Anti-Diesel Pollution Society re-entered the fray with a call for the re-establishment of an electric trolley bus system. A spokesman for the DTMB rejected the request. "It has been argued ad nauseam."³⁵⁾ The next day the Daily News, reacting to the above report, criticised the DTMB in an editorial :

32) Daily News, October 26 1968.

33) Ibid., November 28 1968.

34) Natal Mercury, September 17 1970.

35) Daily News, September 21 1972.

"DIESEL DILEMMA

A spokesman for the Durban Transport Management Board, which runs the city's buses (at a loss), yesterday refused to comment on a reasoned plea by the Anti-Diesel Pollution Society for a return to smokeless trolley buses. "It has been argued ad nauseam," he said."

In 1966 Durban's trolley and diesel buses carried 32 million passengers while in 1971 the single decker diesels carried only 22 million. It is abundantly clear that the population has become disenchanted with the bus service. Turning a deaf ear, ad nauseam, to well-intentioned advice won't help."³⁶⁾

In August 1972, the Movement for Improved Passenger Transport (MIPT) was formed to keep city officials informed of trolley bus developments throughout the world and to promote trolley buses in Durban in particular. MIPT wrote to City Councillors setting out a scheme for the reintroduction of trolley buses on certain routes.

These developments prompted the General Manager of the Transport Department, Mr. Flanagan, to defend the DTMBs policies: "Despite modern research on electric traction, engineers had not been able to develop a really worthwhile electrically driven vehicle, other than the outmoded trolley bus, which was not acceptable in modern traffic conditions and involved high overhead maintenance costs."³⁷⁾

The energy "crisis" of late 1973 was the catalyst for a series of articles on alternative energy, a new lifestyle, new transport systems, and so on. Looking back, it is clear that many of the views expressed at the time were either premature or exaggerated. Optimistic scenarios of a large scale switch from private transport to public transport have never materialised, for example. Similarly, calls for the electrification of public street transport have been ignored. Nevertheless, a series of articles about trolley buses in the press was sparked off by the energy "crisis." On November 28 1973, both daily newspapers in Durban carried editorials calling for renewed investigations into trolley buses. This was backed up by a request from city councillors to the DTMB to investigate the matter :

36) Daily News, September 22 1972.

37) Natal Mercury, October 17 1972.

"DISCUSSION ON CALL FOR TROLLEY BUSES

Councillor Mr Joe Ash has asked the city council to set up an "impartial" committee to go into the feasibility of reintroducing an electric public transport system in the city.

Mr Ash said trolley buses were efficient, quiet and clean and he wanted to see them brought into service along the more heavy-traffic bus routes such as North and South Beach, Umbilo and Greyville.

He has received considerable support from his fellow councillors on the issue."³⁸⁾

In response to these requests, the DTMB agreed to discuss the trolley bus issue once more. "The DTMB is to hold a special meeting next month to discuss the future transportation needs of the city, with special reference to trolley buses. It is expected that the Movement for Improved Passenger Transport, which has been working for 10 years for the reintroduction of trolleys, will be represented at the ... meeting. "We are delighted to be able to put our case" said the secretary, Mr J.A. Fann, yesterday."³⁹⁾

The DTMB meeting took place on January 23 1974. John Fann had built a true-to-scale 1/24 size model of a modern, forward-entrance, double deck trolley bus which caused considerable interest at the meeting.

The outcome of the meeting was that the DTMB agreed to investigate the technical and financial implications of trolley buses. A special committee consisting of officials of the transport department, the City Treasurer's department and the City Electrical Engineer's Department was to be formed to carry out the investigation.

The committee sat throughout the remaining months of 1974, holding meetings at regular intervals. MIPT was present at some of the meetings. Finally in December 1974, the DTMB called MIPT in to be presented with a copy of the committee's report. The report was negative to trolley buses. Its main theme was that the cost of installing overhead wires would be prohibitive.

The report will be discussed further in chapter 6.

38) Daily News, November 27 1973.

39) Natal Mercury, December 6 1973.

4.5 THE REASONS FOR THE DECLINE IN WHITE PASSENGERS SINCE 1967

4.5.1 The "official" reasons

The decline in White passenger levels in Durban has been the subject of many newspaper articles. The reason put forward by the DTMB is that the increasing affluence of the average white South African and his desire for status, have sounded the death knell for Durban's bus service. The view of the General Manager, Mr Cuthbert, is that :

"Status is the issue, being seen to be able to afford one's own car and to bring it to work. This, coupled with white South Africans' comfort and convenience - orientated way of life, has made marketing public transport to whites like marketing concrete eggs. In 1968 the white service was carrying 32 000 000 passengers a year - now it is handling 9 500 000."⁴⁰⁾

4.5.2 Some further factors

4.5.2.1 Introduction

Although the excuses about "status" and "convenience" may have some validity, they cannot be regarded as totally adequate. There are certain other factors which have also contributed towards this passenger decline - a decline which is probably the most severe in recent South African transport experience.

To identify these factors it is necessary to go back to 1952. The DTMB was created in that year, and it took over from the City Council a fleet of double deck diesel buses and trolley buses, as well as a number of single deck diesel buses. All the double deckers had rear entrances and were operated by a two-man crew.

At that time the average age of the fleet was comparatively low and for seven years thereafter, no large orders were placed for buses. The DTMB's first large purchase of buses for the white service was in 1959,

40) Daily News, March 14 1985.

when 25 single deck, forward entrance, underfloor-engine, diesel buses were bought. They were designed for one-man operation. (Since its inception in 1952 the DTMB has bought only single deck diesels – about 900 in all.)

Initially these single deck buses were used to expand services and to replace older diesel buses. Problems arose in 1961 when they started to make appearances on the trolley bus routes. These problems can be discussed under two headings :

- Bus design and performance.
- One-man operation, the fare collection system and bus segregation.

4.5.2.2 Bus design and performance

The single deckers of 1959 were thirty-six feet long and were licensed to carry 62 seated and 18 standing passengers. (The comparatively high seated capacity was achieved by using three and two seating in the rear half of the bus). The total theoretical capacity of the bus was thus 80, which was equal to that of the double deck trolley buses in the Durban fleet. (Their capacity was 70 seated and 10 standing).

The transport department emphasised the fact that the passenger capacities of the two buses were equal and that the diesel bus would be cheaper to run because it was operated by one man. In actual everyday operation, however, the capacity of the single deck bus was less than 80. There were two reasons for this. First, the seats which were intended for three people were seldom used by more than two people. Triple seating is unpopular with passengers, particularly on short-distance routes. It is an effort to squeeze past other passengers to reach and to leave a seat and in the case of passengers travelling only a few stops, most prefer to stand. This led to the second problem – that of standing passengers. The aisle was of reasonable width only up to the halfway mark whereafter it became narrower due to the wider seats at the back. The single deck bus could not accommodate 18 standing passengers in comfort and in practice seldom carried more than ten standees.

The cramped, congested atmosphere inside the single deck bus was not the only feature which made it unpopular with passengers. Durban has a hot, humid climate and adequate ventilation is an essential requirement in Durban's buses. The trolley buses were well catered for in this respect. Not only could every window drop its full length in its frame, but the top half of each window was tinted to protect passengers from the sun. On the single deck bus, however, only every alternate window could open. The windows were not tinted, and the temperature inside the diesel bus was noticeably higher than that in a trolley bus.

The fact that the diesel bus had an underfloor engine led to another design problem - a high floor - which proved unpopular with passengers. It was now necessary to climb up four steps into the bus, compared with only two to reach the bottom deck of the double deck bus. Many of Durban's bus passengers are elderly and the additional steps that they had to climb not only caused dissatisfaction among passengers but also slowed down the process of loading and offloading passengers at bus stops.

The noise, heat and vibration caused by the diesel engine beneath the floor was in sharp contrast to the quietness and comparative smoothness of the trolley bus and undoubtedly detracted from the passenger's perception of the diesel bus ride.

Some of the design inadequacies of the early batches of diesel buses were improved in later buses, but by then much of the damage had been done and the image of the diesel bus had suffered considerable harm in Durban. In 1964, the practice of using three- and-two seating was stopped. From then on, buses were fitted with two-and-two seating down their entire length. This reduced the capacity to a more realistic 53 seated and 17 standing passengers. From 1965 onwards, tinted glass was used and sliding windows in every frame were introduced. Unfortunately the high floor and the noisy, hot engine remained.

4.5.2.3 One-man operation, the fare collection system and bus segregation

One-man operation of buses has become universal in South Africa and is nowadays taken for granted. In the early 1960s however, one-man operation was still in its infancy on most of the busier routes in South African cities. Durban was one of the leaders in introducing the concept, but mistakes were made in the process. (Cities such as Cape Town, Johannesburg and Pretoria later introduced one-man operation with less trauma than Durban experienced.)

The delay caused by the collection of fares was a serious problem. In Durban the average boarding time per passenger on a two-man bus was 1,8 seconds. With one-man operation it increased to 7 seconds per passenger.⁴¹⁾ The reason for this was that Durban's fare collection system was based almost entirely on a cash fare. Pre-purchased coupons were available but there was little incentive to purchase them because the saving was very small. Loading times on the routes to the beach were even longer because of the unfamiliarity of most holiday passengers with the fares.

The delays with boarding times not only irritated passengers but also contributed to traffic congestion, because one-man buses slowed down other traffic. Extra bus stop space had to be provided and passengers now had to wait at specific colour-coded stops in the central area. (Previously all buses stopped at all stops along a route). In Durban, the use of pre-purchased coupons (or clipcards) was not actively promoted until the late 1960s. Unfortunately, as in the case of bus ventilation, by the time these were introduced, much damage had been done.

Bus segregation also became a problem with the advent of the single deck one-man bus. With the double deck design, the lower deck was used exclusively by white passengers. The top deck was mixed – the rear ten seats were reserved for black passengers and the front of the top deck was used by whites. At weekends in particular, when black traffic was heavy, the entire top deck would occasionally be occupied by blacks. Although minor incidents between conductors (who were white) and black passengers took place from time to time there were no

41) Based on personal surveys carried out in Durban in 1964.

serious problems and the system worked reasonably well. The most frequent cause of difficulty was disputes over fares and over-riding by passengers. These disputes were normally resolved while the bus was in motion.

The introduction of the single deck one-man bus led to problems. Black passengers were now required to occupy the rear ten seats of the single deck bus, and passengers were now more aware of each other's presence than they had been with double deckers. In addition, the boarding process became much longer, as communication problems arose between drivers and passengers and disputes had to be resolved while the bus was standing.

These problems came to a head during 1966 and 1967 when double deck trolley buses stopped operating at weekends. It then became necessary to introduce a separate bus service for blacks on the trolley bus routes. This meant that the remaining whites-only buses now carried far fewer (white) passengers than before, and the frequency of the white-only service was reduced. This process of cutting services has continued over a period of many years.

4.5.2.4 A note on the use of double deck buses in Durban

It is not the purpose of this study to suggest that the decline in Durban's white passenger levels was entirely due to the popularity or unpopularity of trolley buses and diesel buses. In Durban, the diesel bus was associated with one-man operation and inadequate body design. If single deck trolley buses with the same design inadequacies had been introduced, passenger levels would probably also have fallen to a certain extent although their smoother and quieter operation might have helped to retain some patronage.

Similarly, if double deck one-man diesel buses had been bought, the passenger loss may also have been cushioned to an extent. Unfortunately during the early 1960s, suitable double deckers did not seem to be obtainable. Furthermore, the double deck diesel has not been considered suitable for Durban, as the following exchange of views shows :

"PLEA FOR TRIAL OF DOUBLE DECK BUSES IN CITY

Both the Johannesburg and Pretoria Transport Departments are to loan a Mercedes Benz double decker bus for an evaluation trial period soon. The managements of these undertakings have always been willing to try different types of buses through their enthusiastic approach ... will the Durban Corporation Transport Department recommend that a ... double decker be evaluated here? Unlike their colleagues elsewhere, the DTMB continues to operate single deck, one man buses on all routes regardless of whether they are suitable for the work or not and regardless of whether the passengers like the Board's choice or not."

JOHN FANN ⁴²⁾

The General Manager's reply on the same day was :

"Double deck buses are not considered suitable for Durban due mainly to the topography of the city which is far more severe than both Johannesburg and Pretoria, which to all intents and purposes are flat. Not only does this place heavy stresses on the mechanical components of the buses, but the road cambers in many areas, resulting from the steep gradients, are not conducive to the operation of this type of vehicle."⁴³⁾

It should be pointed out that the General Manager is referring to double deck diesel buses and not to double deck trolley buses which operated for many years on some of the steepest roads in Durban. (It is generally accepted that trolley buses perform better on hills than diesel buses. This has been confirmed in the 1985 Johannesburg trolley bus demonstration project report.⁴⁴⁾

42) Natal Mercury, December 13 1976.

43) Ibid.

44) NATIONAL TRANSPORT COMMISSION, Trolley Bus Demonstration Project, Project Report PR 8/84, Pretoria, March 1985, p.6-9.

4.5.3 Summary

An important factor in the decline of Durban's white bus service seems to have been the elimination of two-man trolley buses and their replacement with one-man diesel buses. The use of an inadequate design of single deck body discouraged passengers. An unsuitable fare collection system aggravated matters. The single decker led to problems with mixing of passengers and it was necessary to introduce separate bus services for blacks and whites. The cuts in service frequencies for white passengers led to a "downward spiral" of lower passenger levels and yet more service cuts.

It is beyond the scope of this study to suggest specific solutions to Durban's bus transport problems. However, there is a more relaxed attitude towards bus integration today than there was in the 1960s and the re-introduction of double deck trolley buses, completely integrated, may provide the spark that is necessary to stimulate a new awareness of public transport in that city. Furthermore, an economic evaluation similar to the one which is set out in Chapter 8 may indicate that trolley buses have a part to play in Durban's transport network.

4.6 CONCLUSION

This chapter has reviewed certain aspects of Durban's trolley bus system and has highlighted the controversial nature of the decision to abandon trolley buses. It has drawn attention to :

- the popularity of trolley buses
- the uncertain economic "justification" for their withdrawal
- the negative attitude of the municipality towards trolley buses and the ignoring of public requests for their retention
- the refusal of transport management to concede that the abandonment of trolley buses could have been a factor in the decline in white passenger levels in Durban during the past twenty years.

CHAPTER 5

THE DECLINE OF THE TROLLEY BUS IN JOHANNESBURG

5.1 BACKGROUND TO THIS CHAPTER

This chapter continues to develop the theme introduced in chapters three and four, namely the public appeal of trolley buses. By reference to press articles, public statements and official reports, it will be shown :

- that trolley buses were a popular form of transport in Johannesburg
- that there was a negative attitude towards them on the part of the municipality
- that their abandonment was criticised by bus passengers and the general public
- that public requests to retain the system have up to mid-1986, been disregarded by the municipality
- that there has been a pre-occupation with "monorails" and underground railways for Johannesburg on the part of the transport planners.

This chapter is divided into the following sections :

- a brief account of the introduction of trolley buses in Johannesburg and the growth of the system until 1960
- the decline of the system between 1964 and 1984 with particular reference to the citizens' objections to the withdrawal of trolley buses
- the events leading up to the trolley bus demonstration project which officially commenced in August 1982 and ended in January 1986.

5.2

THE INTRODUCTION OF TROLLEY BUSES IN JOHANNESBURG

Trolley buses entered revenue service in Johannesburg in 1936, but the history of the system goes back several years before that date. The demonstration Guy trolley bus had arrived in South Africa in 1930 and was first tested in Cape Town and then shipped to Durban. The bus was then towed to Johannesburg where on November 18 1930 the Mayor and City Council were invited to see the bus for themselves and to ride in it. The route chosen for the demonstration was the Bezuidenhout Valley tram line. As in Durban, the bus ran with its negative pole earthed to the tram rails. A contemporary magazine records the day's events :

"The bus was driven by an employee of the City Council with no previous experience of the vehicle, and amply fulfilled the makers' claim for it. The bus was made to pull into the kerb on either side of the street, and did so quite easily without any derangement of the trolleys. It was driven with one set of wheels in the gutter and though the camber was considerable no unpleasant list was noticeable.

Judged from every point of view the test must be regarded as entirely successful.

After the demonstration His Worship and Councillors were entertained to tea at the Carlton.

His Worship in a short speech expressed himself as considerably impressed with this new form of transport, and undertook that it should receive the fullest consideration of the Council."¹⁾

In spite of the success of the demonstration, it was six years before trolley buses were ordered and the orders did not go to Guy. The initial trolley bus routes to Norwood and Sydenham were served by eleven Sunbeams and eleven AECs which commenced duties on August 26 1936. 1939 marked the first expansion of the system with trolley buses being extended to Highlands North and to Parktown North via Oxford Road.

1) South African Truck and Bus Owner, Johannesburg, December 1930, p.22.

The Second World War delayed any further expansion, but in 1948/49 the routes to Parkhurst, Melville, Westdene, Greenside and Parkview were converted to trolley bus operation. In 1959/60 further conversions took place, with trolley buses entering service on the South Hills, Rosettenville, Townsview, Forest Hill, Yeoville, Bellevue East and Mayfair routes. To cater for this expansion programme, 90 trolley buses were ordered during the late 1950s.²⁾

At its maximum strength during the 1960s the trolley bus fleet numbered 165 vehicles operating over 18 routes.

5.3

THE DECLINE OF THE SYSTEM

By 1964 the world-wide swing away from trolley buses had also reached South Africa. Cape Town's system closed early in 1964 and, as described in chapter 4 Durban's trolley bus system was in the balance. Although Johannesburg's newest trolley buses were at that stage only six years old, the following article in the Rand Daily Mail of April 24 1964 indicates that the long-term future of Johannesburg's system was already in doubt :

"RAND TROLLEY BUSES TO STAY UNTIL 1980

Johannesburg will have trolley buses in service until at least 1980, says the general manager of transport, Mr George Ross. Durban's general manager of transport, Mr H.H. Robertson-Cumming has said that trolley buses are as outdated as trams and cost twice as much to run. He has advised Durban to scrap them. But Mr Ross disagrees. "They're slightly dearer to run but certainly not twice as dear as motor buses. They are very high-capacity vehicles and do all the heavy routes and our department shows a profit on most of the routes on which they run. We expect to be using trolley buses until 1980." We don't find that flexibility has hampered us much, for our trolley buses are used on heavily-patronised and well-established services."³⁾

2) PERRY, R.M., Brochure distributed to coincide with the 40th anniversary of Johannesburg trolley buses, September 18 1976.

3) Rand Daily Mail, April 24 1964.

From that time on, the year 1980 was to be mentioned frequently in press articles and council documents dealing with the future of the Johannesburg trolley bus system. Several of the 1958-model trolley buses were destined to survive until June 1984 when the last five buses performed their final duties on the Black routes to Dunkeld and Parktown North.

Trolley bus routes were steadily abandoned after 1971 and the trolley bus fleet dwindled year by year. In many cases, buses were withdrawn as a result of spares shortages and to keep the remaining trolley buses on the road. (The overhead wires were nevertheless retained in position after trolley buses were withdrawn.)

While trolley buses have been "frowned upon" by the municipality, other forms of transport such as monorails and underground railways have been officially advocated for many years. In June 1966 the Star carried the following article :

"MONORAIL PLAN BEING STUDIED

The Johannesburg City Council is to push ahead with an investigation into the possible establishment of a monorail linking the central area with the Southern Suburbs, although several senior council officials are against the project.

The Management Committee has just approved a recommendation which reads : "That a study on the merits of introducing a monorail system for the Southern Suburbs be proceeded with, coupled with establishing the merits of a monorail or mass rapid rail transit system in any area of the city as well as any other form of transport."

Representatives of overseas monorail firms are also to be asked whether they will assist in the investigations."⁴⁾

4) The Star, June 22 1966.

The above article illustrates the pre-occupation of transport planners and officials with capital-intensive projects, while the trolley bus has been shunned for over two decades. The above quotation is of interest because three days previously, the Sunday Times had reported as follows. The storm clouds were gathering for the Johannesburg trolley bus :

"ALL DOUBLE DECKERS TO GO

Johannesburg's R6 000 000 double decker bus fleet is on its way out. Trolley buses and diesel double-deckers will be replaced mainly by one-operator single-decker diesels, Mr M.L. Neppe, the new chairman of the City Council's Utilities Committee, told me. This policy change was due chiefly to manpower shortages. "By 1980 we won't have any more trolley buses in our fleet," Mr Neppe said that a few new type, forward-entrance, rear-engined double-decker buses developed in Britain will also be tried out. It is intended that these should be one-man operated."⁵⁾

The Star repeated the above article, with the addition of the following comment "eventually the trolley buses will be replaced with diesels because diesels are cheaper to operate."⁶⁾

Public reaction to these proposals was swift. A few weeks later the Star published the following letter in the Readers' Views column :

"TROLLEY BUSES : SWITCH TO DIESEL OPPOSED

It is incredible that a municipal councillor should seriously think of advocating the removal of trolley buses in favour of diesel-powered vehicles. Apart from the trolley-bus's incomparable superiority in comfort, spaciousness, cleanliness and minimum of noise, diesel buses would gravely aggravate the already dangerous level of air-pollution and noise which are such pressing health problems today."

"AGASSED"⁷⁾

5) Sunday Times, June 19 1966.

6) The Star, June 22 1966.

7) Ibid., July 28 1966.

The letter had already been referred by the Star to Mr Neppe for comment because his reply was published on the same page. His reply was a lengthy one, and was based on the following points :

- changes in the demand pattern for transport in Johannesburg would pose problems for trolley buses because of their "inflexibility"
- considerable sums had to be spent to alter overhead lines owing to alteration of road systems
- diesel buses were cheaper to run. Diesel fuel was "lower" than electricity
- manufacturers had stopped making trolley buses and spares were going to become a problem
- power failures caused traffic chaos
- diesel buses were as good as trolley buses in respect of speed, spaciousness and comfort
- the fumes of diesel engines were less harmful than petrol fumes
- diesel buses were not the only causes of air pollution
- experiments were in progress to make diesel buses less noisy.

These points obviously failed to impress the readers of the Star. On August 15 1966 four letters appeared together under the names Pro Bono Publico, Trolley Bus Fan, M.J. Botha and Alf Baker.

"Trolley Bus Fan" referred to the "evil-smelling fumes" inside a diesel bus. M.J. Botha felt that "the more diesel buses there are on the roads, the more traffic jams there will be." Alf Baker raised the possibility of oil sanctions. Pro Bono Publico's letter is quoted below :

"CITY COUNCIL IS URGED TO SPARE TROLLEY BUSES

"Although Mr Max L. Neppe has made some valid and practical suggestions in his reply to "Agassed" on the controversy which has been going on on the subject of diesel buses versus trolley buses (The Star, July 28), I am nevertheless inclined to support "Agassed" in singing the praises of trolley buses.

I agree that for comfort, cleanliness and a minimum of noise the trolley bus cannot be surpassed.

True enough, should a power failure occur, as Mr Neppe says, a serious dislocation in the traffic system could occur, but why be so pessimistic?

For that matter anything could happen; there could be an earthquake or any other calamity or emergency could arise.

Such a view should be completely discounted and not be made an excuse to switch from trolley buses to diesel buses.

