Towards 2010
— an ambit for road research

J.B. Metcalf (Editor)
THE PURPOSE OF THIS REPORT
- to present a series of informed opinions about future directions for roads and road transport and related research needs
- to provide a basis for discussion, refinement and definition of those needs

THIS REPORT SHOULD INTEREST
any person concerned with the future of roads and road transport

THE MAJOR CONCLUSIONS OF THE REPORT ARE
- better predictions are needed of future patterns of road use
- vehicles will change relatively quickly
- electronic technology will influence travel behaviour, vehicles, traffic control and road management
- construction and maintenance technology can change only slowly

AS A CONSEQUENCE OF THE WORK REPORTED, THE FOLLOWING ACTION IS RECOMMENDED
- continued debate on research and development needs and directions

RELATED ARRB RESEARCH
all projects

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ABSTRACT: This report presents five personal perspectives of the future trends in road and road transport and the related research directions and needs over the next 25 years. The first argues the need to look forward and contrasts vehicles and road use 25 years ago to today's situation. It points out the changes in community attitudes that developed, influencing the technological differences. The second paper looks at changes foreseen in transport supply and demand, emphasising that roads change slowly but vehicles quickly, that vehicle usage is volatile and can be better managed. It canvassed some of the electronic technology potentials. Traffic issues are considered in the third paper including developments in, and segregation of, vehicle types, control and, safety issues. Social, economic and legal influences and the need for flexible future planning methodology are examined. The fourth paper explores heavy vehicle developments, pointing to increasing sophistication of large vehicles and the potential for better control and management of routing, loading and performance and, the need to integrate heavy vehicle and road design. The final paper discusses road construction and maintenance technology trends, suggesting that maintenance and reconstruction will be the key issues with higher standards and increased productivity being conflicting pressures. The need for a better understanding of the relations between design, construction, maintenance and performance on a life cycle basis is emphasised. The adoption of pavement management systems allied to construction monitoring technology is foreseen together with better understanding of material behaviour and construction technologies. A brief open discussion session is also recorded.

*Non IRRD Keywords
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ROADS AND ROAD-BASED TRANSPORT — A FUTURE SCENARIO
1. INTRODUCTION

A Seminar on the next 25 years in road research highlighted the first day of ARRB 25th anniversary Open Days, which were held on 14-18 March 1985. The speakers at the Seminar were Dr M.G. Lay, Executive Director, Dr J.B. Metcalfe, Deputy Director, and the Chief Scientists of ARRB, Dr M.R. Wigan, Dr J.R. McLean and Dr P.F. Sweatman.

Sections 2 to 6 of this report summarise the verbal presentations of the speakers, plus some prepared notes and visual aids. Section 7 presents discussion that followed the presentations plus a summing-up by all speakers.

The Seminar presentations were intended to be personal and possibly provocative perspectives of the future. To attempt to look forward 25 years is of course necessary for all organisations, but especially so for researchers. There can be no certainties, except that what we now foresee will change, and thus there can be no consensus.

Indeed, no consensus was sought. The views expressed are those of the individuals, and whilst we recognise our debt to our colleagues in forming the ideas, any errors or omissions or flights of fancy are our own.

The views are not those of ARRB, but Directors' publications policy which allows their public statement, is acknowledged.
Dr M.G. Lay is the Executive Director of the Australian Road Research Board. He was educated at Melbourne University and Lehigh University in Bethlehem, Pennsylvania, U.S.A. He holds the degrees of Bachelor of Civil Engineering, Master of Engineering Science and Doctor of Philosophy.

He is a Fellow and National Councillor of the Institution of Engineers, Australia, and was in 1984 Chairman of the Victoria Division. He is a Fellow of the Chartered Institute of Transport, a Councillor of the Royal Society of Victoria, a Member of the Society of Sigma Xi, and a Member of the American Society of Civil Engineers. He is a Member of the Faculty of Engineering at the University of Melbourne and a part-time lecturer at that University.

He is author of 'Source Book for Australian Roads' the third edition of which was published in 1985, of 'Structural Steel Fundamentals' published in 1983, of the 'Source Book for the Australian Steel Structures Codes (3rd Edition)' and co-author of 'Structural Steel Design'.