I ask Mr Neppe not to deprive us of the pleasure which the trolley buses have given us since they were introduced. If diesel buses are required to augment the fleet at peak hours, provide them by all means, but do not eliminate the trolley bus completely."⁸⁾

In 1969, six 1948-model trolley buses were converted to one-man operation. Although their forward-axle layout did not lend itself to one-man operation (the driver had to turn around to collect fares) the rebuilding was considered successful and by 1971 a further 30 trolley buses were converted. This development helped to give the trolley bus a new lease of life in Johannesburg, as staff shortages had up to that time been a severe problem and had led to the cancellation of many trolley bus trips. (It is unfortunate that Durban's transport management had apparently never considered converting its fleet of trolley buses to one-man operation during the early 1960s).

In spite of this development however, the trolley bus position in Johannesburg had become precarious. In 1971 the Rand Daily Mail, in an article headed "The day of the trolley bus wanes" quoted the General Manager of the Transport Department, Mr G. Ross as saying that the trolley bus fleet would be loan-free on June 30 1980. Spare parts had become a problem. "If a part has to be replaced, the bus can be off the road for some time while the spare part is ordered, made and delivered."⁹⁾

8) The Star, August 15 1966.

9) Rand Daily Mail, September 14 1971.

Notwithstanding the fact that 1973 was the year of the fuel crisis, the City Council continued with its plans for trolley bus abandonment. This apparently illogical policy astonished the public and a regular flow of letters appeared in the Johannesburg press. Approximately fifty press articles specifically mentioning trolley buses appeared in 1973 alone – on average, almost one per week. About 40 of these items were letters from the public while about ten were press releases from the Transport Department justifying its anti-trolley stand. Although it is impossible to refer to all of them, it is necessary to quote from some of these documents to emphasize the consistent public popularity of trolley buses.

In a letter to the Star on April 11 1973, signed by six people, the City Council was asked to state its intentions on trolley buses. Mr Ross replied that trolley buses would be phased out by June 1980. Trolley buses were very "inflexible" in the planning of large transport networks and caused traffic problems in power failures. They were difficult to drive and required much concentration in prevailing traffic conditions. Staff did not like driving them.

On May 9 and 10 1973, two further items appeared in the Star. The first was a call by B. Garmeson, chairman of the Greenside Residents Association :

"POLL CALL ON TROLLEY BUSES"

We have recently with the gravest concern, noted Press reports indicating that the Transport Department intends to withdraw all trolley buses and to replace them with diesel buses We are convinced that the overwhelming opinion of the citizens of this city is in their favour. Accordingly, we ask that at the very least the department take a public opinion poll on the subject before it commits the city beyond reversal, which it certainly has not done at this stage. The department is doing its best, we are advised, to persuade people to reject cars in favour of public transport. To make that transport infinitely less attractive in every respect than it is now seems an odd way to achieve its aim."¹⁰⁾

10) The Star, May 9 1973.

As in the case of the call for a referendum in Durban eight years earlier, no official response was forthcoming. However, the Star itself sent out a reporter into the streets and the following day this item appeared :

"PUBLIC WANTS TROLLEY BUSES

Trolley buses are overwhelmingly favoured by the Johannesburg public. They want to see them retained in place of diesels because they are quiet and clean. Of 100 people interviewed in the Loveday Street area, 61 favoured trolley buses, 32 preferred diesels and seven said they didn't mind. According to the survey by CARE (The Star's campaign for Cleaner Air, Rivers and Environment) most of the pro-diesel faction thought trolley buses were unreliable."¹¹⁾

(The question of unreliability is significant. During 1971 and 1972 the trolley bus system in Johannesburg was affected by a power failure once every three days.¹²⁾ It is reasonable to suppose that if trolley buses were less susceptible to power failures and dewirements, the 61% vote would have been higher - probably nearer to the 87% in favour of trolley buses reported in Seattle.)

In an editorial the Star observed :

"Our readers' columns reflect some dismay on the part of the public at the council's decision to phase out trolley buses by 1980 and the council's reasons have rightly been questioned ... Johannesburg must think again."¹³⁾

A few days later, Mr. Neppe defended the council's position in a lengthy article. Most of the points were repetitive (power failures, buses cannot overtake each other, inflexibility, overhead wires are unsightly etc.) "The decision to phase out trolley buses has not been an easy one but it has been made taking into account the future transportation needs of the whole metropolitan area of greater Johannesburg. This system will have to be a very flexible one and its requirements cannot possibly be served by the extension of any existing trolley bus system. The use of buses in

11) The Star, May 10 1973.

12) Unpublished letter, addressed to the Star by Councillor Neppe, dated May 17 1973.

13) The Star, May 18 1973.

connection with the proposed Rapid Rail System for Johannesburg must be considered. Only diesel buses will have the necessary flexibility to be rerouted as required to the various stations."¹⁴⁾

It is pertinent to ask whether a Rapid Rail system meets Johannesburg's requirement for a "very flexible" transport system!

Ratepayers organisations and other groups were active during 1973-76 to stop the abandonment of electric street transport in Johannesburg. In a letter to the Minister of Transport dated August 7 1973 the Roosevelt/Montgomery Park Residents' Association expressed its concern at the "Transport Department's policy of phasing out electrically powered buses. Recent purchases of diesel buses have not endeared themselves to the travelling public ... The Government is promoting the use of electric transport in organisations such as the S.A.R. This Association feels that it is short-sighted of the Transport Department to continue with its present policy." The Greenside Residents Association wrote to the Minister of Transport on June 25 1973, expressing its concern at "the decision of the Johannesburg Municipality to do away entirely with its fleet of trolley buses." An organisation called "Citizens Action" was also active in opposing bus fare increases during this time and in a letter to the Chairman of the local Road Transportation Board dated July 21 1973, associated itself with the sentiments expressed by the ratepayers organisation as quoted above.

The Minister of Transport referred these matters to the Town Clerk of Johannesburg who merely reaffirmed the Council's decision to phase out trolley buses and in a rather doctrinaire way pronounced that "economic factors impose a limit to trolley bus operation in any urban area and in a scattered conurbation such as Greater Johannesburg the demand for surface transport will always be met in large measure by diesel buses."¹⁵⁾

14) The Star, May 30 1973.

15) CITY COUNCIL OF JOHANNESBURG. Notes prepared for the meeting of the Utilities Committee, August 14 1973.

In spite of these attitudes, pressure was apparently building up within City Council and Government circles to take another look at trolley buses. In 1974 the Council put out a vaguely worded tender for new trolley buses. There was no response to this tender, as Mr Neppe, in a letter to the Rand Daily Mail in 1974, pointed out :

"TROLLEY BUS TENDERS

When the Council called for new buses recently, it sent tender forms to every known trolley bus manufacturer. At the request of one of them the tender period was extended for one month. Nevertheless, not a single tender for a trolley bus was received. This gives the correct perspective to the wild claims that there is a worldwide trend towards trolley buses and that trolley bus manufacturers are just falling over themselves to satisfy the alleged demands."¹⁶⁾

A few days later a correspondent, M. Baxter replied to Mr Neppe :

"BUSES OR TROLLEYS?

The unprecedented demand (for trolley buses) has given manufacturers full order books for several months to come. One of them has written to me saying that he was "overwhelmed with orders" and was not interested in the Johannesburg contract. Another firm didn't really believe that the City Council had serious intentions of purchasing new trolley buses. Also the tender documents were completely diesel-orientated and it was not justified to draw up a new design and cost it for such a small order."¹⁷⁾

In February 1976, the Star carried an article "Jo'burg must have tube - or die" in which Mr J.F. Oberholzer, chairman of the city's management committee, said that the city would have to have a tube system in ten years, or it would suffer, decline and die economically. This is a further example of municipal support for a form of transport which has not been seriously requested by citizens or ratepayers. However Mr Oberholzer did emphasize, that "the city's first current priority was to get the bus system right and to encourage people to use buses."¹⁸⁾

16) Rand Daily Mail, September 26 1974.

17) Ibid., October 11 1974.

18) The Star, February 26 1976.

Two days later, as if to underline the council's "first current priority" came the announcement that "Jo'burg seeks to buy new trolleys."¹⁹⁾ The report quoted Brigadier J.T. Durrant, chairman of the Transportation Committee as saying "we are keeping an open mind on the subject of trolley buses because of the oil shortage." By this time, the trolley bus fleet had dwindled to 81 units, and further withdrawals were envisaged for the following year.

5.4 THE TROLLEY BUS DEMONSTRATION PROJECT

5.4.1 The background to the project 1977 - 1982

Late in 1977 the following article in the Star strengthened most observers' views that the Council was having second thoughts about trolley buses :

"TROLLEY POLICY MAY REVERSE

"Johannesburg will decide early next year whether to reverse its policy of phasing out trolleys. Mr Les Pettey, the general manager of the Council's transport department, said trolleys could cost 50 percent more than their diesel counterparts. He added that the feeder system, including overhead wires, would have to be renewed."²⁰⁾

In March 1978 the General Manager submitted a report to the Management Committee of the Council entitled "Interim Transportation Plan - Public Passenger Transport" which recommended, inter alia the purchase of up to 63 new trolley buses.²¹⁾ They would be operated as a basic service at the level required by the off-peak timetable, with additional peak-period trips operated by diesel buses. This would lead to a lower peak-demand tariff, minimise the use of diesel fuel and ensure minimum disruption of the service in the event of power failure. At that stage however, the Council decided to defer a decision, pending a further report on the viability of trolley buses in the future.

During 1979, informal discussions were held with the Government Department of Transport during which it was intimated that the Government would be prepared to assist Johannesburg in financing a trolley bus

19) The Star, February 28 1976.

20) The Star, December 28 1977.

21) CITY COUNCIL OF JOHANNESBURG, A review of the trolley bus demonstration project from the date of its inception up to March 1981, (undated memorandum) p.1.

demonstration project. On July 6 1979 the Management Committee accepted in principle the re-introduction of a trolley bus system in the interests of fuel conservation and it was resolved that the Council approach the Director of Transport for a Government subsidy to finance a trolley bus demonstration project.

The costs of the project were estimated at R2,277 million (R1,227 million for seven prototype trolley buses and R1,050 million for the renewal of obsolete electricity feeder equipment and alterations to overhead lines). In addition 28 existing trolley buses were to be converted to one-man operation and 15 stored trolley buses were to be overhauled. The seven prototype trolley buses were to be operated on the Hillbrow/Forest Hill route.

On August 17 1979 tenders were invited for the supply of seven trolley buses. On March 25 1980 the City Council considered the tenders which had been received and on the following day (no tenders were awarded at that stage) entered into an agreement with the National Transport Commission (N.T.C.) In terms of the agreement the Council would purchase the trolley buses, operate and maintain them while the N.T.C. would reimburse the council at the rate of 60% of all agreed expenses. A committee known as the Steering Committee was to be established to control and monitor the project.

Tenders for the seven trolley buses were awarded on May 7 1980 to the following companies :²²⁾

- Brown Boveri/Mercedes
- Brown Boveri/Sigma
- Ansaldo/Springfield
- Toshiba/Springfield
- A.E.G./Springfield
- G.E.C./Springfield
- Siemens/Springfield

The buses were numbered from 800 to 806 and the contract prices varied from R175 267 (Ansaldo) to R247 876 (Siemens).

22) CITY COUNCIL OF JOHANNESBURG, op. cit., annexure E.

Numbers 800 to 804 were double-deck two axle buses while 805 and 806 were single-deck articulated buses mounted on three axles. Each bus was equipped with an auxiliary motor (either petrol or diesel), intended mainly for use in depot and workshop areas and for emergency, short distance, low-speed diversions.

The first bus to be delivered was no 800, which made its first trip under the wires on June 30 1981 to Parktown North. (While being towed from Port Elizabeth to Johannesburg, the bus was involved in a collision with a car near Graaff-Reinet.) Public service began in August, but differential problems sidelined the bus within a week and it was not seen in service again until November. Bus no 801 arrived soon after no 800, but an accident in the Transport Department workshops led to chassis damage and a bent axle. Electrical problems followed, and the bus did not see service again until December. The remaining buses, nos 802 to 806, were delivered between September 1981 and August 1982.²³⁾ Originally it had been anticipated that all seven buses would be commissioned by January 1982 and that the official opening ceremony would take place in April. This had to be postponed, however, first to June 10 and later to August 4 1982. The last bus to be delivered, no 806, arrived direct from the Springfield works the previous day, August 3.

Media coverage of the demonstration project was positive. "Die trolliebus kry nuwe lewe." Die dubbeldek-onderstel is ontwerp om meer as 100 passasiers te vervoer en word óf deur middel van oorhoofse elektriese toevoer óf onafhanklik van die kraglyne deur sy eie viersilinderdieselenjin aangedryf."²⁴⁾ At the opening ceremony, the Minister of Transport, Mr Hendrik Schoeman said "Die regering is baie positief ingestel teenoor die toekoms van trolliebusse en sien met groot belangstelling uit na die verslag oor die demonstrasieprojek."²⁵⁾

23) Trolley Bus Magazine, January 1982, pp. 16-17.

24) Rapport, March 21 1982.

25) Die Transvaler, August 5 1982.

To those who had been following the fortunes of trolley buses in South Africa over the previous twenty years these comments were encouraging, but it seemed prudent to withhold judgement until the demonstration project had run its course. For the previous three years or so the flow of pro-trolley bus articles and letters had virtually stopped. It seems that the pro-trolley bus movement had maintained a low profile, accepting in good faith the apparent new attitude towards trolley buses on the part of transport authorities and planners.

5.4.2 The course of the project 1982 - 1986

By early 1983 it was obvious that the demonstration project was experiencing problems. The average availability of the buses during the previous six months had been low. Only three out of seven buses were in service on an average day. By May 1983, after the project had been underway for ten months, some of the buses had been performing at a rate of as little as seven kilometres per day. The distances covered by each bus at that stage were :

800	21 000 km
801	14 200 km
802	5 200 km
803	1 710 km
804	2 000 km
805	2 600 km
806	5 000 km

The poor performance of the buses had already been the subject of comment in "Tollgate", the journal published by City Tramways. In the September 1982 issue, Tollgate referred to problems with power steering on no 800, problems with the high mounting of the trolley pole bases on no 802 and "mechanical faults" on no 803.²⁶⁾

26) Tollgate, City Tramways, Cape Town, September 1982, p.1.

"Road Transportation" magazine of March 1983 in an article headed "Trolley Tangle" referred to the "pitiful performance of the buses". It quoted Ed Curtis, technical manager of the Johannesburg Transport Department as warning the manufacturers to "get their buses running and keep them running - or they will not be allowed to take part. If we decide to go ahead with trolley buses, we will pick the best features from the seven buses and, when drawing up the specification, we will avoid those that cause grief."²⁷⁾ Road Transportation queried the merits of the experiment, however :

"If the experiment works, it could lead to the reintroduction of trolley buses in South Africa. But exactly what would that achieve? The answer is, very little. The amount of diesel fuel used by all the municipal buses in South Africa is insignificant. Even if every bus in South Africa was replaced by a trolley bus, the saving on the total fuel bill would be 0,6%. Is it worth it?"²⁸⁾

In the Sunday Times of November 20 1983, Mr Sarel Ras, General Manager of Buscraft, was equally unsympathetic. "The trolley bus project should be allowed to die a natural death" he said.²⁹⁾

The Financial Mail of February 24 1984 announced :

"TROLLEYS FLOP" OF JOHANNESBURG

Johannesburg's great trolley bus experiment, financed 60:40 by the State and the Johannesburg City Council, seems to have come to grief. The blame, it seems, lies at the feet of some of the manufacturers who supplied seven buses for evaluation. Johannesburg Municipal Transport technical manager Ed Curtis says "the trolleys are prototypes and unique. Their electrics result, with one exception, from new technology, and the companies trying them out have not trained specialists to cope with breakdowns. Experts have to be flown in from overseas whenever there's a hitch."³⁰⁾

27) Road Transportation, Johannesburg, March 1983, p. 13.

28) Ibid., p.13.

29) Sunday Times, November 20 1983.

30) Financial Mail, Johannesburg, February 24 1984.

The autumn 1984 issue of "Tollgate" referred once more to the poor performance of the buses. "Only two of the vehicles have completed more than 10 000 km and human error has on more than one occasion made nonsense of the auxiliary motor concept; in one case for instance the auxiliary motor could not be started because the battery was flat and in another there was no fuel in the auxiliary motor's fuel tank!"³¹⁾

The publicity given to the demonstration project overshadowed the fact that the "old" trolley buses, still in service on the Dunkeld and Parktown North routes, were in their final days. The fleet had shrunk from its maximum of 165 buses, twenty years previously, to 24 buses in May 1984. By June 22 1984 only ten buses remained in service. Five of these were withdrawn during the weekend of June 23/24, leaving five trolley buses to see out the "old" trolley bus service. They were numbers 1633, 1640, 1649, 1659 and 1670. On Thursday June 28 1984, trolley bus 1659 left for Dunkeld at 5.20 pm, returning to the city at 5.55 pm. This was to be the final "old" trolley bus trip. There were no ceremonies or announcements to mark the occasion.

In March 1985 the Steering Committee issued its report³²⁾ on the trolley bus demonstration project. Its main conclusion was the "the operation of such trolley buses in Johannesburg is for the foreseeable future not economically viable."³³⁾ By June 1985 this report had been made public and typical comment was as follows :

"TROLLEY BUSES ARE RULED OUT

Trolley buses are not a solution to Johannesburg's mass transport problems, a project report handed to the Government has found. The Minister of Transport Affairs, Mr Hendrik Schoeman, told the House of Assembly yesterday that trolley buses could not be operated economically in Johannesburg in the foreseeable future."³⁴⁾

31) Tollgate, City Tramways, Cape Town, Autumn 1984, p. 4.

32) NATIONAL TRANSPORT COMMISSION, Trolley Bus Demonstration Project, Project Report PR8/84, Pretoria, March 1985.

33) Ibid., p. 10-1.

34) The Star, June 12 1985.

On October 29 1985 the City Council of Johannesburg approved the abandonment of the demonstration project and the disposal of the trolley buses and infrastructure, based on the findings of the project report.

On December 29 1985 the Sunday Times reported :

"EXPERTS GO OFF THEIR TROLLEYS

Dreams of restoring the noiseless and odourless trolley bus as a major form of public transport in Johannesburg have been shattered.

The news came in a report to the city council on the results of a prototype demonstration. Seven prototype trolley buses were bought for the project and put into service on the busy Hillbrow - Forest Hill route across the city. According to the report, only two of them covered the 30 000 km regarded as the normal distance for a bus to travel in a year. The rest failed because of unreliability and frequent periods out of service awaiting technical advice and spare parts from overseas.

Abandoning the experiment with the prototype trolley buses would save Johannesburg R700 000 a year, the report estimated. It said that, compared with diesel buses, a fleet of 72 trolley buses would cost the city R9,6-million a year more to run.

Modern trolley buses cannot do without highly-qualified technical maintenance staff because of their sophisticated electrical control equipment, the report added. About all it could say in favour of trolley buses was that they were twice as energy-efficient as diesel buses, and caused on average 10 percent less internal noise.

The opposition PFP transport spokesman, Mr Max Neppe, MPC, said a rapid rail system, such as an underground railway, must come."³⁵⁾

35) Sunday Times, December 29 1985.

The final paragraph of the above extract is significant. Having unsuccessfully attempted to operate a comparatively inexpensive trolley bus project, the municipality continues to advocate a more expensive, and less flexible rapid rail system.¹ As if to confirm the Council's determination to advocate the underground system is this extract from Die Beeld :

"JOMET SÊ MOLTREIN MOET IN 1990 KOM

'n Ondergrondse vervoerstelsel vir Johannesburg se middestad het 'n stap nader aan die werklikheid gekom nadat die Johannesburgse Metropolitaanse Vervoerstudie (Jomet) se vervoeradviesraad onlangs by die owerheid aanbeveel het dat só 'n stelsel teen 1990 gebou word om 'n dreigende krisis in die stad se vervoerstelsel af te weer.

Die voorstel word nou deur die Departement van Vervoer oorweeg.

Die geraamde aanvanklike koste van so 'n ondergrondse spoorstelsel is sowat R650 miljoen. Die hele stelsel sal uiteindelik waarskynlik meer as R1 000 miljoen kos.

Jomet beveel in sy verslag aan dat die stelsel aanvanklik net tot die digbeboude dele van die stad beperk word en dat pendelaars per bus of per motor na ondergrondse spoorstasies moet reis van waar hulle per spoor na die middestad geneem sal word."³⁶⁾

It is worth noting that such a system will cost at least R650 million and that it will serve only the densely populated areas of the city. Transfers from other modes will also have to take place on a large scale.

The final revenue run of a demonstration trolley bus was that of no 806 on the afternoon of January 10 1986. All seven prototype trolley buses were then taken out of service pending disposal.

During February 1986 various citizens groups challenged the decision to abandon the project. These included the Parktown North Residents Association, the Johannesburg Metropolitan Action Group, and the Northern Areas Group (a co-ordinating body of ratepayers associations).³⁷⁾

36) Die Beeld, February 18 1986.

37) Private correspondence between the named groups and the Minister of Transport

On May 21 1986 the dismantling of the overhead wires commenced, although negotiations are believed to be in progress between the Department of Transport and the Johannesburg Municipality to retain certain trolley bus routes indefinitely.

The outcome of these negotiations is as yet unknown, at the time of writing (October 1986).

5.5

CONCLUSION

This chapter has reviewed certain aspects of Johannesburg's trolley bus system and has highlighted the controversial nature of the decision to abandon it. As in the case of Durban, it has drawn attention to :

- the popularity of trolley buses
- the negative attitude of the municipality towards them and the ignoring of public requests for their retention
- the pre-occupation of transport planners with underground railways for Johannesburg.

In Chapters 7 and 8 the matters arising from the evaluation of trolley buses in Johannesburg will be dealt with in greater detail.

CHAPTER 6

THE ARGUMENTS AGAINST TROLLEY BUSES

6.1 BACKGROUND TO THIS CHAPTER

In previous chapters, reference was made to the anti-trolley bus arguments raised by transport operators and city officials in cities in North America and South Africa. These arguments were not analysed in depth but were merely mentioned in order to contrast them with the pro-trolley bus views of certain sections of the public.

Some of these arguments will be set out in greater detail in this chapter. They will be evaluated by reference to the experience of other, established trolley bus operators and to the views of transport researchers and observers. Where an argument can be quantified, use will be made of any relevant statistics which are available.

Various documents have been produced in South Africa in recent years which, between them, have repeated most of the major anti-trolley bus arguments. Three of the most significant are :

- a booklet issued by the public relations department of Cape (or City) Tramways.¹⁾ This booklet amounts to approximately 1 400 words and contains most of the commonly-quoted anti-trolley bus arguments.
- the Johannesburg Trolley Bus Demonstration Project Report issued in March 1985.²⁾ In this chapter the report will be referred to as the JTD report.
- a report³⁾ signed by the General Manager of the Transport Department and the City Treasurer of Durban.

It is proposed to quote from these documents, (in particular the Cape Tramways booklet) and to comment on them.

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- 1) CAPE TRAMWAYS, Why not electric buses?, Cape Town, April 1979.
 - 2) NATIONAL TRANSPORT COMMISSION, Trolley Bus Demonstration Project, Project Report PR 8/84, Pretoria, March 1985.
 - 3) CITY COUNCIL OF DURBAN, Financial and technical implications of re-introducing trolley buses on Durban services, Durban, November 8 1974.

6.2

ANTI-TROLLEY BUS ARGUMENTS

The major anti-trolley bus arguments fall into the following categories, each of which will be dealt with separately :

- Higher initial cost
- Maintenance problems
- Standardisation of fleets
- Higher operating cost/cost per km
- Need for subsidies
- Inflexibility and overtaking
- Power failures
- Urban unrest
- Driver resistance
- Visual intrusion of wires.