Dr Max Lay
2. THE NEED TO LOOK FORWARD

M. G. Lay

It is essential for us in research to look forward, because to plan a good research program you need to be three or four years ahead in thinking and preparing for the projects. And then of course for the research to be useful when finished, it still has to be in advance of what is going on. Thus, in order for research to be applied we have to look at a time span of about five to ten years. To achieve this at ARRB, many of you know we have a rolling three year plan (Anonymous 1984), and this at least forces us, each year, to look formally at research planning — three years ahead. To look a little further forward we less frequently prepare a research perspective document (Lay 1977) which raises our view to a ten year time span. Copies of the draft of the current 'perspective' are being distributed at this Seminar (Appendix A). In the Seminar we will look forward 25 years.

Although this is a very necessary process in research, it is equally an issue for anyone in the road area or any area of major investment. When a road is built, the construction process often has been preceded by ten or more years of planning. Of course, a road having been put into service will be operating for 25 years at the very least. So perhaps even more so than in research, the whole community needs to be continually taking its view ahead. I say 'perhaps' because our research must also be looking at that road at the end of its life. So this discussion, although it might seem a difficult one — you might think it pretentious to even attempt it — is a very necessary discussion. It is difficult because 25 years is a long way ahead.

Or is it such a long way ahead? If we look 25 years back Fig. 1 shows the sort of car we were buying in 1960 — 25 years ago. The Zephyrs (Fig. 2) and Holdens did not just appear in advertisements, they used the roads, and a few still do. The critical point is that they do not look so much different from the automobile produced by the technology of today. Even if the truck in Fig. 3 has fewer wheels and looks a little less glamorous, it is still a truck and the technology is not vastly different from today.

When we look at changes on the way — and of course a few ideas fall by the wayside — things are not that different. If the change in cars from 1985 to 2010 is no different than the change from 1960 to 1985, then it should be reasonably predictable.
There are some other changes that we can see as first signs of some of the techniques we have today. That is, some of the year 2010 is already here, if only in preview or in early childhood. From a traffic and transport viewpoint, Figs 4-6 show that we have spent most of the last 25 years using up the capacity of our existing system rather than, in Australia at least, creating a lot of extra capacity. We now use our road space much more efficiently in a static sense. When we look at other countries we can see that, for example, freeway building in America in 1960 can well be translated to parts of Australia today (Fig. 7). I could have put another caption on Fig. 8 and you would not have really been too aware that this 1960 U.S. freeway was not a 1985 freeway in Australia.

One thing that photos (Figs 9-10) of city 're-developments' indicate is that tastes have changed more than construction techniques. Figs 8-10 show some of what were fairly enthusiastically reviewed pieces of construction, but I doubt that any of them would be so reviewed today. Some, to our eye, look to be fairly horrendous constructions within a city. So community perceptions and standards and social values have altered. Devastating a whole city block, as Figs 9-10 show, for the length of a city to put an arterial road through its middle would now be far less acceptable as would the outmoded technology that required it and the design and construction techniques that made it possible.

So as much as looking at technology, we have to look at what community values happen to be. Perhaps it is a thing of the past — to build in an urban area. Back in Australia, Fig. 11 shows that in the 1960s we were often still struggling with getting out of the mud and dirt. We are still tackling that problem and the end is not yet nigh.
As I said earlier, we have just about utilised our 'static' road capacity — these intersections are now running full, and one of the features of Figs 12-13 is the sparseness of road use. You could not even take a picture of Sydney Harbour Bridge today unless you took it with a flash camera late on Monday night (Fig 14). However, I suspect that in 2010 people will be storing video clips of today's traffic and remarking on how inefficiently road use in 1985 wasted the road space in a 'dynamic' sense.
Traffic control technology has improved a little as Figs 15-17 show, and throughout the seminar you will hear about somewhat more modern traffic technology than the holster, the gun and the amphometer. But the changes have not been that dramatic have they?

I now pass over to Marc Wigan. My message has been that it is essential that we take on this task of looking into the future. We do it by default all the time, and this is an attempt on one occasion to do it a little more formally. Finally, I have attempted to demonstrate that traffic is not that difficult a topic. However, beware of forecasts. Studies of transport planning forecasts in the post war period group shows that they are almost always very wrong (Roslean and Whitehead 1984).

REFERENCES


3. FORESEEABLE CHANGES

M.R. Wigan

My task is to draw your attention to the sorts of changes one can reasonably suspect will occur. I will simply point out those kinds of changes we know will occur and question how much attention we should pay them as a matter of choice, opinion, discussion and debate — until the future overtakes us and we find we are already too late. If we review the different kinds of factors we will have to accommodate, they can be grouped into a few major headings:

- economic, social, physical environments;
- changes in lifestyle;
- changes in workstyle;
- patterns of demand;
- supply of road and transport services;
- information technology: catalyst and tool.

First, the Economic Environment. If in the future we have more money, are we going to spend more of it in moving around? Does the same apply to goods vehicles?

Social Environments. How many people will be in work? There is likely to be a smaller percentage of the population involved in full-time work and more economically active in work. Does that mean that we are going to have more movement or less? The answers are not necessarily obvious; leisure can be travel intensive.

Fiscal Environments. We must account for the implications of what, for the next 25 years or 30 years, will be a predominantly ageing population. We are already locked into that trend and even substantial immigration will not have great influence upon it.

Twenty five years is perhaps too far ahead in one sweep, so let us split it into two parts. The year 2000 has always been stated as being a long way away, just as Orwell’s 1984 was, but it is only 15 years away. There are going to be changes, but not nearly as much as you might think. Let us look at the kind of changes we have seen in the past 25 years, because these tell us about the future. We have different patterns of demand for transport and for movement and for different kinds of activities. We certainly now do different things; we have different amounts of time available; we go to different places. From the past, from only 1960, you can project forward and see more changes could occur.

The pace of change is difficult to grasp until it is broken down:

- In 2000 30 per cent of today’s cars will still be registered;
- Less than 2 per cent of today’s road system is added or totally rebuilt each year;
- Freight movement follows people, activities and economic activity; and
- Changes in the use made of the vehicle fleet are far more volatile:
  * In 1992 12-20 per cent of the value of U.S. cars will be electronics
  * In 2000 ... much of the future is already here
  * In 2010 ... vehicles change, but the roads remain;
- Research time scales are 10-15 years.

Then ask yourself where the big budget aspirations are and will be in public expenditure; education, welfare, medical, and where the pressures will be on national allocation between sectors. Economic, social and fiscal environments primarily determine the possible, the most probable and even the most practicable futures. Their underlying influence is probably more important than some of the more ‘popular’ future expectations, such as the already evident changes in lifestyle.

For example, the increasing employment activity rate of females will probably bring yet more women into work (if not necessarily into full-time employment). Female activity rates have been steadily increasing over the centuries and are now at a very high level. Unless there are major changes in this trend or some fundamental reason for a large reduction in this activity rate there is unlikely to be any great change in the general trends of the employment statistics. The downward trend in fertility rates and the later ages of child-bearing seem to be related to the overall level of economic wealth, but as the effect of changes in these areas is slow, even over 25 years, the present trends provide a sound initial basis for our forward view.
More people, under increasing economic pressures, and altered patterns of employment opportunities are choosing to change their lifestyle; moving to job sharing, part-time working, home working. There is an increasing number of people who are choosing that way of life, not because they are forced to work in this way, but because they are choosing to give priority to their personal time and quality of life, as much as to material goods and services.

Incremental changes in the real income of the community are now more likely to be discretionary in their allocation. Motor vehicles stopped being inelastic goods 25 years ago, and became luxury substitutable goods. A similar change is now occurring for other consumer goods.

There have, of course, been fundamental changes in work styles, which will continue to spread. Telecommuting and distance working is already a reality and has been routine for some years for a small but steadily growing part of the community. There are also indications, from America in particular, that industrial locations are being chosen on the basis of communications, in terms of the telecommunications and living environment quality of the location, rather than the classical transport, people and resources location requirements. Some of these fundamental changes in work style are being instigated by a relaxation of the pressure for everyone to be working at the same place at the same time in the same location in close proximity to others doing the same thing.

The essential questions are: Where do you want to be? When do you wish to have interchange (of goods) or contact (with people)? The necessary links between these two factors (time and proximity) are already fragile for many purposes.