6.2.1 Higher initial cost

6.2.1.1 Argument

"As far as trolley buses are concerned, the Director of Urban Transport of the S.A. Department of Transport warned recently that it would be foolish for any operator to invest in a new trolley bus system without very careful consideration of the immense capital outlay involved. The Johannesburg Municipality is at present conducting a feasibility study into electric trolley buses. Tenders recently received indicate that a double-deck trolley bus would cost R130 000, compared with R80 000 for a diesel bus of comparable capacity. To the cost of the more than 600 buses required to serve a medium-sized city, add the enormous cost of erecting overhead trackwork, support poles and transmission supply lines, and acquiring the sophisticated back-up equipment – and one ends up with a figure totalling tens of millions of rands!"⁴⁾

4) CAPE TRAMWAYS, op. cit., p. 3.

6.2.1.2 Comment

Although the quotation refers to the "enormous cost" and "immense capital outlay" of a trolley bus system, it merely refers to the initial purchase price of each bus. No attempt is made to quantify the total cost, or to project the costs over the life of the equipment. When comparing the economics of different forms of transport which have different life expectancies, different installation costs and different cost patterns, it is essential to carry out a long-term projection of costs and to set out clearly the various steps involved. Because of the importance of this subject, a separate section (chapter 8) has been devoted to the economics of trolley buses. In that chapter, the circumstances under which trolley buses can be justified will be set out in greater detail.

6.2.2 Maintenance problems

6.2.2.1 Argument

"Modern trolley buses and overhead lines feature technical innovations but – like recent "advanced" diesel buses with which Tramways and others have had disastrous experience – also require more sophisticated spare parts and maintenance."⁵⁾

6.2.2.2 Comment

It is true that trolley buses make use of more sophisticated technology than before, but the implication that trolley bus maintenance is more expensive and difficult is not borne out by the JTD report, which merely refers to the unfamiliarity of local maintenance staff with the buses and

5) CAPE TRAMWAYS, op. cit., p. 3.

with the long delays in obtaining spares.⁶⁾ These problems can be expected with unique prototypes. The (verbal) opinion of trolley bus manufacturers is that the use of trolley buses in sufficiently large numbers will justify the training of local staff and the stocking of sufficient spare parts.

6.2.3 Standardisation of fleets

6.2.3.1 Argument

"Public transport operators using trolley buses still have to provide diesel buses on less heavily patronised and more inaccessible routes, and as emergency reserves. Not only does this mean more vehicles are needed in total, but duplicated ranges of spares must be kept. All operators of trolley buses, in effect, have to run two completely different types of operation concurrently!"⁷⁾

6.2.3.2 Comment

This viewpoint can be described as the "standardisation" argument. This argument was also raised in Durban where it was claimed that a bus fleet had to be interchangeable to ensure maximum efficiency.

If this argument is taken to its conclusion, then it can be reasoned that all public transport in a city must be of one type only (ie. all bus, all heavy rail etc). Vuchic deals with this aspect as follows:

"There can never be a single "optimal" mode for all urban transportation. Conditions and requirements for urban travel vary so much that in most cities, except in very small ones, the optimal transportation system should consist of several complementary modes co-ordinated in a single multimodal system. It can be observed that cities with good transit planning and operations generally make use of a greater variety of modes than do cities in which transit is neglected."⁸⁾

6) NATIONAL TRANSPORT COMMISSION, op. cit., p. 2-9.

7) CAPE TRAMWAYS, op. cit., p. 5.

8) VUCHIC, V.R., op. cit., pp. 102-111.

Even those cities which use diesel buses only, sometimes use more than one make of diesel bus, which would presumably increase the range of spares to be kept on hand.

6.2.4 Higher operating cost/cost per km.

6.2.4.1 Argument

"The cost of electrical power in most cities overtook that of diesel many years ago, apart from which expenditure by a bus operator on fuel represents only a fraction of the overall operating costs. Insurance, maintenance and a host of other factors have to be considered, along with the major expense – labour.

Recent costs obtained from overseas cities using trolley buses :

	<u>TROLLEY</u>	<u>DIESEL</u>
Guadalajara (Mexico)	35,25 c/km	18,22 c/km
Seattle, USA	37,50 c/km	19,60 c/km
Helsinki	Trolley bus costs 12% more than diesel.	
Bergen	*Operation costs "approximately the same." ⁹⁾	

6.2.4.2 Comment

The first paragraph of the above quotation is not supported by the JTD report which states that electric power is 11,71 c/km¹⁰⁾ while diesel fuel is 29,97 c/km.¹¹⁾ Maintenance of trolley buses is 68% of diesel bus maintenance.¹²⁾

9) CAPE TRAMWAYS, op. cit., pp. 5-9.

10) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.10.

11) Ibid., para. 7.2.11.

12) Ibid., para. 7.2.8.

Although the figures which follow are dated they underline the fact that it can be misleading to generalise about cost per km figures :

In the financial year ended July 31 1964, Durban's bus service (diesel and trolley) operated at a deficit of R102 716. Diesel bus costs were 30,8c per mile – trolley bus costs were 53,1 cents per mile. Trolley buses, however made a profit of R127 746 while diesels incurred a deficit of R230 462.¹³⁾ Although the bus service was losing money, and the trolley buses were "costing" more than the diesels, the trolley bus routes were actually subsidising the diesel routes. These figures show that even though trolley buses may cost more per km to operate, their income per km may exceed costs. Further the conditions on trolley bus routes may be such that costs per km will be higher (eg. lower speeds in congested areas, heavier loadings, steeper hills etc.) so that diesel costs per km may also rise if they are used on trolley bus routes.

The reference to Guadalajara is significant. In chapter 3 it was pointed out that the trolley buses used there originally came from Chicago where they had already covered more than a million kilometres each. This may help to explain their higher cost per km.

6.2.5 Need for subsidies

6.2.5.1 Argument

"It is of interest that there is no viable privately-owned trolley bus system anywhere in the world today. Wherever they are used, massive state or ratepayer contributions make up operating losses. Are local ratepayers prepared to bear an additional burden running into tens of millions?"¹⁴⁾

13) DURBAN TRANSPORT MANAGEMENT BOARD, Annual report for the year ended July 31 1964.

14) CAPE TRAMWAYS, op. cit., p. 5.

6.2.5.2 Comment

Because of the comparatively large amounts of initial finance required, capital-intensive forms of transport are usually operated by public authorities. This is true of most trolley bus systems in the world – with one known exception – Araraquara in Brazil – where the trolley bus system is operated by a private company which pays 12% p.a. to its shareholders and which, in 1983, was purchasing new trolley buses out of company profits.¹⁵⁾

Whether trolley buses are subsidised or not, is irrelevant. If they cost less to run than other forms of transport on a particular route, they should be considered because the subsidy, or contribution from rates would then be lower than with other forms of transport.

If trolley buses are cheaper to operate on certain routes, there is no reason to believe that ratepayers will block a trolley bus scheme. In 1966 the citizens of Schaffhausen approved the introduction of trolley buses by a vote of 5 454 to 640.¹⁶⁾ There is no known record of any ratepayers organisation in any city asking for trolley buses to be eliminated, either for seasons of economy or for any other reason.

6.2.6 Inflexibility and overtaking

6.2.6.1 Argument

"Flexibility – the ability to use alternative routes in the event of an accident, or during roadworks or other disruptions – is a major consideration in the provision of efficient public transport. In Cape Town for example, heavily-patronised major bus routes overlap for considerable distances. Trolley buses are forced at all times to wait

15) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Trolley Coach News No. 59, 1985, p. 129.

16) Trolley Bus Magazine, July – August 1984, p. 73.

behind each other while the leader takes on or drops passengers, or during the course of some other obstruction. Tramways officials study contemporary systems overseas constantly and are well abreast of the latest developments – including the availability of trolley buses with auxiliary internal combustion engines, which, apart from requiring an additional inventory of spares, not to mention more skilled technicians, are simply not practical."¹⁷⁾

6.2.6.2 Comment

a) Inflexibility

The pre-occupation of some transport operators with inflexibility is in contrast to the more relaxed attitude of trolley bus operators such as Edmonton, for example :

"Dwelling on inflexibility in breakdown or detour situations stems from looking at a few specific incidents rather than at the overall picture. The routes on which trolley buses are operated are main lines where the travel desire has remained constant over a long period. If necessary, detours can be arranged for major construction projects."¹⁸⁾

None of Edmonton's trolley buses are fitted with emergency power systems.

Vancouver operates 270 trolley buses. When British Columbia Transit looked at the need for "off-wire operation" it found :

"Records were sketchy on the number of delays and incidents that occurred on the extensive trolley bus system in Vancouver but it appeared clear that 90% plus of all incidents were minor. They involved a bus being stuck on an insulator, a defective switch, a span wire or an intersection down – the sort of things that do not need a lot of stored energy to correct."¹⁹⁾

17) CAPE TRAMWAYS, op. cit., pp. 5-7.

18) TRANSPORTATION RESEARCH BOARD, op. cit., p. 33.

19) Ibid., p. 12.

Toronto's attitude is "if (trolley bus) use is restricted to stable established routes this is not a serious handicap."²⁰⁾

The JTD report dwells at length on the question of flexibility, route diversions and turning buses short.²¹⁾ However, not once in 619 personal visits to the test route between April 1983 and January 1986 was it necessary to divert a trolley bus or to turn it short. A few detours at other times were reported by drivers but these were minor.

b) Overtaking

It is true that trolley buses cannot overtake one another unless loops are provided in the overhead lines. There is however, no record of any existing operator of trolley buses elsewhere in the world claiming that "overtaking" is a problem. The overhead wiring maps of most operators show that loops are provided at key bus stops; whether they are unsightly is a matter of opinion. Where possible, trolley bus drivers adopt the practice of "skipping" a stop to let the bus behind pick up the passengers. Where several routes run together along the same street this might not be possible, but even then, diesel buses may be unable to overtake each other easily.

6.2.7 Power Failures

6.2.7.1 Argument

"It could be catastrophic were power failures to result in the entire public transport system – both trains and buses – going out of action at once. Imagine the chaos on a freeway service if the buses broke down, or the trolleys jumped the cables!"²²⁾

Power failures were also emphasised in the JTD report.²³⁾

20) TORONTO TRANSIT COMMISSION, Report no. 5 of 1969, op. cit., p. 3.

21) NATIONAL TRANSPORT COMMISSION, op. cit., para. 4.2.

22) CAPE TRAMWAYS, op. cit., p. 7.

23) NATIONAL TRANSPORT COMMISSION, op. cit., para. 4.1.1.

6.2.7.2 Comment

Modern substation equipment on the test route in Johannesburg reduced power failures to an insignificant level. Not one power failure was experienced during 619 personal visits between April 1983 and January 1986 although drivers reported isolated failures at other times amounting to approximately one hour in total. (If power failures should occur, the auxiliary generator allows the trolley bus to keep moving, even though the normal service may be affected to a certain extent).

The experience of Edmonton is :

"The detailed study done for Edmonton Transit showed less than one power breakdown in 100 000 miles operated on a system using many recycled components.²⁴⁾

On a personal visit to Seattle in August 1986, the manager of the overhead lines department, Mr Tripper, told the author that since the beginning of the calendar year 1986, Seattle had experienced five power breaks. Each failure had affected one substation only and had not disrupted the entire system. The average duration of each failure was 59 minutes. According to Mr Tripper, this was not considered to be a serious problem in Seattle.

In 1976, Erwin Gonser, technical chief of the Swiss trolley bus system in Lucerne, who was visiting South Africa at the time, said that power failures did not occur more than once or twice a year. It only took 10 or 15 minutes to sort out problems when power failures did occur. "Our older trolleys have batteries which enable them to pull to the side of the road. Our newer trolleys have VW generators which enable them to travel up to 30 km in an emergency."²⁵⁾

24) TRANSPORTATION RESEARCH BOARD, op. cit., p. 33.

25) The Star, February 28 1976.

6.2.8 Urban unrest and sabotage

6.2.8.1 Argument

"By continual re-routing at extremely short notice during the civic unrest of 1976, Tramways was able to prevent the loss of buses worth millions of rands, along with countless lives. This would not have been possible had the buses been literally tied to a route - and easily immobilised by would-be saboteurs."²⁶⁾

6.2.8.2 Comment

Sabotage and urban unrest have become serious issues in South Africa. The point should be made that there seems to be no experience (either local or elsewhere) of operating trolley buses into "violent" areas. It is therefore possible for those with anti-trolley bus attitudes to emphasise the risks and to conjure up images of burning and stranded trolley buses, power lines torn down and general disorder. It is significant that Beirut, which experiences severe urban violence, has had no "conventional" bus service since 1975.²⁷⁾ In other words, not even diesel buses can operate in conditions of extreme unrest. If it is expected that urban terror will escalate to the Beirut level in South Africa, then all conventional public transport will be threatened.

If, on the other hand, urban unrest is limited to incidental acts of arson, stone-throwing, barricade-building and bombing, then the risks involved in operating trolley buses would be power failures due to damage to substations, poles and wires and damage to buses themselves. In the event of a power failure the trolley bus will be able to continue moving by means of its auxiliary generator.

To minimise the opportunity to cause damage, trolley bus wires in "risk" areas should be supported on robust railway-type masts supporting a catenary system which enables the masts to be spaced further apart. Another reason for masts is that some roads lack pavements and the risk of collision from passing vehicles is greater than in the city. Masts would withstand such impact better than poles would.

26) CAPE TRAMWAYS, op. cit., p. 7.

27) Jane's Urban Transport Systems, 1985, Jane's Publishing Company Ltd., London, 1985, p. 28.

It should be remembered that other forms of mass transport such as underground railways and heavy rail are equally if not more vulnerable to sabotage. The installations of the S.A. Transport Services are accessible to the public at stations and level crossings in "sensitive" areas. In many places, the overhead contact wires pass only a few centimetres below public footbridges and road bridges. If there have been any attempts over the years to damage these installations they have been sporadic and largely ineffective.

6.2.9 Driver resistance

6.2.9.1 Argument

The JTD report comments on the attitude of drivers towards driving trolley buses; some drivers experience "great difficulty" and "lack ... confidence" in driving them. "Particular care is required when negotiating frogs, insulators and curves. With a diesel bus it is possible to weave through heavy traffic without the constraints imposed by overhead lines. This has undoubtedly contributed to the apprehension of and the antagonism shown towards driving trolley buses."²⁸⁾

This argument was raised in Johannesburg in 1973 when Councillor Neppe wrote : "It has also been the experience of operators everywhere that the majority of drivers prefer diesel buses because of the complication and strain of concentrating on the overhead lines with the "frogs" and crossings and the not infrequent "dewiring" that occurs when driving trolley buses."²⁹⁾

6.2.9.2 Comment

It should be pointed out that in spite of Councillor Neppe's claim, the author is unaware of any similar reports from other trolley bus operators. Where overhead lines are properly maintained and correctly positioned, the trolley bus driver will experience no significant problems. This is borne out by personal discussions with trolley bus drivers themselves.

28) NATIONAL TRANSPORT COMMISSION, op. cit., para. 4.5.1.

29) The Star, May 17 1973.

6.2.10 Visual intrusion of wires

6.2.10.1 Argument

The JTD report refers to "visual intrusion" of overhead lines, although it concedes that overhead lines "help to identify to the prospective user the availability of public transport."³⁰⁾

6.2.10.2 Comment

Instead of regarding the presence of overhead wires as "visual intrusion", it is becoming recognised that such fixed installations raise the image of public transport, as the JTD report itself admits. This point is taken further in a recent editorial :

"People will plan their lives, buy their homes and choose their children's schools in the knowledge that a transport service with tracks (especially one with poles and wires) is not going to give up."³¹⁾

The physical presence of overhead lines and fixed installations may be able to play a significant role in the marketing of public transport.

6.3 THE DURBAN REPORT

6.3.1 Background to the report

On January 23 1974 the Movement for Improved Passenger Transport (MIPT) was invited to meet the management of the Durban Transport Department to discuss the calls by MIPT for trolley buses to be re-introduced in Durban.³²⁾ As a result of this meeting, a sub-committee consisting of municipal officials was set up to consult more fully with MIPT and to submit a report to the General Manager.

30) NATIONAL TRANSPORT COMMISSION, op. cit., para. 4.6.

31) Modern Tramway and Light Rail Magazine, June 1985, p. 181.

32) Natal Mercury, December 6 1973.

6.3.2 Findings and recommendations of the report

This report was duly tabled on November 8 1974. It amounts to 32 pages, and the findings are summarised below :

- "1. It will be seen that most of the claims made by MIPT ... have since been either withdrawn entirely by these people or modified substantially, so that the claims made have not been substantiated.
2. Whilst the known advantages of trolley buses have never been denied ... the disadvantages which caused (their withdrawal in Durban) are still existing.
3. ... To save time and expense, the Johannesburg City Council which was making a world survey of the trolley bus market, would make available to us the result of their findings.
4. ... A tender put out by the Johannesburg City Council (for trolley buses) drew no response from any ... manufacturer.
5. The City Treasurer indicated to the sub-committee in detail the information which would be necessary to enable a full financial evaluation to be effected, but as reliable information could not be obtained by the sub-committee, it was not possible to make any progress in this matter."³³⁾

The recommendation was :

"Quite evidently the Durban Transport Management Board could not in such circumstances be expected to embark on a programme of re-introducing trolley buses and we have therefore to recommend that no further action be taken in this regard by the Board and that the members of MIPT be recalled in order to explain the outcome of the enquiry and indicate the Board's decision in the matter."³⁴⁾

33) CITY COUNCIL OF DURBAN, op. cit., p. 4.

34) Ibid., p. 5.

6.3.3 Comment on the report

The body of the report discussed inflexibility, power failures, and world trends away from trolley buses (as supplied by Johannesburg).

No figures were quoted for the cost of new trolley buses, their life expectancy, their power costs, or maintenance costs. The only costs quoted were for overhead lines – the report stated that 742 km (seven hundred and forty-two kilometres) of route would have to be electrified at a total cost of R65 132 000.³⁵⁾

MIPT queried this figure of 742 km as Durban's entire bus service at that stage covered a route distance of not more than 300 km. The figure of 742 km could only be arrived at if special tour bus routes to Pietermaritzburg and Oribi Gorge were also electrified.

Attempts by MIPT to establish how this kilometre distance was arrived at were unsuccessful – on March 6 1975 the D.T.M.B. replied that no further correspondence would be entered into on the subject.³⁶⁾

6.4 CONCLUSION

This chapter has considered a number of anti-trolley bus arguments. By reference to the views and experience of established trolley bus operators and other sources it has been shown that these arguments are to a certain extent overstated. It has also shown that certain estimates and assumptions made in official reports have been queried but not satisfactorily answered.

The economics of trolley buses will be discussed further in chapter 8 where the circumstances under which they can be economically justified are set out in greater detail.

35) CITY COUNCIL OF DURBAN, op. cit., annexure C, pp. 4-6.

36) Letter from the DURBAN TRANSPORT MANAGEMENT BOARD, addressed to MIPT.

7.4.1 The objective of the project

The main objective of the Johannesburg trolley bus demonstration project was to "establish the desirability and economic viability of operating a trolley bus system as part of the Johannesburg transport system"¹⁹⁾ This objective is somewhat limited, in that only the technical and economic aspects were considered and then only in relation to a specific geographical area.

It seems to have been the intention at one stage, however, to consider passenger suitability, because the report makes the following comment :

"PASSENGER SUITABILITY

A valid survey could not be done, due to the intermittent availability of the prototype buses."²⁰⁾

It is not clear how this survey would have been carried out or what it would have attempted to show. It is understandable however, that little could be done in this regard under the circumstances.

The demonstration project began in August 1982 and ended on Friday, January 10 1986. As early as April 1983 it had become obvious that the performance of most of the buses was erratic. On June 30 1983 a letter was sent to the General Manager of the Johannesburg Transport Department asking for certain information. The following reply was received :

"... no information relating to the operation and performance of the demonstration trolley buses may be released at this stage. Regrettably, from your point of view, the (demonstration project) report is unlikely to be made public much before the end of the year."²¹⁾

19) NATIONAL TRANSPORT COMMISSION, op. cit., para. 2.1.

20) Ibid., para. 4.4.

21) Letter from the Johannesburg Transport Department addressed to the author, August 8 1983.

CHAPTER 7

THE ROLE OF THE TROLLEY BUS IN IMPROVING THE IMAGE OF PUBLIC TRANSPORT AND ATTRACTING PASSENGERS

7.1 BACKGROUND TO THIS CHAPTER

In the chapters dealing with the retention of trolley buses in North America and the scrapping of trolley buses in Durban and Johannesburg, it was shown that they enjoy the support of certain sections of the public. It was also shown that the withdrawal of trolley buses in Durban was followed by a fall in passenger levels.

The extent of public preference for trolley buses has not been measured in a scientific way. The few statistics which are available are based on comparatively small samples of the population, and it has been argued that where pro-trolley bus sentiment has been expressed, it has been exaggerated as a result of the efforts of zealous minority groups.

The relationship between trolley buses and higher passenger levels has also received only superficial attention. Few statistics are available and those which do exist have not been subjected to rigorous statistical analysis.

The first part of this chapter will, nevertheless, attempt to demonstrate a basic consistency in pro-trolley bus sentiment by referring to the attitude of certain sections of the public in a number of cities. It will also refer to statistics which suggest that there is a link between trolley bus usage and higher passenger levels. It is not the purpose of this chapter to "prove" that trolley buses are more popular or that they lead to higher passenger levels. It will merely be suggested that further research is necessary into these matters.

This chapter is divided into two parts. The first part of this chapter will consider two areas :

- Does the public prefer trolley buses?
- Does the trolley bus attract passengers?

The second part of this chapter will consider various aspects relating to the passenger suitability of trolley buses in the South African context. Reference will be made to the Johannesburg trolley bus demonstration project and to research carried out by the National Institute for Transport and Road Research.

7.2 DOES THE PUBLIC PREFER TROLLEY BUSES?

7.2.1 Introduction

This section will describe the attitudes of the public in six different cities, covering the period 1967-1986.

7.2.2 Durban

"At a heated meeting in Durban last night a motion that "the Durban City Council be called upon to provide an electrically operated bus service throughout the city" was carried by an overwhelming majority."¹⁾

This was the newspaper report following a public meeting organised by the Anti-Diesel Pollution Society. The meeting was held in the Jubilee Room of the City Hall and was attended by about 200 people, according to the press article.

7.2.3 San Francisco

In April 1969, a group of students at the University of California carried out a public preference study in San Francisco relating to streetcars (trams), trolley buses and diesel buses. Respondents were asked to rate each type of transport on a scale from 1 to 5 - "dislike" to "like". They were also asked to express an opinion on the appearance of overhead lines and air pollution on a scale from 1 to 5 - "serious" to "not serious". They were also asked to state the type of transport they wished to have serving their route. 403 reply paid cards were distributed and 143 were returned.

"In summary, the streetcar (tram) was the overwhelmingly preferred vehicle followed closely by the trolley bus. Eighty-four per cent of the respondents marked 4 and 5, "like" for the streetcar

1) Natal Mercury, March 2 1967.