### Trends
- Transport takes an increasing share of GNP
- Public transport subsidies will grow (ageing)
- Vehicle ownership will rise
- Freight vehicle total loads will rise
- Family expenditures will shift to leisure ends
- Pressures on personal time will rise
- Social priority of safety will rise

### Supply
- Social welfare spending will squeeze the road dollar
- Management, maintenance, construction and operation will integrate
- Physical distribution management will dominate freight movements
- Freight capacity and level of service will become high priority
- Road design and maintenance standards will interact more
- Road capacity will be aided by charging and guidance
- Better management of people on roads will help
- Shortages of PEOPLE for the roads sector

While these factors influence the demand for travel, it is equally important to look at the supply factors. We spend a great deal of money both on supplying and improving the quality of transport. The quality of the ride on a road and the quality of the ride on public transport are aspects of supply. Travel demand responds quite swiftly to changes in circumstance. However, planning for the supply of a service in the transport area, particularly in road transport, is a slow process. We cannot influence very much of the system at one time or in one year and must look a long way ahead to reach consistent and coherent goals nation wide.

Demand drives the provision of transport facilities, but what we are discussing here is an appropriate matching of the supply of roads and road transport to that demand. We are moving from building roads to maintaining roads and the management of the infrastructure. Supply dollar now calls for integrated management of roads as a multi-purpose resource.
The fiscal determinants of transport supply should be of special concern to all involved in transport and the activities it serves: public sector funds are influenced by many factors, and progressive integration to operations and maintenance from an overwhelming commitment to construction is a signal of changing community emphasis and interest. These forces will continue to influence an increasingly integrated treatment of transport systems. The underlying determinants of service good movement will remain stable but the range of sources from which such goods may be drawn will probably continue to expand and thereby increase the movement component of many of them. This will be reflected in both urban and rural freight movement.

Advances in technology are not occurring solely in information technology — which tends to be regarded as influencing people movements, services and communications around the globe, making Australia part of the world market. The changes to manufacturing are equally important. How much of your car is at present made up of electronics? Every year we see a vast increase in electronics capability for the same dollar price. American estimates range up to 20 per cent in terms of value by 1992. If you now consider the effect of three or four generations of micro-processors and plastics technology over a further seven to eight years horizon, new cars in 2010 may be completely new forms of transport.

### Information Technology
- surveillance of road users
- monitoring and adjustment of capacity
- dynamic traffic management
- workstyle effects
- expert systems
  - to aid the public
  - to aid professionals

The rate at which changes occur depends on the rate at which society can accept or afford them. It is important, therefore, to concentrate on the pace of change in each of the elements of the transport system — which must respond to changes in demand, location and supply in a manner which very little else in the social infrastructure is forced to do so quickly, or to have to plan for so far ahead.

Thirty per cent of the vehicles currently registered will still be registered in the year 2000; this doesn't mean to say that 30 per cent of the road traffic movement will still be undertaken by that 30 per cent of vehicles. In fact, we can be confident that much less will be undertaken. Current trends indicate that vehicles will become more specialised and individuals will own more vehicles better tailored to their different transport needs and will be renting more vehicles of greater variety. Indeed, hire companies already provide such fleets. Mobility will remain a crucial factor to individuals but the concern about access to a particular vehicle over a particular time may well delay the possibly economically justified growth in the use of rental and common access vehicles.

These sorts of changes are far more volatile than the changes we can expect on the road system itself. It would take a consistent effort over 20 years to work on 40 per cent of the network, and as the life of roads varies over 20 years, or 30 years, major changes must add up to less than this 40 per cent. This really means that most of the rights of way are already available, and it is the quality of service upon them that is now the primary emphasis. Unless there are major population and location changes, the number of new rights-of-way will be limited. The potential for altering capacity and its utilisation by greater investment in traffic management can be expected to take place mainly in the urban areas.