(tram), and 61% marked 4 and 5 for the trolley bus. On the other hand, 66% marked 1 and 2, "dislike" for the diesel bus. As to important related issues of diesel fumes and overhead trolley wire, 80% of the respondents marked 1 and 2, indicating that they believed diesel exhaust fumes to be a serious problem, whereas only 32% marked 1 and 2, indicating that they thought overhead trolley wire was a serious problem. In addition to preferring the trolley coach, the respondents indicated by a ratio of 5 to 2 that they would prefer to have the particular line that they were riding served by the trolley bus rather than the diesel bus."²⁾

A public meeting was held in the Cowell Hall at the University of San Francisco on August 14 1986, to consider the introduction of trolley buses on the 31-Balboa route in San Francisco. The author had the opportunity to address the meeting, which was chaired by the Director of Planning of MUNI, Mr Peter Strauss and which was attended by 25 people. The only objectors to the proposal were two people who felt that the overhead lines would be unsightly. Mr Strauss pointed out that such wires formed part of the "street furniture" of a city together with items such as fire hydrants, robots and parking meters and should be regarded as a necessary part of the city's life-support system.

7.2.4 Dayton

A public meeting organised by the Miami Valley Regional Transit Authority was held in Dayton on March 13 1973 to discuss "the merits of diesel buses and trolleys". The following day's newspaper reported :

"As the 20 witnesses stepped to the microphone, the message was obvious : a lot of people get "high" watching a trolley go by.

- All the witnesses endorsed the continued use of electric buses
- No-one favoured an all-diesel fleet

2) NATVIG, C.L., The Economics of the Trolley Coach, unpublished M.B.A. thesis, San Francisco State University, 1975, p. 91.

The public comments were so lopsided that halfway through the hearing, W.W. Owen was eager to point out the trend. "We've had 11 speakers so far. And I haven't heard anyone speak in favour of the diesel."³⁾

7.2.5 Johannesburg

"Trolley buses are overwhelmingly favoured by the Johannesburg public. Of 100 people interviewed in the Loveday Street area 61 favoured trolley buses, 32 preferred diesels and seven said they didn't mind."⁴⁾

This report followed an informal poll carried out by the Star. Loveday Street was at that time a busy trolley bus terminal area. It has already been pointed out that this survey was carried out at a time when trolley buses were under official disapproval in Johannesburg and that they were unreliable in operation at that time.

7.2.6 Portland

In 1979 the Oregon Journal, a local newspaper in Portland, carried out an informal poll among its readers. The following questions were asked :

- 1) Do you think trolley buses are a good idea for Portland? YES/NO.
- 2) Some people used to think the overhead trolley wires contributed to "visual pollution" although the buses themselves were quiet and odourless. Do you think the overhead wires would be unsightly? YES/NO
- 3) Regardless of the appearance of the wires, do you think Tri-Met (the local transport authority) should help reduce U.S. dependence on foreign oil by installing electric trolley buses? YES/NO.⁵⁾

3) Dayton Journal Herald, March 14 1973.

4) The Star, May 10 1973.

5) Oregon Journal, October 15 1979.

On October 23 1979 the Oregon Journal published the results. 111 readers responded to the questionnaire. The response was :

Do you think trolley buses are a good idea?

Yes 97 No 14

Do you think the overhead wires would be unsightly?

Yes 26 No 83

Should Tri-Met reduce reliance on foreign oil?

Yes 95 No 15⁶⁾

(Portland has since decided to introduce a light rail system.)

7.2.7 Seattle

Speaking at a workshop on trolley bus applications held in Seattle in August 1982, George Benson, representing the Seattle City Council, said : "When my office polled 45 000 citizens along proposed trolley routes, more than 87% said they wanted the service."⁷⁾

7.2.8 Summary

The experience of these six cities reveals a degree of consistency in public attitudes toward trolley buses. The comment from the Dayton Journal Herald - that people get "high" watching a trolley go by is significant. Even though opponents of trolley buses may argue that such a response is illogical and emotional, trolley buses seem to evoke a positive reaction among the public and it seems reasonable to suggest that such a reaction could be exploited in the effective marketing of public transport in cities.

6) Oregon Journal, October 23 1979.

7) TRANSPORTATION RESEARCH BOARD, op. cit., p. 9.

Natvig suggests the following reasons for a pro-trolley bus response :

"The citizen does not want noise, vibration and fumes penetrating his home or assaulting him on the streets. The transit operator should be most concerned with selecting the mode with the lowest negative environmental and fossil fuel impacts in order to reduce socio-economic impacts, attract patrons, and promote public good-will."⁸⁾

7.3 DOES THE TROLLEY BUS ATTRACT PASSENGERS?

7.3.1 Introduction

While it is a comparatively simple matter to ask the public "do you think trolley buses are a good idea?", it is a more complex matter to measure the impact of trolley bus operations on passenger levels. This section will describe the available data with reference to a number of cities throughout the world.

7.3.2 Ridership levels – Europe

One possible way to show whether trolley buses attract more passengers or not, would be to compare bus passenger levels in two cities which are identical in every respect, except that one city uses trolley buses and the other does not. It is, unfortunately, impossible to create such conditions (identical levels of population, income, car ownership, identical transport routes and so on). Nevertheless, an analysis is carried out by Vuchic in which he compares the "transit ridership" of 55 cities in Northern Europe (West Germany, France, Switzerland, Belgium and the Netherlands). He points out that "there is no discernible major difference in the character of the plotted cities but there is a significant difference in policies."⁹⁾

8) NATVIG, C.L., op. cit., p. 62.

9) VUCHIC, V.R., op. cit., p. 114.

The purpose of Vuchic's exercise is to show that transit ridership is higher in cities with rail modes than in cities served by buses only. It is significant that although only eight of the 55 cities on Vuchic's list use trolley buses, they are used in the top three cities (Zurich, Geneva and Lausanne) and they appear five times in the list of top nine cities :

CITY		NUMBER OF TRIPS PER PERSON PER YEAR
ZURICH	*	360
LAUSANNE	*	260
GENEVA	*	240
MUNICH		210
LUDWIGSHAFEN		210
NEUCHATEL	*	210
FREIBURG		190
KASSEL		190
SAINT-ETIENNE	*	190

* Uses trolley buses.

7.3.3

Ridership levels - United States

The 1985 edition of Jane's Urban Transport Systems¹⁰⁾ gives passenger and population statistics for 58 cities in the United States and Canada. Eight of the 58 listed cities use trolley buses. The average passenger ridership in these 8 cities is approximately 177 trips per person per year against an average of approximately 100 trips per person for all 58 cities. San Francisco, which has the largest fleet of trolley buses in the U.S., is one of the leaders on the list with 384 trips per person per year. (This figure does not include passengers on the cable cars, trams or BART.

10) Jane's Urban Transport Systems, 1985, op. cit.

7.3.4 Ridership levels – specific cities

- a) Some specific research into ridership levels has been carried out in San Francisco. Two trolley bus routes were temporarily converted to diesel bus operation from November 1970 to December 1972 due to roadworks. These routes, the 1-California and 3-Jackson, had shown a stable patronage history for the period 1956-1969, with an average change of 1% p.a. in passenger levels. After diesel buses were introduced, passenger levels on these routes fell by 12,7%. Not only was this drop much greater than the previous changes on these routes but was also greater than the percentage changes in passengers on nearby routes which were not converted. These routes showed variations in passengers ranging from +1% to -2% over the same period.¹¹⁾

(MUNI points out that the replacement diesel buses were much more modern than the trolley buses and were fitted with air suspension and interior heating which the trolley buses did not have.)

- b) Philadelphia also reports that when trolley buses are replaced by diesel buses, a drop of 5,7% in passengers takes place.¹²⁾
- c) Few new introductions of trolley buses have taken place in recent years. Such introductions have been accompanied by changes in routes, combinations of routes and so on, which make strict before-and-after comparisons difficult. One example is that of Nancy, France, where a new trolley bus system opened in November 1982 – the first to open in Western Europe since Schaffhausen in 1966. Nancy's traffic problems were similar to many other cities :

11) SAN FRANCISCO MUNICIPAL RAILWAY, Issue Paper No. 3, July 1978, p. 15.

12) SOUTH EASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY, Project 416, Alternative Analysis : Trolley Bus vs. Diesel Bus, March 1977, p. 15.

"Zo degenereert het openbaar vervoer langzamerhand tot een versnipperd tweederangs systeem, dat lijdzaam moet toesien hoe elke investering in verkeersinfrastructuur ten koste gaat van het serviceniveau. Daarbij dreight het stadscentrum door de wurggreep van het autoverkeer onbereikbaar te worden."¹³⁾

Three scenarios were considered to overcome the problem – a tram system, an improved diesel bus system and a trolley bus system. Trams and diesel buses were turned down on the basis of cost and environmental disadvantages respectively. Trolley buses were chosen, in conjunction with alterations to the road network :

"In eerste instantie wordt vooral aan de wegen gewerkt. Er worden enkele verbindingen en tunneltjes gebouwd, alsmede bus-stroken aangelegd."

"In de binnenstad wordt de Rue St. Jean gereserveerd voor bussen en voetgangers, waarbij de rijbaan wordt versmald en de trottoirs worden verbreed. Place Maginot wordt geheel voetgangersgebied."¹⁴⁾

The introduction of trolley buses was accompanied by a publicity campaign, including a comic strip called "Les aventures de Troll." Public reaction was positive :

"Sinds de indienststelling van de trolleybussen zijn de reizigers aantallen op de betrokken lijnen met meer dan 10% gestegen, een bewijs dat het gekozen concept goed aanslaat."¹⁵⁾

Further trolley bus expansion is planned so that "rond 70% van het openbaar vervoer in de agglomeratie Nancy per trolleybus worden afgewikkeld. De modal-split auto/openbaar vervoer/fiets moet zich dan

13) Openbaar Vervoer, Uitgave van de Stichting Tijdschrift Openbaar Vervoer, Utrecht, Junie-Julie 1983, p. 227.

14) Ibid., p.228.

15) Ibid. p. 231.

wijzigen van 66/18/16 in 1979 naar 56/28/16 in 1990."¹⁶⁾ This is an increase of over 50% in the role played by public transport in Nancy.

7.3.5 Summary

The conclusion which can be drawn from the available statistics is that the public shows a favourable attitude towards trolley buses relative to diesel buses. Flowing from this is the implication that what people like they are more likely to use. This implication is also borne out by the available evidence.

Vuchic's explanation for the higher riding habit of cities using electric street transport is based on the higher quality of service that such transport offers.

"In addition ... the rails themselves, even the overhead wires of trolley buses, give these modes an identification that has a strong psychological effect on passengers."¹⁷⁾

Better planning, operations and marketing have also been factors in attracting more passengers. Vuchic concludes :

"It can be observed that cities with good transit planning and operations generally make use of a greater variety of modes than in cities where transit is neglected. Major modernisation and improvements of transit in medium and large cities throughout the world can be achieved only through utilisation of a greater variety of modes, although mostly conventional ones, than has been the case until now."¹⁸⁾

16) Openbaar Vervoer, op. cit., p. 231.

17) VUCHIC, V.R., op. cit., p. 113.

18) Ibid., pp. 111-115.

This reply merely confirmed the need for an independent record of daily events on the test route. The comments which follow are based on personal visits to the test route on 619 operating days (out of a possible 700 operating days) between April 6 1983 and January 10 1986. The actual distance travelled on the test buses during that period was approximately 6000 km.

7.4.2 Riding quality – prototype trolley buses

Before a meaningful comparison can be made between the seven test buses and diesel buses in general it is necessary to distinguish between the type of diesel bus operated by the Johannesburg City Council and the type of diesel bus used by other operators. The Johannesburg municipal fleet in 1986 includes approximately 360 Mercedes diesel buses (115 single deck and 245 double deck) which offer a high standard of comfort. They have automatic gears, a low floor, air suspension, a rear engine and are reasonably free from vibration and noise. It is generally accepted that they are among the best commuter diesel buses in the country. (Other operators of this type of bus include the municipalities of Pretoria, Germiston, Roodepoort and Boputhatswana Transport Holdings (Pty) Ltd.)

Most of the diesel buses used in South Africa however, are characterised by spartan bodywork, high floors, noisy engines (either directly under the passengers or in the front of the passenger compartment), jerky gear-changes and hard suspension. It should be conceded that there are circumstances where this type of bus is the only choice. It is comparatively cheap to run, and is more suitable where the roads are in poor condition. Nevertheless the low standards experienced by passengers in this type of bus can be considered to contribute to the high level of dissatisfaction reported by passengers as described in paragraph 7.4.4.5.

The riding quality of the seven test trolley buses must therefore be evaluated against the riding quality of the two types of diesel bus described above. Briefly the conclusion is that :

- In comparison with the "high quality" diesel bus some of the test trolley buses offer a ride of equivalent standard, while others are actually inferior.

- In comparison with the "low quality" diesel bus, all seven test trolley buses are superior.

In these circumstances it is perhaps fortunate that no "passenger suitability survey" was carried out. The reason is that passengers on the test route, if asked, "Do you prefer a trolley bus to a diesel bus?" would have compared it with a high-quality diesel and would therefore have expressed no strong preference. In fact the jerky acceleration of the resistance - controlled test buses and the snatching brakes of some of the others might have produced a negative reaction.

Before describing certain basic features which from the point of view of the passenger should be incorporated in trolley buses for South African conditions, the following points should be made about the riding quality of each of the seven test buses :

- a) No 800 Double deck BBC/BUSAF/MERCEDES (51 000 km)

This bus was the best performer in terms of distance and was popular with passengers and drivers. It was fitted with thyristor control which gave it a smooth acceleration and jerk-free operation at low speed. (These are important requirements, particularly on routes with many stops and starts). However, there was a whine in the differential which tended to "grind" at speeds above 50 km/hr.

- b) No 801 Double deck T.C.O./BUSAF/SIGMA (36 300 km)

The second best performer in terms of distance covered. Because it was fitted with resistance control it tended to jerk at low speed and for this reason did not find favour with passengers.

- c) No 802 Double deck ANSALDO/SPRINGFIELD (7 200 km)

This bus covered the lowest distance of the seven. Its riding quality was acceptable. The first step from the street was rather high and this led to difficult boarding with less agile passengers.

- d) No 803 Double deck TOSHIBA/SPRINGFIELD (14 000 km)

This bus was characterised by jerky starting and whiplash in the drive

train which passengers found unpleasant. Like no 802, it had a first step which was too high.

- e) No 804 Double deck A.E.G./SPRINGFIELD (13 200 km)

Although the riding quality was acceptable, severe problems with snatching brakes were experienced and drivers were understandably unwilling to drive this bus. Like no 802, it had a first step which was too high.

- f) No 805 Articulated single deck G.E.C./SPRINGFIELD (10 500 km)

The performance of this bus was acceptable but was marred by excessive vibration from the compressor. Passengers on the test route were accustomed to riding in double deckers and as a result, did not adapt very easily to the articulated single deckers. The result was that the articulated single deckers were less popular than they would be on these routes where passengers are accustomed to more crowded conditions.

- g) No 806 Articulated single deck SIEMENS/SPRINGFIELD (15 440 km)

This bus is considered to be the best of the seven. Its acceleration was smooth and its performance at speed was vibration free. Like no 805, this bus was not readily accepted by passengers accustomed to double deckers.

(The above comments relate only to the quality of the ride. It is quite possible that the less popular buses were technically superior or easier to maintain.)

7.4.3 Certain basic features of trolley buses

The best buses from the passenger point of view, were nos. 800 and 806. In a letter to the Minister of Transport dated November 5 1985 the author stated "Trolley buses nos. 800 and 806 possess features which, if combined, would result in the best commuter bus in South Africa. These features are essential requirements on the busier routes in all urban areas of South Africa."

These features include the following :

- Full thyristor control. This results in smooth operation at low speed, which benefits standing passengers and those who are walking to and from their seats.
- Buses should be geared for 75 km/hr and not 60 km/hr. The "grind and rumble" from differentials at speeds above 50 km/hr is irritating. The differential fitted to no 806 seems to be ideal.
- A low floor. In this respect nos 800, 801, 805 and 806 were satisfactory.
- Equipment such as compressors and auxiliary motors should be quiet as possible and should be mounted in such a way as to avoid vibration.
- Anti-dewirement trolley heads should be fitted. Bus no 801 was fitted with these heads and its regular driver reported no dewirements in seven months.

Although not strictly a passenger requirement, it is essential that the driver should be able to switch from overhead line to emergency power quickly and without necessarily having to lower the trolley poles. The sequence of switches on some of the buses was confusing and time-consuming.

7.4.4 Articulated single deck trolley buses

7.4.4.1 Introduction

The question of whether to use double deck, single deck or articulated trolley buses has not apparently been considered in any depth in the South African context. The JTD report refers to the subject very briefly :

"Articulated single-deck buses are at present being evaluated in Johannesburg, because they may be useful in certain situations, such as travel over shorter distances. Typical passenger capacities for this type of bus are 76 seated and 69 standing."²²⁾

22) NATIONAL TRANSPORT COMMISSION, op. cit., para. 1.6.

There is no further reference to the articulated trolley bus in the JTD report and it is not clear whether the steering committee formally decided to disregard this type of bus or whether the omission is due to an oversight. Whatever the reason, the report's silence on the matter must be regarded as strange, because at least one of the disadvantages of trolley buses emphasized at length in the report – its axle-load problem – would be overcome by the use of the three-axle trolley bus. No mention is made of the higher passenger capacity of the design or of its ability to accommodate a more substantial auxiliary motor without axle-load problems.

It is possible to consider articulated bus operation under four headings :

- financial
- passenger capacity
- operational
- potential for use in black areas

7.4.4.2 Financial

The financial implications of articulated trolley buses are dealt with in chapter 8 and will not be discussed further here. On the basis of the assumptions made, they appear to be marginally cheaper to operate than double deck trolley buses.

7.4.4.3 Passenger capacity

Although the articulated buses have a theoretical capacity of 145 (76 seated and 69 standing) the practical capacity is somewhat less in the case of White passengers. This is due to White passengers' unwillingness to stand too close together, as well as their unwillingness to move all the way to the back of the bus unless told to do so by the driver. The situation with black passengers is somewhat different. For a five month period, between February and June 1984, the articulated trolley buses were used on the Dunkeld route which is one of the Johannesburg's municipality's busiest black routes. During this period, the author made approximately twenty trips on the Dunkeld route on these buses. Although their availability was poor, their ability to move heavy loads was adequately tested and on a few occasions the theoretical capacity was actually exceeded.

The maximum number carried was 160. This passenger load was, however abnormal and could only be achieved by subjecting the passengers to an unacceptable degree of discomfort.

In practice it would seem prudent to allow the articulated bus a capacity of 125 passengers, even for black routes, and to base the fleet requirement on this figure. Any additional capacity can be regarded as a bonus because even at 125 passengers the articulated trolley bus has a slight financial advantage over the double deck trolley bus.

The full potential of the articulated trolley buses was not exploited in the demonstration project. It has already been stated that White passengers did not adapt easily to the new design. One of the reasons for this was that the drivers were instructed not to open the door on the rear section of the bus, except at certain stops. This was apparently done to prevent passengers boarding through the rear door without paying. The effect of this was to create confusion and irritation among the passengers who would wait, in vain, for the rear door to open. Because of the long walk to the back, the rear section was seldom fully occupied by White passengers. On the few occasions when an enterprising driver, enthusiastic about the bus and aware of its potential, broke the rules and operated the rear door at all stops, the flow of passengers was much quicker.

With Black passengers these problems were not as acute. On the Dunkeld route the long-distance riders moved to the rear of the bus without hesitation.

7.4.4.4 Operational

Because of their length, the use of articulated buses (trolley or diesel) in city streets where blocks are short is not recommended. This would preclude their use on north-south routes through the centre of Johannesburg, for example.

The reaction of drivers to the articulated trolley buses was initially one of apprehension. The six or seven drivers who had the opportunity to become familiar with them soon developed an enthusiasm for driving them.

7.4.4.5 Potential for use in black areas

Most of the evidence relating to the public preference for trolley buses and their passenger-attracting ability is based on "first-world" experience. In the overseas cities mentioned, so far, trolley buses have been compared with diesel buses of a reasonably high (in some cases even higher) standard.

In situations where diesel buses are of a lower standard, it seems reasonable to suppose that the response of the community in general and passengers in particular will be even stronger in favour of the trolley bus. This situation applies on most routes serving black passengers in South Africa.

During 1980/81 the National Institute for Transport and Road Research (NITRR) carried out a Black Commuting Study in the Pretoria area to measure commuters' attitudes towards various attributes of the bus and rail transport system. These attributes included :

- crowding, frequency, travel time, cost, transfers, seating, crime, and driver courtesy.

Some of the more important findings are briefly summarised below.

Crowding is considered to be one of the most negative aspects of public transport. The survey found that 87% of respondents were dissatisfied. Bus users were more dissatisfied than train users and the length of the journey tended to increase the commuter's dissatisfaction. The incidence of crime also played a part.²³⁾

23) NATIONAL INSTITUTE FOR TRANSPORT AND ROAD RESEARCH, C.S.I.R., Pretoria, Report BCP9, March 1983, p. 32.

The survey found that 42% of commuters were dissatisfied with the length of the walk to the bus stop or station.²⁴⁾ Train users had longer walks and tended to be more dissatisfied than bus users. Taxi passengers, as could be expected, had the shortest walking times.

The survey found that 62% of commuters were dissatisfied with their total travel time, which averaged 106 minutes per passenger.²⁵⁾ Factors which raised this percentage were the need to stand, the number of transfers and the income of the commuter.

Transferring from one bus to another caused dissatisfaction for 28% of passengers. Where different modes were involved (ie. bus/train) the figure dropped to 14%.²⁶⁾

Fifty-nine per cent of passengers were dissatisfied with the cost of the journey.²⁷⁾ Long journey times and low income levels raised the percentage significantly.

An important conclusion which emerges from the above statistics is that high levels of dissatisfaction cannot be ascribed to any one cause. For example, dissatisfaction with crowding is not only related to the actual number of people in the vehicle but is also influenced by incidence of crime. Dissatisfaction with cost is not only related to the actual fare, but is also influenced by the length of the journey.

This phenomenon can be referred to as "derived dissatisfaction." Although the NITRR investigated a number of attributes, there can be little doubt that other transport characteristics are also involved which have a bearing on the dissatisfaction of bus passengers. These are :

- the amount of interior noise in a diesel bus
- the effect of gear-changing
- vibration while the bus is stationary

It is clear that the NITRR is aware of these problems. In an NITRR paper entitled. "The design and manufacture of the prototype Pendelbus" the authors state :

"Among non-white commuters, there will be growing reaction

24) NITRR, op. cit., p. 33.

25) Ibid., p. 33.

26) NITRR, Report BCP 11, January 1983, p. 13.

27) NITRR, Report BCP 8, December 1982, p. 16.

against the noise and inconvenience of the upright engine positioned at the front ... making effective noise control virtually impossible."²⁸⁾

In addition to the noise problem is the effect of gear changing, which is accompanied by both a change in engine pitch and a jerk, however slight, even in buses fitted with fully automatic gears. This "jars" the senses and can leave the passenger with a sense of fatigue at the end of the journey. The passenger does not seem to experience the same sense of fatigue at the end of a trolley bus ride.

The effect of these factors are sub-conscious and difficult to measure, but it seems likely that the high levels of dissatisfaction reported by diesel bus passengers would be lower if trolley buses were used.