The most economically important road movements are of freight. However, if the public sector allocates less funds to servicing road freight or indeed, if greater cost recovery from freight is required then the end result is a direct transfer to the consumer. The question is which is the most efficient way of minimising resource costs. We can expect that freight vehicles will stay on the vehicle register fewer years than motor cars as they respond to the economics of their utilisation, the degree of specialisation required and to the nature of the task they must undertake; this occurs in the current freight fleets. Changes in those fleets and the manner of their utilisation will continue to be a sensitive indicator as to how the transport system must change and how it is performing. The necessary association between road design standards, construction and maintenance cost and the types of vehicles in use, are already the subject of integrated research at ARRB.

One can confidently predict a widespread extension of the concepts of physical distribution management which consider all aspects of the movement of goods, delivery, stockholding, reliability of delivery, quantities, natures of trans-shipment, throughput and packaging. This is essentially what is required of the freight transport system and has as much to do with constraints on delivery space and time as on the freight movement. We can therefore expect greater attention to the integration of materials handling, warehousing and movement and indeed greater attention to specialisation of vehicles. The manufacturing sector is moving steadily towards timing the delivery of goods closer to production requirements at critical times and quantities as is supermarket retailing.

Some of the social changes linked to this kind of development are an increasing likelihood that the artificial constraints on trade and activity provided by restricted shop and office opening hours will come under increasing pressure, and will break down as an increasing percentage of the population cannot gain access to goods and services through traditional means at traditional timings. Once these costly time and space restraints are removed from the servicing community a very different pattern of utilisation of the roads for freight (and people) might reasonably be expected to occur. Certainly a further flattening of urban peak traffic flows as a result of the more relaxed control on access to and presence at work, that has already occurred. We can expect the morning peak for freight movement will alter if the constraints for delivery and acceptance of goods alter too. This will increase utilisation of the network and of the vehicles and both of them will increase mobility, access and
efficiency. The peak travel demand on quite a number of major highways is now recreational, with weekend and the holiday peaks.

Much of the year 2000 is around us if one knows which particular section of 1985 to look at. The question is how far and how fast such future trends will extend over the community as a whole, be it the community of people, of cars, of freight vehicles, of public transport utilisation or of road infrastructure. It is already apparent that the rate of social adaptation to much of the improving technological capability is very slow and there is no real reason to suppose that it will speed up greatly. Indeed, adequate road pricing techniques and electronic vehicle identification equipment were developed in the early 1970s to enable a practical experiment to be undertaken, but the first experiment is now taking place in Hong Kong — 13 years later. The initial technology and the design of the overall system is essentially very little different from the 1972 capabilities and proposals. The functions have remained the same and indeed the equipment has been ready in technical design terms for that initial trial for a very long time. It is the change of social attitudes and the unique features of Hong Kong, where special circumstances provide an opportunity to undertake the experiment on this technology that has allowed this project to begin. The reason for this slow adaptation is because of the wider implications of integrated information and control technology — the 'big brother' syndrome and even more important the purely practical underlying economic factors.

While the capability was essentially already there in 1972, the overwhelming cost was for vehicle identification equipment. This is where the pressures for change are increasing most quickly. The incremental cost is declining swiftly and can be expected to be a purely marginal cost within a very few years. The rate of social adaptation to these capabilities will be the primary determinant of the changes in the road and travel environment, not the purely technical capability.

Of equal importance are the priorities sustaining and underpinning the economics of public transport. The substantial subsidy of public transport is in competition with different types of economic and social expenditure. The district ageing of the population profile in Australia and the very different patterns of consumption of the elderly make it an open question as to whether the priority currently given to public transport subsidy will remain at the same levels.

Changes in that area may lead to reinforcement of the tendency of low income elderly households to own vehicles at far lower incomes than any other type of household, but to use them considerably less. The provision of mobility may become a goal instead of the sustaining of potential mobility that public transport provides. Public transport users need not remain the same due to changes in the work place, changes in leisure habits and changes in the age structure and the location of population in Australian cities; can we not expect the treatment of public transport to follow? An increase in the vehicle population does not necessarily mean increasing use. Consequently, should revenue raising from motor vehicles be on use or on ownership? One can envisage a situation where many individuals in a household have access to more than one vehicle at a time. This has implications for insurance, for liability, owner liability, for petrol taxation, for fixed charges — and indeed for vehicle identification.