To measure the attitudes of black passengers it has been suggested to the Department of Transport in Pretoria that the articulated single deck trolley buses used on the demonstration project be operated on the Dunkeld route in Johannesburg where they would be compared with diesel buses of the front engine type operating the same route. This suggestion has been turned down.²⁹⁾

As the improvement of the quality of life in black areas has now become a national priority, the introduction of the trolley bus should therefore be seen as an element of such improvement programs in view of its superior environmental standards and passenger-attracting ability.

Although the question of sabotage to trolley bus installations has been discussed in Chapter 6 it is necessary to repeat that trolley buses running through "sensitive" areas should be fitted with an off-wire capability sufficient to keep them moving at full speed should the power supply be interrupted. Until a three-axle double deck trolley bus is developed, it is only the articulated single deck design which can accommodate the additional weight of the equipment necessary to supply sufficient emergency power.

If trolley buses are introduced on routes running through sensitive areas they should therefore be articulated.

28) Road Transportation, Johannesburg, August 1983, p. 13.

29) Letters between the author and the Department of Transport dated May 2 1985 and June 4 1985.

7.5

CONCLUSION

The available evidence quoted in this chapter points to a degree of public preference for trolley buses. This preference is in the vicinity of 60-85%. Furthermore, it appears that trolley buses attract approximately 5% to 10% more passengers than diesel buses of equivalent standard.

These statistics are based on a comparison of trolley buses and "high-quality" diesel buses. Where "low-quality" diesel buses are used, it seems reasonable to suppose that passenger attraction will be greater than 10%.

Transit ridership is considerably higher in cities where trolley buses are used, although this is partly due to the presence of other factors, such as better planning, operations and marketing.

There is no evidence of research into the passenger attracting ability of trolley buses in South Africa. Furthermore, the social significance of operating trolley buses on black routes has not been formally considered. In this respect the Johannesburg trolley bus demonstration report must be regarded as inadequate, as it did not deal with these matters. It is suggested that a controlled test should be carried out on the Dunkeld route in Johannesburg comparing the test trolley buses with low-quality diesel buses to establish passengers' reactions. It is possible that low standards of travel (noise, gear-changing and vibration) are contributing towards the high levels of dissatisfaction reported by black passengers.

CHAPTER 8

THE ECONOMICS OF TROLLEY BUSES IN SOUTH AFRICAN CONDITIONS

8.1 BACKGROUND TO THIS CHAPTER

In the introduction to this study (para. 1.2) it was pointed out that the trolley bus is a moderately capital intensive form of transport which in terms of its initial cost, falls between the diesel bus on the one hand and light rail on the other.

It has become customary, when carrying out an economic evaluation of trolley buses, to compare its costs with those of diesel buses only. This is a limited approach, because the trolley bus should also be compared with more "expensive" forms of transport such as light and heavy rail.

This limited approach has in certain cases been restricted still further, to a mere comparison of initial costs only. This has led to one of the main anti-trolley bus arguments - namely that it is too "expensive". In para. 6.2.1.2 of this study it has been pointed out that certain anti-trolley bus comments had been based only on a comparison of the initial price of new buses and that no projection of costs over the life of the equipment had apparently been made. In para. 6.3.3 reference was made to the economic evaluation carried out in Durban which took into account only the cost of installing overhead wires.

Because the trolley bus has a higher initial cost than the diesel bus, a longer life and a different operating cost pattern, it is essential to carry out a long-term projection of costs. Cities such as Toronto,¹⁾ Philadelphia²⁾ and San Francisco³⁾ have considered a 24 or 25-year evaluation period when justifying the renewal of their trolley bus fleets. Such a long-term projection of costs may show that the higher initial cost of the trolley bus will be more than offset by its longer life and lower

1) TORONTO TRANSIT COMMISSION, Report No. 5 of 1969, op. cit.

2) SOUTH EASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY, Project 416: Alternative Analysis; Trolley Bus vs. Diesel Bus, Philadelphia, March 1977.

3) NATVIG, C.L., op. cit., p. 11.

operating costs. The purpose of this chapter is to set out the circumstances under which trolley buses can be economically justified and to show that subsidies for trolley buses may be unnecessary, despite their higher initial cost.

This chapter is divided into the following sections :

- the estimation of the basic data required to carry out an economic evaluation;
- an evaluation based on a theoretical bus route;
- a sensitivity analysis showing the effect of changes to the basic data on the ranking of the different types of bus;
- a note on the pattern of the cash outflows over the life of the project.

8.2 THE ESTIMATION OF THE BASIC DATA REQUIRED TO CARRY OUT AN ECONOMIC EVALUATION

8.2.1 Introduction

The cash outflow associated with the operation of trolley buses and diesel buses consists of two elements:

- The periodic (annual) repayment of interest and capital on loans raised to purchase the equipment.
- The periodic (usually monthly) payment of operating expenses such as wages, materials, power, fuel and administration costs.

It is important to make a clear distinction between these two elements. The first element (repayment of interest and capital) is a fixed annual amount, determined at the beginning of the loan period and remaining constant until the loan is redeemed in full. In other words, this amount is not subject to inflation. (Some loans are subject to changes in the rate of interest and such changes will affect the annual repayment but in this analysis it will be assumed that the loan is repaid at a fixed rate of interest). These fixed annual amounts will be referred to as "loan repayments".

The second element, which will be referred to as "operating expenses" is not fixed but varies from period to period. There are two reasons for this variation. First, there may be changes in the amount of work performed. Overtime may be increased or reduced. Kilometres operated may go up or down with a resultant effect on maintenance and fuel costs. Second, price changes (usually upward) will increase "operating expenses" from period to period, even when the amount of work performed remains the same. These price changes will be referred to as "inflation".

An economic evaluation of a long-term project financed by loans consists of the following steps:

1. An estimate of the annual "loan repayments" over the period of the project.
2. An estimate of first year's annual "operating expenses".
3. An estimate of the inflation rate.
4. An estimate of the discount rate.

When the inflation and discount rates are applied to the annual cash outflows (that is, loan repayments and operating expenses) the resulting figure is regarded as the "net present value" of the outflows for that year. The individual years' outflows are then totalled to arrive at the total net present value of the outflows over the entire life of the project.

The total net present value of one project can then be compared with the total net present value of another project. The project with the lowest total net present value will (if cost is the only criterion) be the recommended project.

The following estimates will be made;

- Capital cost – trolley buses
- Capital cost – overhead lines
- Capital cost and expected life of equipment – trolley buses and overhead lines
- Expected life of equipment – diesel buses
- Rate of interest on loans
- Rate of inflation
- Discount rate
- Operating expenses (maintenance of buses and overhead lines, electricity, drivers wages, and fuel)

The economic evaluation included in the Johannesburg trolley bus demonstration project report (which will be referred to hereafter as the JTD report) will be used as a basis for some of the estimates in this study. Since the costs referred to in the JTD report are as at June 1983, they have been escalated at 10% p.a. to June 1986.

(This percentage can be regarded as conservative, since the purchase price of new diesel buses bought by Johannesburg has approximately doubled between 1983 and 1986.)

8.2.2 Capital cost – trolley buses

a) Double-deck bus

The June 1983 price of a "typical trolley bus" was R245 000.⁴⁾ The report is referring to a double-deck two-axle bus similar to no 800, whose original 1981 price was R189 595. Together with auxiliary drive (R16 400) the price becomes R261 400. The JTD price is based on an order quantity of 30 buses. Escalating this price from June 1983 to June 1986 at 10% p.a. gives a price of R348 000. This analysis assumes that this type of bus has a capacity of 110 passengers.

b) Articulated single-deck bus

For the purpose of this chapter it is necessary to calculate a price for an articulated single-decker (The JTD report disregards the economics of this type of bus. It is therefore necessary to estimate various costs relevant to the articulated single-decker).

The original (1981) price of articulated bus no 806 was R197 448. The equivalent June 1983 price is R255 146. If a more powerful auxiliary motor is fitted, approximately another R30 000 would be added to the cost, giving a June 1983 price of R285 146. Escalation to June 1986 gives an amount of R379 000.

It should be repeated that these prices relate to an order for 30 buses of each type. As the analysis in this chapter is based on an order for 100 buses, the actual price may be lower. In the case of the double deck design, the price for a 100-bus order may be in the vicinity of R320 000 and that of an articulated trolley R350 000.

4) NATIONAL TRANSPORT COMMISSION, op.cit., Table 7.3A

It should also be pointed out that the above prices are based on the most expensive of the seven buses (nos 800 and 806). In view of the fact that the other trolley buses were between 7% and 25% cheaper, the possibility of obtaining buses at correspondingly lower prices should not be overlooked. The effect of lower prices has not been included in the sensitivity analysis, however.

8.2.3 Capital cost – overhead lines

The Johannesburg experiment did not involve major construction of overhead lines and, as a result, the JTD report deals with this question rather briefly :

"Owing to the introduction of cross-city routes, several kilometres of additional overhead lines will be required if a fleet of 72 trolley buses is to be operated. The cost of installing new overhead lines, including power supply equipment, is R180 000 per km."⁵⁾

It is implicit in the above that the cost relates to overhead lines in the central area, where no special arrangements have to be made for underground cabling etc. According to Natvig⁶⁾ construction costs increase by approximately 30% where such arrangements have to be made, which results in a cost of R234 000 per km. With escalation at 10% this gives a June 1986 cost of R311 000 per km.

8.2.4 Expected life of equipment – trolley buses and overhead lines

The JTD report deals with economic life in two separate paragraphs :

"Trolley buses are invariably kept in operation longer than their diesel-engine counterparts and are said to have a longer economic life."⁷⁾

and :

5) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.7.

6) NATVIG, C.L., op. cit., p. 35 (columns 4 and 7).

7) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.1.4.

"Trolley buses are generally assumed to have a longer economic life than diesel buses. This may, though, be due to subjective factors including the higher initial purchase cost and historical precedent. Diesel buses can sometimes (depending on the type) be kept on the road for a much longer period and trolley buses are probably also sometimes kept on the road even when their maintenance costs become expensive".⁸⁾

There seems to be a reluctance on the part of the authors of the JTD report to acknowledge unequivocally that trolley buses have a longer life than diesel buses. The above comments reflect an awkwardness about the work output of trolley buses. The report goes on :

"It would appear that an economic life of 20 years for a trolley bus and 14 years for a diesel bus would be reasonable".⁹⁾

Because of the uncertainty of expected "life" it would therefore be appropriate to consider the expected kilometre output of a trolley bus. The JTD report implies that the trolley bus is capable of 720 000 km (36 000 km/year x 20 years).

Johannesburg Transport Department records show that many of the trolley buses placed in service in 1948 achieved well over 1 000 000 km before withdrawal. Bus no. 618, for example had reached 1 349 000 km on withdrawal in 1976. The distances achieved by trolley buses introduced in 1958 were, in general, lower. This was due a reduction in services, particularly during the off-peak and to problems with spares, particularly the Ansaldo and Sunbeam trolley buses.

Because of the uncertainties involved, this analysis will consider two scenarios for trolley buses:

- A 25 year/1 000 000 km scenario (which is considered to be the "most likely" scenario).
- A 20 year/800 000 km scenario.

8) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.4.

9) Ibid., para. 7.2.4.

8.2.5 Capital cost and expected life of equipment – diesel buses

As stated in the previous paragraph, the JTD report gives the diesel bus a 14 year/504 000 km life. This is the implicit expected performance from a Mercedes 305 diesel bus (single or double deck) of which the Johannesburg Transport Department has 360 in service. The purchase price of a double deck diesel bus is given as R142 000 (June 1983) which escalates to R189 000 in June 1986. The JTD report does not give prices for other types of diesel bus but it is necessary to consider them for the purposes of this analysis.

Most routes serving black areas are operated with single-deck front-engine diesel buses of 100 passenger crush capacity. The current price (1986) of such a bus is approximately R110 000. The life expectancy of such buses is between five years and sixteen years depending on road conditions and other factors.¹⁰⁾

This analysis will consider the following three options for diesel buses:

1. A double-deck diesel bus – purchase price R189 000 – life 14 years – 560 000 km.
2. A single deck diesel bus – purchase price R110 000 – life 10 years – "normal" urban conditions – 400 000 km.
3. A single deck diesel bus – purchase price R110 000 – life 8 years – "arduous" urban conditions – 320 000 km.

In the "light rail" study¹¹⁾ carried out for the Republic of Bophuthatswana the diesel bus is given a lifetime of seven years.

10) The prices and life expectancies for single deck diesel buses are those reported by members of the South African Bus Owners Association as at June 1986.

11) Bruinette, Kruger, Stoffberg, Odi-Moritele Mass Transit Study, Pretoria, May 1983, Volume 2, p. 99.

It should be noted that both diesel buses and trolley buses can be overhauled or re-bodied at the end of their economic lifetimes. The financial impact of this process will be considered later in this chapter (para. 8.5.9).

8.2.6 Rate of interest on loans

In this analysis it will be assumed that all equipment is purchased out of funds which are borrowed at commercial rates of interest and that equal annual repayments are made on these loans sufficient to reduce them to nil at the end of the loan period. The loan period will be equal to the expected life of the equipment.

According to the 1984/85 Municipal Year Book, the average rate of interest on external loans paid by the larger municipalities is 9,5% p.a.¹²⁾ Because finance for transport projects is not necessarily raised by means of municipal bonds (which tend to have a lower rate of interest than commercial loans) a 13% interest rate has been assumed in this analysis. An interest rate of 20% has also been included in the sensitivity analysis. The Bophuthatswana study¹³⁾ assumes an interest rate of 12,5% p.a. on long-term loans between 1988 and 2007.

8.2.7 Rate of inflation

The JTD report assumes an inflation rate of 10%.¹⁴⁾ Although there is much uncertainty about future expected rates of inflation, particularly insofar as they affect imported fuel and electricity, for the purposes of this analysis the above rate will be used. The Bophuthatswana study assumes 11%.¹⁵⁾ In view of the high rate of inflation on the purchase price of new buses since 1983 (para. 8.2.1 of this study) an inflation rate of 12% p.a. on the purchase price of new buses will be also considered in the sensitivity analysis (para. 8.5.8).

12) 1984/85 Official South African Municipal Year Book, Table C1, pp. 286-291.

13) Bruinette, Kruger, Stoffberg, op. cit., p. 98.

14) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.3.

15) Bruinette, Stoffberg, Kruger, op. cit., p. 96.

8.2.8 Discount rate

The JTD report states that "for an analysis of this nature the normal discount rate is 10%".¹⁶⁾ This rate, which is also suggested in the Bophuthatswana report¹⁷⁾ will be used in this analysis.

8.3 OPERATING EXPENSES

8.3.1 Introduction

The following items will be considered under the heading "operating expenses":

- Maintenance of buses
- Maintenance of power supply system
- Cost of electricity/diesel fuel
- Salaries of drivers.

8.3.2 Maintenance of buses

- a) The JTD report¹⁸⁾ states that maintenance of diesel buses, based on Johannesburg's fleet, amounts to 28,8 cents per kilometre. This amount presumably refers to direct labour and materials only and does not include workshop overheads. The equivalent average costs for a trolley bus will be 19,58 cents per kilometre, according to the JTD report. These amounts will be used in this analysis in respect of the double deck diesel and double deck trolley bus respectively.
- b) It is necessary to estimate maintenance costs for articulated single-deck trolley buses and single-deck diesel buses.

According to San Francisco¹⁹⁾ an articulated trolley bus costs 21% more to maintain than a "standard" single deck trolley bus. This difference has been based on a reasonably thorough analysis of individual items of cost. Much of the difference in cost is attributable to body repair. Since the JTD maintenance figure is based on a double deck body, the cost differential should be smaller. A difference of 15% has been estimated.

16) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.3.

17) Bruinette, Kruger, Stoffberg, op. cit., p. 96.

18) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.8.

19) SAN FRANCISCO MUNICIPAL RAILWAY, A preliminary plan for trolley bus expansion, May 1983, p. F3.

Single-deck diesel bus maintenance is estimated at 15% less than double deck maintenance in the case of the 10-year bus and 25% less in the case of the 8-year bus. The reason for the larger percentage reduction in the case of the 8-year bus is that it may receive slightly less maintenance if it is the intention to dispose of it after 8 years. (According to the Edmonton study²⁰), single deck diesel maintenance is 12% less than double deck diesel maintenance, mainly due to body repairs, tyres and the interior fittings). A larger percentage reduction is made in this analysis (15-25%) because of the lower quality of the single-deck bus used in South Africa. In 1982 the Corporation for Economic Development reported diesel bus maintenance costs ranging between 17,59 c/km and 35,47 c/km for five different areas,²¹ with a weighted average of 27,36 c/km. Inflation since 1982 raises this average to approximately 40 c/km. If allowance is made for the poor roads over which CED buses operate, the costs below would seem to be reasonable.

The maintenance figures per km are summarised as follows:

Double deck trolley - 19,58 c/km plus escalation (1983-1986)	= 26,06 c/km
Double deck diesel - 28,80 c/km plus escalation	= 38,33 c/km
Articulated trolley - 19,58 c/km plus 15% plus escalation	= 29,97 c/km
10-year single deck diesel - 28,80 c/km minus 15% plus escalation	= 32,58 c/km
8-year single deck diesel - 28,80 c/km minus 25% plus escalation	= 28,74 c/km

The relationship between trolley and diesel maintenance cost is therefore:

Double-deck trolley to double deck diesel	68%
" 10-year single-decker	80%
" 8-year single-decker	91%
Articulated trolley to double deck diesel	78%
" 10-year single decker	92%
" 8-year single decker	104%

20) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, Special Bulletin no. 9, April 1975, p. 9.

21) Bruinette, Kruger, Stoffberg, op. cit., (Vol. 1), p. 67.

These percentages are somewhat higher than the relationships reported by other trolley bus operators, some of which are quoted below:

San Francisco	22)	77%
Edmonton	23)	76%
Vancouver	24)	65%
Philadelphia	25)	73%

(No specific mention is made in the JTD report of the maintenance of the auxiliary motor and it is presumed that it has been included in the amount of 19,58 cents per km).

8.3.3 Maintenance of overhead lines

8.3.3.1 Introduction

The JTD report divides overhead line maintenance into two sections – maintenance carried out by the Electricity Department (presumably substations and switchgear amounting to 5,13 cents per kilometre and maintenance carried out by the Transport Department (presumably overhead lines and poles) amounting to 18,32 cents per kilometre.²⁶⁾ The total is therefore 23,45 cents per kilometre. When this amount is expressed as a percentage of the 19,58 cents for trolley bus maintenance it amounts to 120%.

8.3.3.2 North American Cities

When the costs of overhead line maintenance are compared with the costs of bus maintenance in other cities, the following is obtained:

22) SAN FRANCISCO MUNICIPAL RAILWAY, op. cit., p. 13.

23) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, op. cit., p. 9.

24) TRANSPORTATION RESEARCH BOARD, op. cit., p. 11.

25) SOUTH EASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY, Project 416 : Alternative Analysis; Trolley Bus vs. Diesel Bus, March 1977, p. 12.

26) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.9.

a) San Francisco

Salaries of line crews (1982) \$ 1 100 000²⁷⁾

Maintenance of buses (1980) \$2 093 817²⁸⁾

If maintenance of buses is inflated by 7% p a (S F rate) then this amount would have increased to \$2 397 211 in 1982.

Overhead line maintenance is therefore 46% of trolley bus maintenance.

$$\left(\frac{1\ 100\ 000}{2\ 397\ 211} \right)$$

b) Toronto

According to the Toronto trolley bus report, trolley bus maintenance in 1968 was 5,5 cents per mile. Trolley bus overhead maintenance was 0,9 cents per mile.²⁹⁾ Overhead line maintenance in Toronto was therefore 16% of trolley bus maintenance.

c) Edmonton

According to Edmonton, the cost of substation and overhead maintenance was 1,12 cents per mile. Bus maintenance was 6,56 cents per mile.³⁰⁾ Overhead line maintenance was therefore 17% of trolley bus maintenance.

d) Philadelphia

According to the SEPTA report³¹⁾, trolley bus maintenance amounts to \$3 382 per bus per year. Substation and overhead line maintenance amounts to \$2 067 per bus per year, or 61% of trolley bus maintenance.

27) SAN FRANCISCO MUNICIPAL RAILWAY, op. cit., p. 18.

28) Ibid., p. F3.

29) TORONTO TRANSIT COMMISSION, Report no. 5 of 1969, op. cit., p. 2.

30) NORTH AMERICAN TRACKLESS TROLLEY ASSOCIATION, op. cit., p. 9.

31) SOUTH EASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY, op. cit., pp. 12-14.

The average of these four percentages is 35%. The highest percentages are reported by Philadelphia and San Francisco, and it is significant that both systems pointed out that at the time their evaluations were carried out, renovation programs were in progress to rehabilitate their overhead systems. According to San Francisco, over 95% of overhead wire maintenance relates to "special work" (that is, crossings and switches). MUNI believes that "damage repairs should be reduced substantially in the future as the old crossings and switches are entirely replaced with the new types of constant carbon contact crossings and inductive control switches. These new types should reduce dewirement and damage while reducing wear and extending the useful life of the overhead components."³²⁾ MUNI expects maintenance cost to fall to 30% of its previous level as a result of these improvements.

8.3.3.3 Johannesburg

What is, then, the reason for the remarkably high 120% overhead maintenance ratio reported by Johannesburg? The JTD report attempts to explain the cost by saying that there is a "need for a crew to be on standby, ready for any emergency."³³⁾ This cannot adequately explain an absolute amount of R475 000 per year (18,32 cents/km x 36 000 km x 72 buses). The more likely reason is that the Johannesburg City Council decided to retain the overhead network intact after trolley buses were withdrawn. This network had to be maintained whether it was used or not, and it seems that the cost of this maintenance has been spread over a comparatively small number of trolley bus kilometres. The Department of Transport (Pretoria) has conceded that this figure is "unduly high."³⁴⁾

This analysis will assume a more realistic relationship of 45% between overhead line maintenance and trolley bus maintenance (This percentage is higher than the average of 35%, to allow for the possible effects of sabotage and urban unrest – an aspect which has been considered in Chapter 6).

32) SAN FRANCISCO MUNICIPAL RAILWAY, op. cit., p. 17.

33) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.9.

34) Letter from the Department of Transport (Pretoria) to the Randse Afrikaanse Universiteit, dated August 15 1986.

This relationship gives an overhead line maintenance figure of 11,73 c/km (45% of double-deck bus maintenance of 26,06 c/km). Where articulated trolley buses are used, the number of kilometres will be 12% lower than double deckers because of their higher passenger capacity. Maintenance of overhead lines is likely to remain constant however, whether single or double deckers are used, so that the cost of the articulated trolley must be increased to 13,33 c/km, to arrive at the same absolute amount.

8.3.4 Electricity

The JTD report³⁵⁾ gives a cost of electricity of 11,712 cents per km. This is based on "2,4 units per km (increased from 1,9 to allow for line and transformer losses and average passenger loads)" and is based on a charge of 4,88 cents per unit. The above figure will be used for the purposes of this analysis. Although the articulated trolley buses consumed power at precisely the same average rate as the double-deck buses³⁶⁾ an increase of 10% for articulated buses has been assumed to allow for heavier loads which they will carry on other routes.

Power cost is therefore:

Double-deck trolley 11,712 c/km plus escalation = 15,59 c/km

Articulated trolley – as above + 10% – = 17,15 c/km

8.3.5 Passenger capacity and drivers wages

This analysis assumes the following passenger capacities for different types of bus (diesel or trolley):

"Standard" single deck bus	-	100 passengers
"Standard" double deck bus	-	110 passengers
Articulated single deck bus	-	125 passengers

35) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.10.