Over the longer term, 25 years, we will see a wider access in time and space at lower overall cost to the community. The opportunity to respond to cost constraints can now be achieved by positive guidance without the intervention of a price mechanism. This is where electronic advances can change the question from 'Is it possible to implement an electronic means of achieving pricing or control?' to 'Are there better means of using communications and information systems to achieve that end?'

The implication of this subtle shift from control to influence is fairly obvious. For example, how few of the people on the road have to be influenced to alter their routes to be able to achieve a better balance of capacity dynamically for the whole range of users of the network. It certainly does not need to be all of them, but how many? And so a much closer attention to the behaviour of people on roads in a somewhat broader sense will have direct and practical payoff. The mechanism and the infrastructure to apply that knowledge is rapidly arriving.

Over ten years we have seen area traffic control systems spring up across Australia. Over the next ten years, integration between public transport, private vehicle and area traffic control will achieve yet more movement capacity or possibly no more vehicle movement across the system.

Another interesting aspect of supply shortages already apparent, is that the investment in multi-specialist knowledge, which is needed for integrated traffic and transport planning and management, is already in short supply and likely to become even shorter. The infrastructure investment is known to need a ten to 20 year horizon. It is often forgotten that investment in people has a five to ten year horizon. Research has a cycle which starts perhaps ten years or more before the wide application and adoption of the principles identified. We have to develop people with specialised knowledge, who are then accessible. This long cycle of research identification, execution, dissemination and adoption becomes a matter of great concern as the level of integration of the road transport system increases. Yet to maintain adequate response time for the shorter run applications and to translate research findings into operationally usable forms, to sustain and support that process requires a very costly, time consuming manpower effort other than the original research. The one thing that we can be sure of is that change — and the rate of change — is increasing and if we are already encountering difficulties in adapting in an organisational sense, then the only answer to this is people. To anticipate this it will take a fundamental rethink.

We can also look to delivering our research much more efficiently. There are tools which make our work (which may be complicated to carry out), much more easy to manage for the end users. It is also very much more straightforward than it used to be to provide people with a means of access to the judgement of those people who have the skills. Perhaps the biggest bottleneck is people. Roads and transport are about people. If we can get more productivity out of our
research and more productivity out of our operating staff dollars, we are doing well. If we can increase access to at least some of the high level expertise which exists in Australia we are doing even better. The emergence of operational expert systems and other decision support and training tools give us every hope that we will be able to do this as well.

Key Points in Closure

- Roads change fairly slowly
  - thus integrated monitoring evaluation and management improvements are needed
- Vehicle fleets change faster
  - must therefore develop and maintain vehicle fleet characteristics projection and monitoring methods
- Vehicle usage is volatile
  - must therefore improve demand and projection methods, evaluation methods

- Road usage can be better managed
  - guidance, road pricing, surveillance, monitoring and driver behaviour integration
- Determinants of demand
  - need to anticipate these changes in location and timing of road use
- Tools for research product delivery
  - expert systems already needed for codes, regulation and standardization of advice at a low level
  - shortages of skilled people will continue to push up the priority of research delivery and transfer

M.R. Wigan,

Marc Wigan has worked in transport research and policy since he gained his doctorate in Nuclear Physics from Oxford University in 1967, when he joined the U.K. TRRL and worked on electronic road pricing, environmental impact, long distance travel and transport planning models.

In 1974 he moved to the Greater London Council to lead the development of an integrated freight transport and operations policy for the region.

In 1976 he moved to ARRB as Head of the Transport and Traffic Division (now Chief Scientist), and worked on transport demand analysis, time and money expenditure on transport, travel and activity analysis, valuation of life, vehicle ownership and vehicle fleet dynamics, and safety.

Marc now serves as chairman of the Australian Standards Committee AU/12 for motorcycle and car helmets, and is a member of the Victorian Ministry of Transport State Bicycle Committee.

Always deeply involved in information technology, Marc spent part of 1982/83 in the U.K. as SERC visiting Fellow in Information Technology and Transport at Leeds University, and has subsequently been actively involved in traffic and transport applications of information technology from electronic publishing, computer aided communication and knowledge based systems to image processing applications and integrated road pricing and user advice systems. Marc is Associate Editor of Transportation Research, and a member of U.S. Transportation Research Board committees on Bicycles, Motorcycles and Freight.
4 TRAFFIC ISSUES

J.R. McLean

The Back Bearing

To put our forward projection in perspective, it is worth first taking a back bearing to see how we arrived at the present situation.