36) Ibid., Table C-1.

In order to move, say, 5 000 passengers, 40 articulated buses will be required against 46 double deckers and 50 "standard" single deckers. This means that fewer drivers will be required if articulated buses are used.

In this analysis it will be assumed, for reasons of simplicity, that the relationship between the number of buses required for service and the number of drivers is 1 : 1. In practice, more drivers may be required to cover longer hours of duty, for example.

A value must be placed on every driver "saved". In this analysis an annual amount of R15 000 per driver will be assumed. If all types of bus are assumed to cover 40 000 km/year the cost per km will be 37,5 cents.

8.3.6 Cost of diesel fuel

As in the case of electric power, diesel fuel consumption can vary depending on circumstances. Prices also vary from area to area. The JTD report gives a cost of 31,03 cents per kilometre³⁷⁾ which will be used in this analysis for the double-deck diesel. The escalated price then becomes 41,3 cents per km.

For single-deck diesel buses a cost of 36 c/km will be used. This is based on a fuel consumption of 45 litres per 100 km³⁸⁾ and an April 1986 price of 80 cents per litre.

8.3.7 Other expenses

All other expenses are considered to be equal for both types of bus. It is assumed that the service is operated by a public authority and that there are no tax implications. It is also assumed that the assets have no salvage value at the end of their lives.

37) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.2.11.

38) Average fuel consumption reported by 11 municipal bus operators in the 1983 Official South African Municipal Year Book, p. 269.

TABLE 8.1 FACTORS TO BE INCLUDED IN THE FINANCIAL CALCULATIONS

	ARTICULATED TROLLEY BUS	DOUBLE DECK TROLLEY BUS	DOUBLE DECK DIESEL BUS	SINGLE DECK DIESEL BUS 10 - YEAR	SINGLE DECK DIESEL BUS 8 - YEAR
PASSENGER CAPACITY	125	110	110	100	100
PURCHASE PRICE (R'000)	379	348	189	110	110
OVERHEAD LINES - COST PER KM (R'000)	311	311	-	-	-
LIFE IN YEARS	25	25	14	10	8
RATE OF INTEREST ON LOANS (%)	13	13	13	13	13
INFLATION RATE (%)	10	10	10	10	10
DISCOUNT RATE (%)	10	10	10	10	10
OPERATING EXPENSES (CENTS PER KM)					
MAINTENANCE					
- BUSES	29,97	26,06	38,33	32,58	28,74
- OVERHEAD LINES	13,33	11,73	-	-	-
- POWER/FUEL	17,15	15,59	41,30	36,00	36,00
- DRIVERS SALARIES	37,50	37,50	37,50	37,50	37,50

SOURCE: Paragraphs 8.2.2 to 8.3.6.

The information in the above table can now be "slotted in" to various theoretical sets of circumstances. The following steps are involved:

STEP

1. Determine the length of route to be electrified, in kilometres.
2. Determine the number of buses required to serve the route.
3. Calculate the initial capital cost of the various combinations, using the unit prices shown. This gives the amount of the loan which must be raised.
4. Using the expected rate of interest, calculate the annual repayment required to redeem the loan over the anticipated life of the equipment. This is a constant absolute amount for each year of the project.
5. Determine the kilometres to be operated each year by the different types of bus.
6. Multiply the kilometre figure by the different cost factors. This gives the expected annual outlay in the first year.
7. Increase the amount calculated in step 6 by the inflation percentage for each subsequent year of the project.
8. Add the amounts arrived at in step 4 and step 7 for each year of the project.
9. For each year of the project, apply the relevant discount rate to the amount arrived at in step 8.

8.3.9 The evaluation of projects with unequal life spans

The question arises – how are projects compared which have unequal life spans? If a trolley project has a life of 25 years and a diesel project has a life of 14 years, what common factor can be used to rank them in order of preference?

Grant and Ireson acknowledge that "a disparity in lives of alternatives creates ... difficulty. Various methods of dealing with this difficulty are developed. No one method is completely satisfactory."³⁹⁾

The procedure suggested by Winfrey is "to use an analysis period equal to the shorter lived alternative and to allow a terminal value for the remainder of the life of the longer lived alternative."⁴⁰⁾ Because of their comparatively long life the estimation of a terminal value for trolley buses and their infrastructure after an 8, 10 or 14-year period would be somewhat arbitrary. Winfrey suggests that when an exact repetition of the cycle of cash flows is logical for a second or greater number of cycles, and if the two time periods have a common multiple, then "a pair of mutually exclusive alternatives having different analysis periods may be directly compared."⁴¹⁾

Although the time spans of the different types of bus in this study do not have a conveniently low common multiple, all costs have been projected to the 25-year level for purposes of comparison. The rankings obtained in this way are consistent with the rankings of average cost per year for each type of bus over its initial lifetime of 8, 10, 14 or 25 years respectively.

(The cost figures in the evaluation which follows have been calculated by means of computer programs which are listed in the appendices B to F).

8.4 AN EVALUATION BASED ON A THEORETICAL BUS ROUTE

8.4.1 Basic data

The following example is not based on a specific route, but may reflect conditions to be found on a number of routes in urban areas throughout South Africa.

A route 25 kilometres long, will be assumed, linking a black residential area with the centre of a city. The service frequency is approximately one bus per minute during the peak and approximately one bus every

39) GRANT, E.L. and IRESON, W.G., Principles of Engineering Economy, The Ronald Press Company, New York, 1964, p. 88.

40) WINFREY, R., Economic Analysis for Highways, International Textbook Company, Scranton, Pennsylvania, 1969, p. 159.

41) Ibid., p. 158.

five minutes during the off-peak. If the total round trip time is two hours, approximately 120 single-deck diesel buses of 100 passenger capacity will be required to operate the service. This figure is increased to 125 in this example to arrive at a relationship of 5 buses per kilometre of route. No allowance is made for spare buses in this example. It is assumed that each bus covers 40 000 km per year.

In order to move the same number of passengers, 114 double deck diesel or trolley buses will be required, or 100 articulated single deck trolley buses. These figures are based on the assumed passenger capacities of 110 and 125 respectively.

8.4.2 Initial investment

The initial investment for each type of bus, based on the cost table, is :

TABLE 8.2 INITIAL INVESTMENT

	<u>R MILLION</u>	<u>PERIOD OF LOAN</u> <u>(YEARS)</u>
Articulated trolley (100 buses and overhead)	45,68	25
Double-deck trolley (114 buses and overhead)	47,45	25
Double-deck diesel (114 buses)	21,55	14
Single-deck diesel (125 buses)	13,75	10 or 8

SOURCE: Calculated in this study.

8.4.3 Annual repayment

The annual repayment of the initial loan at 13% interest is:

TABLE 8.3 ANNUAL REPAYMENT

	<u>R MILLION</u>	<u>PERIOD (YEARS)</u>
Articulated trolley	6,23	25
Double-deck trolley	6,47	25
Double-deck diesel	3,42	14
Single-deck diesel (8 year loan)	2,87	8
Single-deck diesel (10 year loan)	2,53	10

SOURCE: Calculated in this study (Appendices B to F)

These payments remain constant for the number of years shown in the "period" column. After 8, 10 or 14 years however, new loans have to be raised to purchase new diesel buses at the prices expected to apply at that stage.

For example after 14 years at an inflation rate of 10%, the double deck diesel bus will have to be replaced at 3,79 times its initial purchase price. (At an inflation rate of 12%, the factor increases to 4,88 times). The loan repayments at that stage will therefore increase by this factor.

In para. 8.2.5 of this study it was noted that both diesel and trolley buses can be rebodied or overhauled at a lower cost at the end of their economic lifetimes. It will assumed that this process can be carried out at the end of the lifetime of the bus at the same cost as its original purchase price and that the life of the bus can be extended by 50% as a result. The effect of this process is shown in para. 8.5.9.

8.4.4

Discounted annual repayments

The effect of inflation is to increase the annual repayment each time new buses are bought. Discounting these payments at 10% each year, reduces the amounts, so that the present value of the annual loan repayments after 25 years for each type of bus is:

TABLE 8.4 DISCOUNTED ANNUAL REPAYMENTS

	<u>R MILLION</u>
Articulated trolley	62,22
Double-deck trolley	64,63
Double-deck diesel	52,13
Single-deck diesel (8 year loan)	53,31
Single-deck diesel (10 year loan)	44,82

SOURCE: Calculated in this study (appendices B to F).

This schedule presents a different picture to the pattern shown in the initial investment schedule (para. 8.4.2). It shows that although the initial price of a trolley bus installation may be 3,28 times higher than the diesel alternative, the present value of the repayments over 25 years may be only 1,16 times higher.

Expressed another way, although the diesel option may have an initial price of 30% of a trolley bus alternative, the present value of the loan repayments over 25 years can be 86% of the trolley repayments.

8.4.5 Annual operating expenses

The present value of the annual operating expenses of the different types of bus over 25 years must now be calculated, based on the amount shown in the cost table in para. 8.3.8. The initial operating expense in the first year is:

TABLE 8.5 ANNUAL OPERATING EXPENSES

	<u>R MILLION</u>
Articulated trolley	3,92
Double deck trolley	4,14
Double deck diesel	5,34
Single deck diesel (8 year life)	5,11
Single deck diesel (10 year life)	5,30

SOURCE: Calculated in this study (appendices B to F)

These amounts are subject to inflation at 10% each year. The discount rate of 10% reduces each year's payment to its original value so that in this analysis the present value of the operating expenses over 25 years is the above amount multiplied by 25 (the number of years). This gives the following:

TABLE 8.6: PRESENT VALUE OF OPERATING EXPENSES OVER 25
YEARS

	<u>R MILLION</u>
Articulated trolley	97,95
Double deck trolley	103,60
Double deck diesel	133,53
Single deck diesel (8 year life)	127,80
Single deck diesel (10 year life)	132,60

SOURCE: Calculated in this study (appendices B to F)

8.4.6

Total annual costs

If the amounts calculated in para. 8.4.5 are added to the present value of the annual loan repayments calculated in para. 8.4.4, the total present value of the cost of each alternative over 25 years is :

TABLE 8.7: PRESENT VALUE OF COSTS (R MILLION)

	LOAN REPAYMENTS	OPERATING EXPENSES	TOTAL
Articulated trolley	62,22	97,95	160,17
Double-deck trolley	64,63	103,60	168,23
Double-deck diesel	52,13	133,52	185,65
Single-deck diesel (8 year life)	53,31	127,80	181,11
Single-deck diesel (10 year life)	44,82	132,60	177,42

SOURCE: Calculated in this study (appendices B to F)

The ranking of the different alternatives in order of present value of cost is:

TABLE 8.8: INDEX OF COST OVER 25 YEARS (DOUBLE-DECK
DIESEL = 100)

1.	Articulated trolley	86
2.	Double-deck trolley	91
3.	Single-deck diesel (10 year life)	96
4.	Single-deck diesel (8 year life)	98
5.	Double-deck diesel	100

SOURCE: Calculated in this study.

Over a period of 25 years the present value of the cost of the cheapest trolley bus alternative (86) is 10% lower than the cheapest diesel alternative (96) based on the estimates and the assumptions made.

It should be noted that the JTD report itself conceded that trolley buses are cheaper to operate under certain conditions.⁴²⁾ It has been suggested in this study that these conditions do, in fact, apply in the South African situation.

8.5 SENSITIVITY ANALYSIS

8.5.1 Introduction

In this section the effect of changes to the basic estimates will be considered. The list is not exhaustive but covers the most likely adjustments.

What would the impact be if -

- the number of single-deck diesel buses is reduced from 5 per km to 3 per km
- the distance covered by buses is reduced from 40 000 km/year to 30 000 km/year (or increased to 50 000 km/year)
- the economic life of the trolley bus is reduced from 25 years to 20 years
- the rate of interest on loans is increased from 13% to 20%
- operating costs are reduced (or increased) by 10% for the trolley and the diesel, alternately
- the rate of inflation of operating costs is increased or reduced
- the rate of inflation of costs of purchase prices of buses is increased
- the discount rate is increased to 15%.

The effect of these adjustments to the estimates will be set out below. In each case, scenario i) is the "basic" scenario described in para. 8.4.1. Columns 1 to 5 refer to the articulated trolley, double deck trolley, 10-year diesel, 8-year diesel and double deck diesel respectively.

8.5.2 Changes to the number of buses per km

Since the initial cost of overhead lines remains constant irrespective of the number of buses using the system, a reduction in the number of buses per km will prejudice the trolley bus. The cost of maintenance of overhead lines is also "inelastic" in relation to the number of buses. The

42) NATIONAL TRANSPORT COMMISSION, op. cit., Table 7-5, assumption (k).

following table shows that the articulated trolley bus (column 1) is still marginally competitive with the "cheapest" diesel bus at a level of approximately 3 single-deck buses per km of route:

TABLE 8.9 CHANGES TO THE NUMBER OF BUSES PER KM

SCENARIO :	1*	2*	3*	4*	5*
i) 5 single deck diesel buses/km (basic scenario)	86	91	96	98	100
ii) 3 single deck diesel buses/km	94	96	96	98	100

SOURCE: Appendix G

8.5.3 Changes to the distance covered by buses per annum

Since the trolley bus has a higher fixed capital investment than the diesel bus, a drop in km per year will reduce its competitiveness because the capital investment is being used less intensively:

TABLE 8.10 CHANGES TO THE DISTANCE COVERED BY BUSES PER ANNUM

SCENARIO :	1*	2*	3*	4*	5*
i) 40 000 km per bus per year (basic scenario)	86	91	96	98	100
ii) 25 000 km per bus per year	94	97	94	98	100
iii) 50 000 km per bus per year	83	89	96	97	100

SOURCE : Appendix G

-
- *Column 1. Articulated trolley bus.
 - 2. Double deck trolley bus.
 - 3. 10-year diesel bus.
 - 4. 8-year diesel bus.
 - 5. Double deck diesel bus.

From the above table it appears that the trolley bus ceases to be competitive at an annual distance of approximately 25 000 km per bus. (column 1 = column 3). On the other hand, an increase to 50 000 km/year favours the trolley.

It should be pointed out that the above two tables should be considered together, since they compensate each other to a certain extent. It may be possible to justify trolley buses even if there are fewer than 3 single-deck diesel buses per km provided that the annual km per bus is sufficiently high. Conversely, although a route may have as many as seven buses per km it may operate during rush-hours only with a low distance per bus per year. This situation will favour the diesel.

8.5.4 Changes to the economic life of the trolley

A reduction of its economic life from 25 to 20 years leaves the articulated trolley bus marginally cheaper than the "cheapest" diesel bus while the double-deck trolley becomes more expensive than the single-deck diesel options. It remains cheaper than the double-deck diesel, however :

TABLE 8.11 CHANGES TO THE ECONOMIC LIFE OF THE TROLLEY

SCENARIO :	1*	2*	3*	4*	5*
i) Trolley bus - 25 year life	86	91	96	98	100
ii) Trolley bus - 20 year life	92	97	93	97	100

SOURCE : Appendix G

It should be repeated here that the "life" of the overhead wires is also reduced to 20 years, which is conservative. In practice it may have a residual value at that stage which is not reflected in the above figures.

-
- *Column 1. Articulated trolley bus.
 2. Double deck trolley bus.
 3. 10-year diesel bus.
 4. 8-year diesel bus.
 5. Double deck diesel bus.

8.5.5

Changes to the rate of interest on loans

Since a higher proportion of the total annual cost of operating trolley buses consists of repayment of interest and capital, trolley bus costs will be more sensitive than diesel bus costs to changes in the rate of interest on loans. An increase in the rate to 20% leaves the articulated trolley bus marginally cheaper than the alternatives:

TABLE 8.12 CHANGES TO THE RATE OF INTEREST ON LOANS

SCENARIO :	1 *	2 *	3 *	4 *	5 *
i) Rate of interest on loans - 13%	86	91	96	98	100
ii) Rate of interest on loans - 20%	93	97	93	95	100

SOURCE: Appendix G

8.5.6

Changes to operating costs

If operating costs (monthly expenses) as set out in the cost table in para. 8.3.8 are higher or lower than those estimated, what will the effect be? For example, an operator of 8-year-life diesel buses may report maintenance costs of only 24 cents per km instead of the 28,74 cents used in the cost table. Actual fuel costs may also be lower or higher than those estimated. If it is assumed that total operating costs (maintenance, fuel, wages) are reduced or increased by 10%, the effect will be :

-
- *Column 1. Articulated trolley bus.
 2. Double deck trolley bus.
 3. 10-year diesel bus.
 4. 8-year diesel bus.
 5. Double deck diesel bus.

TABLE 8.13 CHANGES TO OPERATING COSTS

SCENARIO :	1*	2*	3*	4*	5*
i) Basic scenario	86	91	96	98	100
ii) Diesel operating costs down by 10% – trolley held constant	93	98	95	98	100
iii) Trolley operating costs down by 10% – diesel held constant	81	85	96	98	100
iv) Diesel operating costs up by 10% – trolley held constant	80	85	96	97	100
v) Trolley operating costs up by 10% – diesel held constant	92	96	96	98	100

SOURCE : Appendix G

Increases in operating costs affect the diesel bus to a greater extent because of the higher proportion that they represent of total diesel bus costs.

8.5.7

Changes to the rate of inflation (operating costs)

In the basic scenario an annual inflation rate of 10% was assumed. By virtue of its higher proportion of operating costs, the diesel bus is more exposed to the effects of higher inflation rates than the trolley bus:

TABLE 8.14 CHANGES TO THE RATE OF INFLATION

SCENARIO :	1*	2*	3*	4*	5*
i) Rate of inflation 10%	86	91	96	98	100
ii) Rate of inflation 9%	89	93	95	97	100
iii) Rate of inflation 12%	82	86	97	99	100

SOURCE : Appendix G

-
- *Column 1. Articulated trolley bus.
 2. Double deck trolley bus.
 3. 10-year diesel bus.
 4. 8-year diesel bus.
 5. Double deck diesel bus.

8.5.8 Changes to the rate of inflation (purchase price of buses)

If the rate of inflation on the purchase price of buses is higher than the average rate of inflation (say, 12% as against 10%) the diesel bus will become less competitive :

TABLE 8.15 CHANGES TO THE RATE OF INFLATION (PURCHASE PRICE OF BUSES)

SCENARIO :	1 *	2 *	3 *	4 *	5 *
i) Basic	86	91	96	98	100
ii) Inflation on buses 12%	83	87	96	99	100

SOURCE : Appendix G

8.5.9 Rebuilding of buses

If it is assumed that a diesel bus can be "rebuilt" at the end of its initial lifetime at a cost equal to its original purchase price and that this process adds 50% to its original life, the effect on the relationships is :

TABLE 8.16 REBUILDING OF BUSES

SCENARIO :	1 *	2 *	3 *	4 *	5 *
i) Basic	86	91	96	98	100
ii) Rebuilding of diesel buses	89	93	96	99	100

SOURCE : Appendix G

The adjustments shown in paragraphs 8.5.8 and 8.5.9 should be treated with some caution, however. In both cases they show the effect of short-term trends or actions which benefit one kind of bus only. In para. 8.5.8 the trolley bus will also have to be replaced after 25 years at a compound rate of 12%. The effect of this will be felt only during its second 25 year cycle, at the end of which the ranking will revert to that of the basic scenario. By stopping the calculation at the 25 year level, the trolley bus receives an unjustified "benefit".

-
- *Column 1. Articulated trolley bus.
 2. Double deck trolley bus.
 3. 10-year diesel bus.
 4. 8-year diesel bus.
 5. Double deck diesel bus.

The converse applies in para. 8.5.9. In this case the trolley bus can also be rebuilt at 25 years, but the benefit will be felt only during the second 25 year cycle. By stopping the calculation at the 25 year level the diesel bus receives the unfair "benefit".

Whether the calculation is done over a 25 year period or longer, table 8.9 shows that although the rebuilding of buses may seem to offer attractive cash flow benefits in the short-term, the effect of discounting and inflation over a period of 25 years reduces the effect of these benefits to a less significant level.

8.5.10 Changes to the discount rate

The basic discount rate chosen for this analysis has been 10%. If it is increased to, say, 15% to allow for a greater degree of uncertainty the position will favour the diesel :

TABLE 8.17 CHANGES TO THE DISCOUNT RATE

SCENARIO :	1*	2*	3*	4*	5*
i) Basic	86	91	96	98	100
ii) Discount rate 15%	92	97	95	97	100

SOURCE : Appendix G

A higher discount rate should, however, be seen in conjunction with a higher rate of inflation than 10%, which will favour the trolley.

8.5.11 Summary

It has not been the purpose of the above examples to show the "breakeven" point between trolley and diesel buses. The number of variables is so large that each situation must be evaluated individually.

-
- *Column 1. Articulated trolley bus.
 2. Double deck trolley bus.
 3. 10-year diesel bus.
 4. 8-year diesel bus.
 5. Double deck diesel bus.

The sensitivity analysis does show however that a reasonably significant adjustment to each one of the individual basic estimates will have to be made for the trolley bus to become more expensive than the diesel bus. On the other hand, if all the basic assumptions were to be significantly changed, the effect could be material. This is considered unlikely, however.

8.6

A NOTE ON THE PATTERN OF ANNUAL CASH OUTFLOWS

The complete annual pattern of cash outflows for the basic scenario is set out in the appendices which show that trolley bus outflows are higher than diesel bus outflows at least until the ninth year of the respective projects. This is due to the higher initial loan repayments on the trolley system. The additional cash outflow in the early years is an obvious immediate additional burden. How can the bus operator absorb this amount? Before answering this question it is necessary to refer to the JTD report where it is stated that subsidies are necessary from Government to introduce trolley buses :

"These may be provided either to cover operational losses or ... as a contribution to capital costs... Subsidies may take other forms such as preferential loans, low interest charges, cheaper electrical charges and the writing off of outstanding debts."⁴³⁾

The above passage may give the impression that only trolley buses are subsidised. (Only superficial mention is made in the JTD report of the fact that diesel fuel is "subsidised" by the Government). Nevertheless the higher cash outflow associated with trolley buses in the early years may justify assistance from the Government. This assistance could take the form of a reduced rate of interest on trolley bus loans in the early years. This initial rate would be "pitched" at whatever level is necessary to equalise the annual outflows and would slowly rise thereafter until the "cross-over" point is reached. It would then remain constant.

43) NATIONAL TRANSPORT COMMISSION, op. cit., para. 7.1.4.

In the basic scenario, which assumes an interest rate of 13% throughout, the actual interest rate on the trolley bus loan in year one would have to be approximately 7% to equalise the outflows. Thereafter it would rise by approximately one percentage point each year until the "cross-over" point is reached. By then it would have risen to approximately 15% - 17% at which level it will remain until the 25th year. This will give an average rate of 13% over the life of the trolley bus project. It must be repeated that this arrangement is not a subsidy, but assistance to enable a capital-intensive project to be launched. The lender of the capital will ultimately receive the full amount of interest due.

The fact that a trolley bus system can "pay its way" over its lifetime is in contrast to the situation which will apply in the case of underground railways or other forms of mass transport which will require substantial Government capital grants.