The 1960s saw the EH Holden and unprecedented growth in urban traffic (Fig. 18). The road authorities geared up to cope with this. The bright young engineers were sent for post-graduate training in the U.S. and returned with the urban freeway solution. However, despite political pressure from the motorists associations, we never achieved anything like the 90 cents in the dollar federal funding necessary to make the urban freeway solution affordable.

The 1970s saw the emergence of OPEC as a significant international economic force, and a growing community and political questioning of capital works solutions to urban problems. To their credit, the road authorities adjusted to these realities and devised strategies to cope with increasing urban traffic without major works.

Traffic management schemes, and particularly electronic traffic control systems, have been very successful in handling increased urban traffic demand. However, it must be recognised that traffic control improves the utilisation of the infrastructure traffic capacity, but it does not add to that capacity.

It would appear that, despite initiatives to reduce the demand for private vehicle travel, urban traffic continues to grow (Fig. 19). More importantly, there is an increasing reliance on road vehicles to handle a growing urban freight task.

Fig. 18 — Total Australian Road Traffic

Fig. 19 — Traffic Growth on Maroondah Highway
The Forward Bearing

This brings us to the point where we might make forward projections.

To date electronic traffic control in Australia has concentrated on improving capacity utilisation at the element or route level. The next step is improved utilisation at the network level. This will be achieved with the sophisticated driver route information systems already under development in Europe and Japan, coupled to automated incident detection systems.

![Fig. 20 — Australian Road Accident Fatalities](image)

![Fig. 21 — Australian Road Fatality Rates](image)

We must anticipate that urban traffic, particularly freight traffic, will continue to grow. Eventually the traffic demand will exceed that which can be catered for by traffic management alone, and there will be growing pressure for more infrastructure. Given the significance of the urban freight task, we can anticipate that much of this pressure will come from the road freight industry.

The need for extra capacity will result in a moderate increase in urban road construction schemes, albeit less ambitious than those envisaged in the 1960s. In particular we will see increasing construction of isolated grade separations (or flyovers) and minimum right-of-way controlled access links. The new construction will not be planned as an additional system, but will be integrated with the existing road network.

In the area of energy, we must anticipate a long-term trend of increasing world prices for liquid fuels. Alternative fuel technologies will become economically viable as the price of traditional sources increases. Evidence to date suggests that, on the 25 year time horizon, this will cause a decrease rather than a reversal of urban traffic growth. The greatest impact will be seen in vehicle design and specialisation, resulting in a greater divergence in vehicle types with regard to size, speed and performance.

The trend towards road user segregation, started with pedestrian malls and bikeways, will expand and continue to cater for the increasing vehicle specialisation. So far we have seen efforts to prohibit trucks from declared areas for environmental reasons. In the next decade, for traffic operational reasons, we will see the beginnings of truck only lanes or even routes.

Road safety will continue to be an issue as long as we have road transport. Taking a public health view, per capita road fatalities have remained fairly stable (Fig. 20). However, in terms of transport efficiency, there have been substantial improvements in road usage based accident rates (Fig. 21). These have largely been brought about by occupant restraint legislation and improvements to vehicle, road and road furniture design. Further gains will be more hardly won and will entail questions of social and economic acceptability.

We should also consider some social factors which are going to influence traffic engineering practice.

Australia is rapidly becoming a very litigious society, and this is being felt in the roads sector. Increasingly, traffic engineering decisions are being based on considerations of legal liability rather than technical merit. It would seem that our mechanisms for updating standards and practices are not keeping pace with the legal process, and the profession is having difficulty adapting.

Similarly, Australians are becoming less accepting and more politically active, resulting in an acceleration in political policy changes and initiatives. Forward planning processes must become more fluid to accommodate these changes, and public authorities will become more visibly accountable.
Research Implications

Research and development will be required to enable the technological advances in computing and electronics to be employed in the optimisation of traffic control systems, including driver information.

New traffic design criteria will need to be designed for the development of minimum right-of-way controlled access arterials in urban areas.