"Daar word algemeen aanvaar dat 'n ondergrondse stelsel nie deur plaaslike owerhede alleen gebou kan word nie. Tussen 60 en 80 persent van die koste van soortgelyke stelsels in oorsese lande (word) deur die sentrale owerhede gefinansier."⁴⁴⁾

8.7

CONCLUSION

One of the main anti-trolley bus arguments has been the claim that it is "too expensive" to introduce - a claim which is partly based on a restricted approach to the subject. This chapter has set out the basic features of a long-term economic evaluation of trolley and diesel buses and has attempted to show that under certain circumstances, trolley buses can be justified in economic terms.

Some of these circumstances include the following :

- where there are more than three single deck diesel buses per kilometre of route
- where the buses operate more than 25 000 kilometres per year
- where the rate of inflation is expected to be at least 10% p.a. over the life of the project (Table 8.14 shows that higher rates of inflation favour the trolley bus)

44) Die Beeld, February 18 1986.

- where the rate of interest on long-term loans is less than 20% p.a.

Under the "most likely" circumstances described in this chapter, it has been suggested that the trolley bus is 10% cheaper over its lifetime than the diesel bus.

The effect of adjustments to the basic estimates has also been measured in the sensitivity analysis which shows that reasonably significant adjustments to the estimates have to be made for the trolley bus to become more expensive than the diesel.

These conclusions are supported by the JTD report which has conceded that trolley buses are cheaper to operate under certain conditions.

The economic benefits of operating trolley buses are not immediate however, and assistance may be necessary in the early years of a trolley bus project in the form of a lower initial interest rate on loans. Such assistance will be recovered in the later years of the project by means of increases in the rate of interest.

In South Africa, most mass transportation studies are carried out either by the following bodies or by consultants acting on their behalf:

- the Department of Transport of Central Government
- the National Institute for Transport and Road Research
- the Council for Scientific and Industrial Research
- the South African Transport Services
- the Metropolitan Transport Advisory Boards
- city councils
- operators such as the Durban Transport Management Board, City Tramways, Putco, United Transport and Bophutatswana Transport Holdings.

This study recommends that the Government should require the organisations listed above to include trolley buses as an option in every significant transportation study or plan which is carried out by them. Further, trolley buses should be compared, not only with diesel buses but also with light and heavy rail proposals. A number of transportation projects which are currently under consideration by the Government could be regarded as potential trolley bus projects. These are listed in paragraph 9.3.5.

CHAPTER 9

REVIEW OF THE STUDY AND SUGGESTIONS FOR FURTHER RESEARCH

9.1

BACKGROUND TO THIS CHAPTER

In Chapter 1 it was pointed out that the electric trolley bus is a moderately capital intensive form of public transport, giving rise to higher economies of scale than the diesel bus. It was suggested that these economies of scale have never been exploited to the full, even in cities where they are used intensively. In order to realise the full potential of trolley buses, the public transport network would possess certain features, which include the following:

- trolley bus routes should not overlap other routes
- transfer of passengers between routes should be facilitated by co-ordinated schedules and ticketing
- co-ordinated planning and control of transport.

It was suggested that because South African transport networks were characterised by only a partial degree of co-ordination, the potential role of trolley buses would therefore have to be evaluated against a more limited background. The following themes were identified for study:

- The role of the trolley bus in creating a positive image for public transport
- the anti-trolley bus attitudes of some transport operators
- the potential role of the trolley bus in developing cities
- the economic characteristics of trolley buses in South African conditions.

It is the purpose of this chapter to review these four themes and to suggest areas which require further research.

9.2 A REVIEW OF THE THEMES DEVELOPED SO FAR

9.2.1 The role of the trolley bus in creating a positive image for public transport

In chapters 3 to 5 it was shown that the survival of trolley buses in some cities, and their abandonment in others, took place in controversial circumstances.

Certain sections of the public queried the official reasons put forward for trolley bus abandonment and in some cities formed themselves into organised groups (eg. COMET in Seattle and MIPT in Durban) to promote their objectives.

Although the efforts of citizens groups and ratepayers organisations were not always successful, the conclusion has been drawn that there is a degree of pro-trolley bus sentiment among the general public. In paragraph 7.2 it was shown that where informal research has been carried out into the attitude of the public towards trolley buses, the majority of those interviewed has been in their favour.

In addition to public preference for trolley buses, evidence was quoted in paragraph 7.3 which shows that passenger ridership is higher in cities which use trolley buses than in cities which do not use them. Although the presence of trolley buses may be only one of many factors at work in raising passenger levels, paragraph 6.2.10.2 suggested that it appears to be a factor of potential significance in any attempts to market public transport and to improve its public image.

Paragraph 7.4 dealt with certain aspects arising from the Johannesburg trolley bus demonstration project report which were not covered in the project report itself. The basic features which commuter trolley buses should possess were set out in paragraph 7.4.3. The low standards of transport experienced by black passengers were described in paragraph 7.4.4.5. It was suggested that some of the dissatisfaction expressed by them may be a "derived" dissatisfaction due to the discomfort, noise and vibration associated with diesel buses. The use of trolley buses may help to reduce these levels of dissatisfaction.

9.2.2

The anti-trolley bus attitudes of some transport operators

In paragraph 2.5.1 some factors which contributed to the decline of the trolley bus in certain countries were mentioned. One of these was the lack of interest in long-term investment in new wires and vehicles during a period when transit was in decline and the motor industry was dominant. The abandonment of trolley buses was frequently supported by a number of anti-trolley bus arguments. These were summarised in paragraph 6.2 and were examined in greater detail in paragraphs 6.2.1 to 6.2.10 where they were compared with the experience of established trolley bus operators and with the views of transport researchers.

It was suggested that these arguments have, to a certain extent, been overstated and that existing trolley bus operators have a more relaxed attitude towards the operation of trolley buses.

9.2.3

The potential role of the trolley bus in developing cities

The modest renaissance of trolley buses in different parts of the world was described in chapter 3. Particular reference was made to the systems in Guadalajara, Mexico and Sao Paulo, Brazil where trolley buses have been introduced instead of more expensive rail systems. It was stated in paragraphs 3.3.3 and 3.4.2 that trolley buses can be used in underground tunnels and on bus-ways where their potential to move passengers will match that of rail-based systems at lower capital cost.

Although most developing cities are characterised by a lower degree of transport co-ordination, paragraph 3.4.2 has suggested that the trolley bus has a role to play even where private operators constitute the largest percentage of the transport network.

9.2.4

The economic characteristics of trolley buses in South African conditions

In paragraph 2.5.1 reference was made to a suggestion that the large-scale abandonment of trolley buses during the 1950s and 1960s was not an economic necessity. This theme was developed in chapter 3 where it was shown that some of the cities which have continued to use trolley buses have justified their decisions in economic terms.

In the case of Durban, paragraph 4.2 noted that the economic justification put forward by the Durban Transport Management Board in support of trolley bus abandonment was contradicted by another municipal report. The recommendation of a commission of inquiry to do a more thorough analysis of the trolley bus issue was not acted upon. In paragraph 6.2.4.2 it was shown that the use of cost per km figures in Durban could be misleading, as the income per km on the trolley buses was sufficiently high not only to cover their higher cost per km but to make them profitable. This profitability seems to have been eroded after trolley buses were eliminated.

In Johannesburg, isolated cost figures were published from time to time in the press but no comprehensive economic analysis was apparently done until 1985, by which time the trolley bus had virtually disappeared from the city. In paragraph 7.4.4.1 reference was made to the failure of the JTD report to consider the economics or operational characteristics of the articulated trolley bus.

The JTD report was considered further in chapter 8. Paragraph 8.3.3.3 dealt with the high cost of maintenance of overhead lines in the JTD report and suggested that these costs had been overstated. It pointed out that the Department of Transport in Pretoria had conceded that the cost figure used was "unduly high".

Chapter 8 dealt with the economics of trolley buses in South African conditions and set out the circumstances under which they can be justified even though their initial cost is higher than diesel buses. Their justification depends on the intensity of the service. It was suggested that they become competitive above a level of three single deck diesel buses per kilometre of route and above 25 000 km per bus per year. In order to equalise the cash outflow in the early years of a trolley bus project, it was suggested in paragraph 8.6 that the Government grant some relief in the form of a lower initial rate of interest. This relief would not be a subsidy, as the initial allowances would be repaid in the later years of the project by means of increases in the rate of interest.

9.2.5 Summary

In paragraph 1.1 of this study it was suggested that proper consideration should be given to those forms of transport which satisfy the following conditions :

- they should be able to raise the image of public transport and attract passengers;
- they should be suitable for third-world conditions;
- they should be economical in operation.

This study has attempted to show that the trolley bus is regarded with favour by the majority of the public and can assist in improving the image of public transport.

It is associated with higher-than-average passenger levels in a number of cities. It has been suggested that trolley buses should be used on routes serving Black passengers to improve their travelling conditions. This study has examined the reasons put forward to justify the abandonment of trolley buses and has concluded that these reasons have been exaggerated.

The trolley bus has been found to have a part to play in the transport networks of developing cities. In spite of its higher initial cost, it is cheaper to operate than diesel buses under certain circumstances. In view of these factors, this study concludes that the role that the trolley bus can play in present-day South African conditions should be reconsidered.

9.3 SOME MATTERS WHICH REQUIRE FURTHER RESEARCH

9.3.1 Introduction

It has been beyond the scope of this study to cover all aspects which have a bearing on the effectiveness of a trolley bus system. No mention has been made of the technical aspects of trolley buses, the type of overhead wiring system which is most suitable in a given situation, the power supply requirements, the quality of management, and so on.

It is the purpose of this concluding section to make brief mention of some matters which have not been covered in the study and which seem to justify further research. The list is not exhaustive:

- co-ordination of operation and routes
- bus design
- research into passengers' attitudes
- potential routes for electrification.

9.3.2 Co-ordination of operators and routes

It was noted that careful planning of routes and co-ordination of schedules will be necessary if the full potential of trolley buses is to be achieved. Most first-world cities with high ridership levels use the grid route system, which consists of a network of routes at right angles to each other that are operated frequently. This system increases the number of potential destinations and leads to a higher level of service on fewer routes serving the central business district. According to Matoff "this higher level of service can justify capital development – either for rail service or trolley bus systems."¹⁾

1) MATOFF, T.G., The trolley bus and system design, TRANSPORTATION RESEARCH BOARD, op.cit., p.37.

No South African city uses the grid system, and research is necessary to establish whether this type of system can be introduced within the context of a large number of bus operators and a free-market philosophy. An investigation into the methods adopted by South American operators may be relevant in this regard.

9.3.3 Bus Design

In a report which was issued simultaneously with the Johannesburg Trolley Bus demonstration project report, Dr R.B. Anderson points out that one way of achieving a higher passenger capacity for trolley buses is to use a three axle chassis with a double rear axle of which only one is driven. He mentions two potential suppliers of such chassis. He goes on "there may be additional possibilities to reduce the rear axle loading which may be even cheaper than converting to three axles, for example a redistribution of the components or using light weight materials and these should all be investigated. Certainly the prototype TBs supplied for the Demonstration Project were not designed with this end in view."²⁾

As previously stated, it has been beyond the scope of this study to deal with the technical aspects of trolley buses but it is appropriate to suggest that proper consideration be given to the use of buses of suitable design. The use of articulated single-deckers and trailers should also be evaluated.

9.3.4 Research into passengers' attitudes

Paragraph 7.4.4.5 has referred to the suggestion to the Department of Transport in Pretoria that the articulated single deck trolley buses used in the demonstration project be operated on the Dunkeld route in Johannesburg. They would be compared with diesel buses of the front engine variety operating the same route.

2) Anderson, Dr R.B., The viability of a trolley bus system in the longer term, National Electrical Engineering Research Institute, Pretoria, 1985, p.1.

Although the Department has turned down this suggestion, both articulated trolley buses are still, at the time of writing, in the possession of the Johannesburg municipality and the Dunkeld wires are still in position. It should, even at this late stage, still be possible to carry out an investigation into passengers' attitudes.

9.3.5

Potential routes for electrification

It has not been the purpose of this study to suggest specific routes which would be suitable for trolley bus operation. Each urban area has certain routes which have more intensive services than others, and such routes should be evaluated individually as possible candidates for electrification.

The justification for trolley bus operation will be stronger in Johannesburg where most of the infrastructure is still in position at the time of writing. The trolley bus routes in Johannesburg are largely based on the previous tram network, however, and the spread of the population beyond the original tram termini means that adjustments and extensions to the trolley bus network will have to be made. Such extensions could include routes to Alexandra, Randburg and Roodepoort.

The feasibility of running trolley buses between the centre of Johannesburg and the black suburb of Alexandra should be investigated as a matter of urgency. This route is already under wires for approximately two-thirds of its length. A survey carried out by the author on April 22 1986 showed that between 15h45 and 17h30 a total of 65 buses in one direction and 47 buses in the other, passed the corner of Louis Botha Avenue and Athol Road on their way to and from Alexandra.

The intensity of this service appears to be sufficiently high to justify an investigation into the use of trolley buses.

In the concluding paragraph of chapter 8 it was recommended that trolley buses be included as an option in all significant transportation studies and that they should be compared with light and heavy rail proposals. Such proposals currently under consideration include :³⁾

- Pretoria - Hammanskraal
- Durban - Inanda
- Port Elizabeth - Uitenhage
- Johannesburg - Ennerdale
- Pretoria - KwaNdebele

It may be found that the trolley bus is a lower - cost alternative to rail in these and other areas, while offering superior travelling conditions and higher levels of accessibility to the population.



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3) SOUTH AFRICAN TRANSPORT SERVICES, Head Office, Johannesburg,
Ref. HQ/RS.5/48.

APPENDIX A

DISCOUNTED CASH FLOW SCHEDULES

Paragraph 8.3.9 referred to the computer program which has been used to calculate the present value of the long-term costs of the different types of bus. The five appendices which follow (B to F), set out the "basic" scenario for each type of bus in full detail for each year of the project. The cumulative total of each schedule at the 25-year level corresponds with the amounts listed in table 8.6.

The program which is based on the Lotus 1-2-3 spreadsheet allows for adjustments to purchase prices, interest rates, life expectancy, operating costs and inflation/discount rates. The sensitivity analysis involves a total of 70 adjustments and because space does not permit the detailed schedules to be shown in each case, a summary is given of all costs in appendix G. These costs have been used to arrive at the indices listed in tables 8.8 to 8.17.



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APPENDIX B ARTICULATED TROLLEY BUS

DISCOUNTED CASH FLOW ANALYSIS

YEAR	PURCHASE PRICE	ANNUAL REPAYMENT	DISCOUNT FACTOR	PRESENT VALUE	OPERATING COSTS	DISCOUNT FACTOR	PRESENT VALUE	TOTAL	CUMULATIVE TOTAL	YEAR
	% RATE	% RATE	% RATE	% RATE	% RATE	% RATE	% RATE			
	10	13	10	10	10	10	10			
	PERIOD(YRS)									
	25									
	(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)	(R.MIL)	
1	45.675	6.231	1	6.231	3.918	1	3.918	10.149	10.149	1
2	50.243	6.231	0.9091	5.665	4.310	0.9091	3.918	9.583	19.732	2
3	55.267	6.231	0.8264	5.150	4.741	0.8264	3.918	9.068	28.800	3
4	60.793	6.231	0.7513	4.682	5.215	0.7513	3.918	8.600	37.399	4
5	66.873	6.231	0.6830	4.256	5.736	0.6830	3.918	8.174	45.573	5
6	73.560	6.231	0.6209	3.869	6.310	0.6209	3.918	7.787	53.361	6
7	80.916	6.231	0.5645	3.517	6.941	0.5645	3.918	7.435	60.796	7
8	89.008	6.231	0.5132	3.198	7.635	0.5132	3.918	7.116	67.912	8
9	97.908	6.231	0.4665	2.907	8.399	0.4665	3.918	6.825	74.737	9
10	107.699	6.231	0.4241	2.642	9.238	0.4241	3.918	6.560	81.297	10
11	118.469	6.231	0.3855	2.402	10.162	0.3855	3.918	6.320	87.617	11
12	130.316	6.231	0.3505	2.184	11.179	0.3505	3.918	6.102	93.719	12
13	143.348	6.231	0.3186	1.985	12.296	0.3186	3.918	5.903	99.622	13
14	157.682	6.231	0.2897	1.805	13.526	0.2897	3.918	5.723	105.345	14
15	173.451	6.231	0.2633	1.641	14.879	0.2633	3.918	5.559	110.904	15
16	190.796	6.231	0.2394	1.492	16.366	0.2394	3.918	5.410	116.314	16
17	209.875	6.231	0.2176	1.356	18.003	0.2176	3.918	5.274	121.588	17
18	230.863	6.231	0.1978	1.233	19.803	0.1978	3.918	5.151	126.739	18
19	253.949	6.231	0.1799	1.121	21.784	0.1799	3.918	5.039	131.778	19
20	279.344	6.231	0.1635	1.019	23.962	0.1635	3.918	4.937	136.715	20
21	307.279	6.231	0.1486	0.926	26.358	0.1486	3.918	4.844	141.559	21
22	338.006	6.231	0.1351	0.842	28.994	0.1351	3.918	4.760	146.319	22
23	371.807	6.231	0.1228	0.765	31.894	0.1228	3.918	4.683	151.002	23
24	408.988	6.231	0.1117	0.696	35.063	0.1117	3.918	4.614	155.616	24
25	449.657	6.231	0.1015	0.633	38.591	0.1015	3.918	4.551	160.167	25
				62,217			97,950			

* APPENDIX C DOUBLE DECK TROLLEY BUS

DISCOUNTED CASH FLOW ANALYSIS

YEAR	PURCHASE PRICE	ANNUAL REPAYMENT	DISCOUNT FACTOR	PRESENT VALUE	OPERATING COSTS	DISCOUNT FACTOR	PRESENT VALUE	TOTAL	CUMULATIVE TOTAL	YEAR
	% RATE	% RATE	% RATE		% RATE	% RATE				
	10	13	10		10	10				
	PERIOD (YRS)									
		25								
	(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)	(R.MIL)	
1	47.447	6.473	1	6.473	4.144	1	4.144	10.617	10.617	1
2	52.192	6.473	0.9091	5.885	4.558	0.9091	4.144	10.029	20.646	2
3	57.411	6.473	0.8264	5.348	5.014	0.8264	4.144	9.492	30.138	3
4	63.152	6.473	0.7513	4.863	5.518	0.7513	4.144	9.007	39.145	4
5	69.467	6.473	0.6830	4.421	6.067	0.6830	4.144	8.565	47.710	5
6	76.414	6.473	0.6209	4.019	6.674	0.6209	4.144	8.163	55.873	6
7	84.055	6.473	0.5645	3.654	7.341	0.5645	4.144	7.798	63.671	7
8	92.481	6.473	0.5132	3.322	8.075	0.5132	4.144	7.466	71.137	8
9	101.707	6.473	0.4665	3.020	8.883	0.4665	4.144	7.164	78.300	9
10	111.878	6.473	0.4241	2.745	9.771	0.4241	4.144	6.889	85.190	10
11	123.065	6.473	0.3855	2.496	10.748	0.3855	4.144	6.640	91.830	11
12	135.372	6.473	0.3505	2.269	11.823	0.3505	4.144	6.413	98.243	12
13	148.909	6.473	0.3186	2.062	13.006	0.3186	4.144	6.206	104.449	13
14	163.600	6.473	0.2897	1.875	14.306	0.2897	4.144	6.019	110.468	14
15	180.180	6.473	0.2633	1.705	15.737	0.2633	4.144	5.849	116.317	15
16	198.198	6.473	0.2394	1.550	17.311	0.2394	4.144	5.694	122.011	16
17	218.018	6.473	0.2176	1.409	19.042	0.2176	4.144	5.553	127.564	17
18	239.819	6.473	0.1978	1.281	20.946	0.1978	4.144	5.425	132.988	18
19	263.801	6.473	0.1799	1.164	23.040	0.1799	4.144	5.308	138.297	19
20	290.182	6.473	0.1635	1.058	25.344	0.1635	4.144	5.202	143.499	20
21	319.200	6.473	0.1486	0.962	27.879	0.1486	4.144	5.106	148.605	21
22	351.120	6.473	0.1351	0.875	30.667	0.1351	4.144	5.019	153.624	22
23	386.232	6.473	0.1228	0.795	33.733	0.1228	4.144	4.939	158.563	23
24	424.855	6.473	0.1117	0.723	37.107	0.1117	4.144	4.867	163.430	24
25	467.340	6.473	0.1015	0.657	40.817	0.1015	4.144	4.801	168.231	25

64,631

103,600

APPENDIX D- SINGLE DECK DIESEL BUS (10-YEAR LIFE)

DISCOUNTED CASH FLOW ANALYSIS

YEAR	PURCHASE PRICE	ANNUAL REPAYMENT	DISCOUNT FACTOR	PRESENT VALUE	OPERATING COSTS	DISCOUNT FACTOR	PRESENT VALUE	TOTAL	CUMULATIVE TOTAL	YEAR
	% RATE	% RATE	% RATE	% RATE	% RATE	% RATE	% RATE			
	10	15	10	10	10	10	10			
	PERIOD(YRS)	PERIOD(YRS)	PERIOD(YRS)	PERIOD(YRS)	PERIOD(YRS)	PERIOD(YRS)	PERIOD(YRS)			
	10	10	10	10	10	10	10			
	(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)	(R.MIL)	
1	13.750	2.534	1	2.534	5.304	1	5.304	7.838	7.838	1
2	15.125	2.534	0.9091	2.304	5.834	0.9091	5.304	7.838	15.446	2
3	16.638	2.534	0.8264	2.094	6.418	0.8264	5.304	7.398	22.844	3
4	18.301	2.534	0.7513	1.904	7.060	0.7513	5.304	7.208	30.052	4
5	20.131	2.534	0.6830	1.731	7.768	0.6830	5.304	7.035	37.086	5
6	22.145	2.534	0.6209	1.573	8.542	0.6209	5.304	6.877	43.964	6
7	24.359	2.534	0.5645	1.430	9.396	0.5645	5.304	6.734	50.698	7
8	26.795	2.534	0.5132	1.300	10.336	0.5132	5.304	6.604	57.302	8
9	29.474	2.534	0.4665	1.182	11.370	0.4665	5.304	6.486	63.789	9
10	32.422	2.534	0.4241	1.075	12.507	0.4241	5.304	6.379	70.167	10
11	35.664	6.572	0.3855	2.534	13.757	0.3855	5.304	7.838	78.005	11
12	39.230	6.572	0.3505	2.304	15.133	0.3505	5.304	7.608	85.613	12
13	43.153	6.572	0.3186	2.094	16.648	0.3186	5.304	7.398	93.011	13
14	47.469	6.572	0.2897	1.904	18.311	0.2897	5.304	7.208	100.219	14
15	52.216	6.572	0.2633	1.731	20.142	0.2633	5.304	7.035	107.254	15
16	57.437	6.572	0.2394	1.573	22.156	0.2394	5.304	6.877	114.131	16
17	63.181	6.572	0.2176	1.430	24.372	0.2176	5.304	6.734	120.865	17
18	69.499	6.572	0.1978	1.300	26.809	0.1978	5.304	6.604	127.470	18
19	76.449	6.572	0.1799	1.182	29.490	0.1799	5.304	6.486	133.956	19
20	84.094	6.572	0.1635	1.075	32.439	0.1635	5.304	6.379	140.334	20
21	92.503	17.047	0.1486	2.534	35.683	0.1486	5.304	7.838	148.172	21
22	101.753	17.047	0.1351	2.304	39.251	0.1351	5.304	7.608	155.780	22
23	111.929	17.047	0.1228	2.094	43.176	0.1228	5.304	7.398	163.178	23
24	123.122	17.047	0.1117	1.904	47.494	0.1117	5.304	7.208	170.386	24
25	135.434	17.047	0.1015	1.731	52.243	0.1015	5.304	7.035	177.421	25

44,821

132,600

APPENDIX E SINGLE DECK DIESEL BUS (8-YEAR LIFE)

DISCOUNTED CASH FLOW ANALYSIS

YEAR	PURCHASE PRICE	ANNUAL REPAYMENT	DISCOUNT FACTOR	PRESENT VALUE	OPERATING COSTS	DISCOUNT FACTOR	PRESENT VALUE	TOTAL	CUMULATIVE TOTAL	YEAR
	% RATE	% RATE	% RATE	% RATE	% RATE	% RATE	% RATE			
	10	10	10	10	10	10	10			
	PERIOD (YRS)									
	8									
	(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)		(R.MIL)	(R.MIL)	(R.MIL)	
1	13.750	2.865	1	2.865	5.112	1	5.112	7.977	7.977	1
2	15.125	2.865	0.9091	2.605	5.423	0.9091	5.112	7.717	15.694	2
3	16.538	2.865	0.8264	2.368	6.156	0.8264	5.112	7.480	23.174	3
4	18.301	2.865	0.7513	2.153	6.804	0.7513	5.112	7.265	30.439	4
5	20.131	2.865	0.6830	1.957	7.484	0.6830	5.112	7.069	37.508	5
6	22.145	2.865	0.6209	1.779	8.233	0.6209	5.112	6.891	44.399	6
7	24.359	2.865	0.5645	1.617	9.056	0.5645	5.112	6.729	51.128	7
8	26.795	2.865	0.5132	1.470	9.962	0.5132	5.112	6.582	57.710	8
9	29.474	6.142	0.4665	2.865	10.958	0.4665	5.112	7.977	65.687	9
10	32.422	6.142	0.4241	2.605	12.054	0.4241	5.112	7.717	73.404	10
11	35.664	6.142	0.3855	2.368	13.259	0.3855	5.112	7.480	80.884	11
12	39.230	6.142	0.3505	2.153	14.585	0.3505	5.112	7.265	88.149	12
13	43.153	6.142	0.3186	1.957	16.044	0.3186	5.112	7.069	95.218	13
14	47.469	6.142	0.2897	1.779	17.648	0.2897	5.112	6.891	102.109	14
15	52.216	6.142	0.2633	1.617	19.413	0.2633	5.112	6.729	108.838	15
16	57.437	6.142	0.2394	1.470	21.354	0.2394	5.112	6.582	115.420	16
17	63.181	13.166	0.2176	2.865	23.490	0.2176	5.112	7.977	123.397	17
18	69.459	13.166	0.1978	2.605	25.838	0.1978	5.112	7.717	131.114	18
19	76.449	13.166	0.1799	2.368	28.422	0.1799	5.112	7.480	138.594	19
20	84.094	13.166	0.1635	2.153	31.265	0.1635	5.112	7.265	145.859	20
21	92.503	13.166	0.1486	1.957	34.391	0.1486	5.112	7.069	152.928	21
22	101.753	13.166	0.1351	1.779	37.830	0.1351	5.112	6.891	159.819	22
23	111.929	13.166	0.1228	1.617	41.613	0.1228	5.112	6.729	166.548	23
24	123.122	13.166	0.1117	1.470	45.774	0.1117	5.112	6.582	173.130	24
25	135.434	28.223	0.1015	2.865	50.352	0.1015	5.112	7.977	181.107	25

53,307

127,800

APPENDIX F DOUBLE DECK DIESEL BUS

DISCOUNTED CASH FLOW ANALYSIS

YEAR	PURCHASE PRICE	ANNUAL REPAYMENT	DISCOUNT FACTOR	PRESENT VALUE	OPERATING COSTS	DISCOUNT FACTOR	PRESENT VALUE	TOTAL	CUMULATIVE TOTAL	YEAR
	% RATE	% RATE	% RATE		% RATE	% RATE				
	10	13	10		10	10				
	PERIOD (YRS)									
	14									
	(R. MIL)	(R. MIL)		(R. MIL)	(R. MIL)		(R. MIL)	(R. MIL)	(R. MIL)	
1	21.546	3.419	1	3.419	5.341	1	5.341	8.760	8.760	1
2	23.701	3.419	0.9091	3.108	5.875	0.9091	5.341	8.449	17.209	2
3	26.071	3.419	0.8264	2.825	6.463	0.8264	5.341	8.166	25.375	3
4	28.678	3.419	0.7513	2.568	7.109	0.7513	5.341	7.909	33.284	4
5	31.545	3.419	0.6830	2.335	7.820	0.6830	5.341	7.676	40.960	5
6	34.700	3.419	0.6209	2.123	8.602	0.6209	5.341	7.464	48.424	6
7	38.170	3.419	0.5645	1.930	9.462	0.5645	5.341	7.271	55.695	7
8	41.987	3.419	0.5132	1.754	10.408	0.5132	5.341	7.095	62.790	8
9	46.186	3.419	0.4665	1.595	11.449	0.4665	5.341	6.936	69.726	9
10	50.804	3.419	0.4241	1.450	12.594	0.4241	5.341	6.791	76.517	10
11	55.855	3.419	0.3855	1.318	13.853	0.3855	5.341	6.659	83.176	11
12	61.473	3.419	0.3505	1.198	15.238	0.3505	5.341	6.539	89.715	12
13	67.621	3.419	0.3186	1.089	16.762	0.3186	5.341	6.430	96.145	13
14	74.363	3.419	0.2897	0.990	18.439	0.2897	5.341	6.331	102.477	14
15	81.821	12.982	0.2633	3.419	20.282	0.2633	5.341	8.760	111.236	15
16	90.003	12.982	0.2394	3.108	22.311	0.2394	5.341	8.449	119.685	16
17	98.003	12.982	0.2176	2.825	24.542	0.2176	5.341	8.166	127.851	17
18	108.904	12.982	0.1978	2.568	26.996	0.1978	5.341	7.909	135.761	18
19	119.794	12.982	0.1799	2.335	29.696	0.1799	5.341	7.676	143.437	19
20	131.773	12.982	0.1635	2.123	32.665	0.1635	5.341	7.464	150.901	20
21	144.951	12.982	0.1486	1.930	35.932	0.1486	5.341	7.271	158.171	21
22	159.446	12.982	0.1351	1.754	39.525	0.1351	5.341	7.095	165.267	22
23	175.390	12.982	0.1228	1.595	43.477	0.1228	5.341	6.936	172.202	23
24	192.929	12.982	0.1117	1.450	47.825	0.1117	5.341	6.791	178.993	24
25	212.222	12.982	0.1015	1.318	52.607	0.1015	5.341	6.659	185.652	25

52,127

133,525

APPENDIX G

SENSITIVITY ANALYSIS

The indices which appear in tables 8.8 to 8.17 are based on the absolute amounts shown below. All amounts are in millions of rand. These amounts have been calculated by means of the computer program mentioned in paragraph 8.3.9.

SCENARIO	ARTICULATED TROLLEY	DOUBLE DECK TROLLEY	SINGLE DECK (10 YEAR)		SINGLE DECK (8 YEAR)		DOUBLE DECK DIESEL
			DIESEL	(10 YEAR)	DIESEL	(8 YEAR)	
1. Basic scenario (appendices B to F)	160,167	168,231	177,421	177,421	181,107	181,107	185,652
2. 3 Single deck diesel buses per km (Table 8.9)	104,067	106,576	106,443	106,443	108,661	108,661	111,193
3. 25 000 km/year (Table 8.10)	127,217	132,131	127,696	127,696	133,185	133,185	135,577
4. 50 000 km/year (Table 8.10)	182,717	194,131	210,571	210,571	213,060	213,060	219,027
5. 20-year trolley bus life (Table 8.11)	139,251	146,133	140,334	140,334	145,861	145,861	150,901
6. 20% interest on loans (Table 8.12)	190,127	199,353	190,611	190,611	194,470	194,470	204,781
7. Diesel operating costs reduced 10% (Table 8.13)	160,167	168,231	164,171	164,171	168,310	168,310	172,277
8. Trolley operating costs reduced 10% (Table 8.13)	150,367	157,856	177,421	177,421	181,110	181,110	185,652
9. Diesel operating costs increased 10% (Table 8.13)	160,167	168,231	190,671	190,671	193,885	193,885	199,002
10. Trolley operating costs increased 10% (Table 8.13)	169,967	178,581	177,421	177,421	181,110	181,110	185,652
11. Inflation rate 9% (Table 8.14)	150,191	157,679	160,656	160,656	164,059	164,059	169,121
12. Inflation rate 12% (Table 8.14)	184,839	194,326	218,786	218,786	223,077	223,077	226,293
13. Inflation on diesel bus prices 12% (Table 8.15)	160,167	168,231	185,387	185,387	190,886	190,886	192,660
14. Rebuilding of diesel buses (Table 8.16)	160,167	168,231	173,139	173,139	179,334	179,334	180,018
15. Discount rate 15% (Table 8.17)	106,776	112,061	109,857	109,857	112,272	112,272	115,960

APPENDIX H.1

Paragraph 7.2.3 of this study has referred to a public meeting held in San Francisco on August 14, 1986 to consider the electrification of a diesel bus route to trolley bus operation.

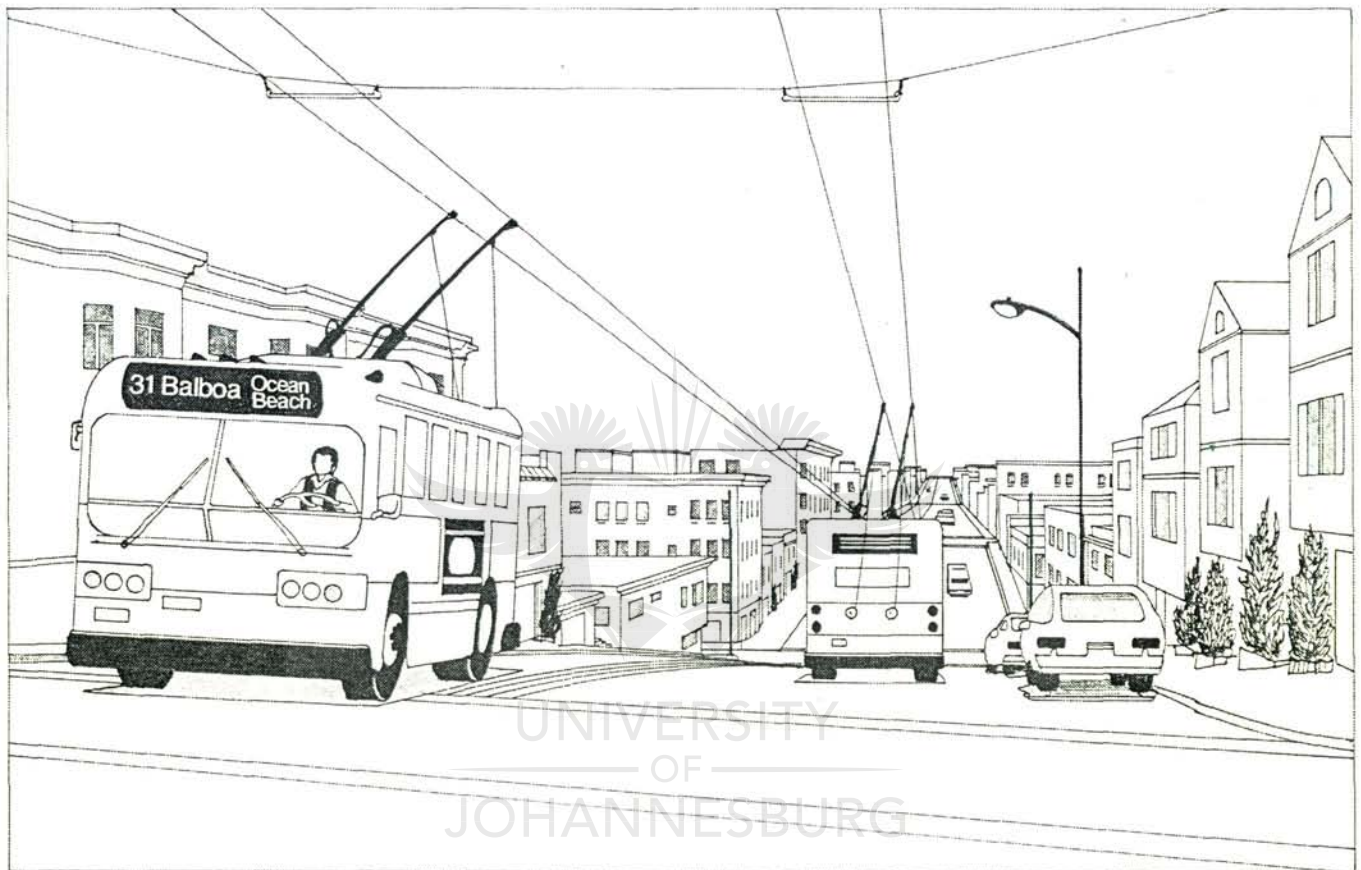
The notice announcing the meeting was distributed to residents of the area, as well as to bus passengers on routes serving the area during the first week of August 1986, and is reproduced in the three appendices which follow.

The notice is an indication of MUNI's commitment to public participation in transport planning in San Francisco and its positive attitude to trolley buses.



UNIVERSITY
OF
JOHANNESBURG

Quiet Efficient Trolley Coaches Proposed for the 31-BALBOA



Which MUNI diesel bus lines would you like to see converted to electric trolley coach operation?

Over the past five years, MUNI has started two new trolley coach lines—the 1-CALIFORNIA and the 24-DIVISADERO—and is in the process of extending the 33-ASHBURY from Golden Gate Park to Children's Hospital.

This is all part of an on-going plan

to expand San Francisco's trolley coach operation which provides quieter, cleaner, more economical and more energy efficient and reliable transportation than diesel buses on San Francisco's hilly streets.

It is now time to decide which line should be the next, and that's why we would like to hear from you, MUNI riders and San Francisco residents and business people.



A Letter from the General Manager

As MUNI's General Manager, I invite you to read this brochure about our Trolley Coach Expansion Program and attend one of our upcoming meetings.

Many people do not realize that San Francisco has the nation's largest fleet of trolley coaches. Trolley coaches are quiet, reliable and efficient. They are especially suited to the topography of our City.

As part of our commitment to provide improved service at reduced cost, MUNI has over the past few years inaugurated two new trolley coach lines—the **1-CALIFORNIA** and **24-DIVISADERO**.

Construction is now under way to extend the **33-ASHBURY** to Children's Hospital. The City has also rebuilt the trolley coach overhead on Market Street to allow four lane trolley coach operation.

This past winter, MUNI held meetings to discuss the possibility of converting local service on the **38-GEARY** from diesel to trolley coach service. Some of you may have read our earlier brochure or attended one of the meetings. Now, we are ready to discuss another candidate: the **31-BALBOA**.

Following meetings, we will re-evaluate both proposals, taking into consideration all comments we have received. Depending in part on your comments, our evaluation and the availability of funding from state and federal sources, we then hope to recommend to the San Francisco Public Utilities Commission at least one candidate for electrification over the next few years.

Sincerely,

William G. Stead
General Manager
San Francisco Municipal Railway

Quiet, Efficient Trolley Coaches Proposed For 31-Balboa

In 1983, MUNI's Planning Department drew up a Preliminary Plan for Trolley Coach Expansion. Among the lines considered for electrification in that proposal are: **38-GEARY, 31-BALBOA, 71-HAIGHT/NORIEGA, 42-DOWNTOWN LOOP, 15-THIRD, 19-POLK, and a new line along Pacific Avenue.**

We would like you to know MUNI's thinking behind trolley coach expansion in general, and the **31-BALBOA** in particular. We also want to receive your comments before any final decisions are made.



Public Meetings

1. Tuesday, August 12, 7:30 p.m., Cabrillo Elementary School, 735 24th Avenue (off Balboa), Multipurpose Room.
2. Thursday, August 14, 7:30 p.m., Cowell Hall, University of San Francisco, Room 114. (The USF campus is located between Golden Gate Avenue and Fulton Street on the north and south and Masonic and Parker Avenues on the east and west. Cowell Hall is approximately in the middle of the campus, and Room 114 can be entered directly from the outside.)
3. Tuesday, August 19, 7:30 p.m., State Office Building, 350 McAllister (between Polk and Larkin), Auditorium—Room 1194 (for wheelchair access, phone 557-1477 to make arrangements).

"How do I make my opinion known if I can't attend?" Please write or call. Our mailing address is:

San Francisco Municipal Railway
Planning Division Room 204
949 Presidio Avenue
San Francisco, CA 94115

or call us at 558-5441 or 923-6100 and ask for Michael Cronbach or Larry Florin.

MUNI staff will be able to make presentations to neighborhood organizations and other community groups concerning MUNI's proposals for new trolley coach service.

Why Expand MUNI's Trolley Coach Network?

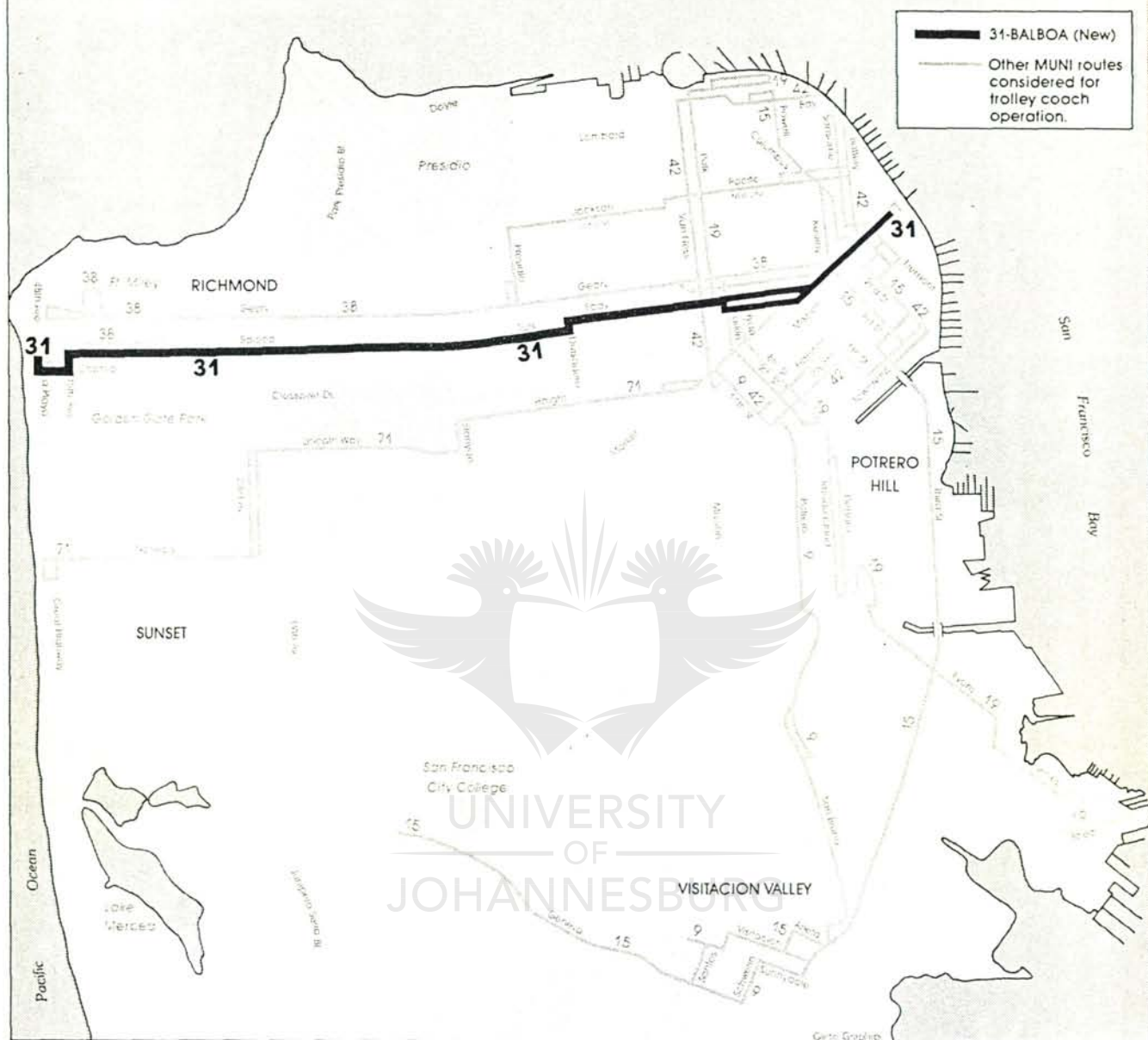
ECONOMY AND RELIABILITY—Trolley coaches are less costly to maintain and power than diesel buses, especially with a large fleet of vehicles such as MUNI's. At a time when fiscal efficiency of City services is of prime importance, we should make the best use of the limited funds available to us.

Trolley coaches can be expected to last about twice as long as diesel coaches even on relatively level routes. Trolleys last 20 to 25 years before they need replacement versus 10 to 15 years for diesels.

TROLLEYS ARE GOOD NEIGHBORS—Trolley coaches are both cleaner and quieter than diesel buses and would improve San Francisco's environment by reducing noise and air pollution.

HILLS—Trolley coaches are ideally suited to serve the hilly terrain of San Francisco. They can climb steep grades with heavy loads quickly and quietly, and are more dependable under these conditions than diesel buses.

Proposed 31-BALBOA Trolley Coach Service



Why Electrify the 31-BALBOA?

Trolley Coaches Are Quiet

The 31-BALBOA operates along a rolling, hilly route from Downtown to Ocean Beach. Electric trolley buses make much less noise than diesels going up and down hills. They're quieter and less polluting than diesel buses in general.

Trolley Coaches Are Efficient

They also cost less to operate. Operating savings resulting from the use of electric coaches rather than diesel fueled buses on the 31 would be over \$350,000 each year, even with today's relatively low prices for diesel fuel. Since operating costs are paid from local sources, this would be a savings to the City which otherwise would have to be made up from fares or taxes.

MUNI Could Make the Best Use of the Resources It Already Has

A portion of the 31-BALBOA route, on Market Street between the Ferry Terminal and Mason Street, is already served by trolley coaches and would not require any new construction.

Also, when MUNI's last trolley coaches were purchased, enough extra vehicles were bought to allow service on several additional lines. MUNI, therefore, currently has enough trolley coaches to allow for the 31-BALBOA to be converted.

What Would Happen During Construction?

Construction would be limited to utility poles and wires, underground electrical cables and a small substation somewhere along the route. It may also be possible to use existing utility poles, until such time as existing utilities are undergrounded, further minimizing impacts.

APPENDIX I

READERS' LETTERS



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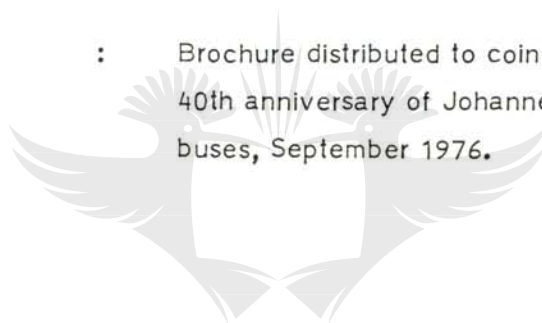
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