Growing divergence of vehicle types will create new research problems in the field of traffic operations, geometric design and safety. Criteria will be required for the planning, design and operation of functionally segregated road facilities.

Road safety research will be targeted at specific identified problems. The research input must be broadly based in order to consider the social and economic aspects of proposed countermeasures as well as their technical merit.

Legal considerations will play an increasing role in traffic engineering and other areas of road authority activity. Legal expertise will become a specialist input to many applied research studies.

Finally, there is a real research challenge in the field of traffic planning methods. These will need to satisfy the apparently conflicting requirements, of greater flexibility, to accommodate a range of policy objectives, and greater transparency, to maintain credibility with an aware public.

J.R. McLean,
B.E.(Mech.), Ph.D., M.I.E.Aust.,
Chief Scientist,
Australian Road Research Board

John McLean graduated in Mechanical Engineering from the University of Melbourne in 1967, and, after a brief period with the Army Design Establishment, returned to complete a Ph.D.

He joined ARR B in 1972 and in 1975, he was appointed Senior Research Scientist and Traffic Engineering Research Co-ordinator.

In 1978-79, John spent nine months in the U.S. as a visiting scholar at the Institute of Transportation Studies, University of California, Berkeley, where he was able to gain first-hand experience of traffic and transportation research in the U.S. and pursue his own research interests in the field of rural road traffic operations. He also spent some time in Europe and Japan.

His major research project involvements are: travel speeds on urban roads, advisory speed survey procedures, vehicle speeds on curves, the review of road design standards and costs associated with design speed standards. He was appointed a Principal Research Scientist in 1979. He currently works in the Road Technology Research Area managing the Accelerated Loading Facility (ALF) program.
5. HEAVY VEHICLE ISSUES

P.F. Sweatman

The scene is set for considerable development of the road freight industry in Australia over the next 25 years. This process will be reflected in changes in the heavy vehicle fleet and in the road laws governing truck size, weight and operations. The vehicle fleet is a very tangible indicator of trends in road transport and heavy vehicles tend to lead fleet changes, the impetus coming from changes in vehicle usage and the demand for more economic operation. It will be a very interesting time for research. Public sector support to heavy vehicle research has been going on in Australia for only a decade or so and has concentrated on size and weight issues related to the twin concerns of infrastructure damage and safety. Less has been done on environmental considerations and even less research on freight movements. This is hardly surprising when one considers that up until the 1950s most concern with heavy vehicles was over road haulage for general freight establishing itself as the legitimate and eventually dominant rival of the railway. Milestones in this regard were the deregulation of Australian road haulage in the 1950s and, as a slightly different example, the publication of the U.S. highway capacity manual in the 1950s making trucks accountable in the traffic stream. Trucks had become bona fide users of the road and scientific interest had to await this state of affairs.

As a result of current research we will see trucks which are quieter, more fuel efficient — with better engines, transmissions and aerodynamics — safer, with regard to more stability, better braked and less aggressive in impact and, less damaging to roads, with more axles and better suspensions (Fig. 22). As a result of industry developments they will also be more diverse and purpose-built and will involve multi-articulated and novel steering configurations. They will be better equipped with on-board scales, electronic tachographs and truck management computers. Most of all, they will be larger and heavier. Individual axle loads in Australia are currently low by world standards, and it is reasonable to foresee in conjunction with advances in pavement design and construction and better load enforcement, some

Fig. 22 — State-of-the-art multi-axle group
increases in axle loads. However, a plateau will be reached and further increases in gross weights will only occur through the addition of more axles not higher axle loads. These vehicles will need to be longer and hence multi-articulated. The forerunner of these vehicles is the so-called 'B-train' (Fig. 23) currently being introduced in some areas to fill the gap between semi-trailers and road trains.

Width and height limits will need to be constrained and significant increases are not envisaged. One important area affecting future trucks and truck operations is electronics. Current human resource problems in enforcement of load limits and constraints on vehicle configurations will be overcome by electronic means of weighing and identifying vehicles. This will not only reduce overloading, but will open the way for more diversity in trucks and truck operations. It may then be possible to regulate trucks by 'invisible' criteria such as turning circle, dynamic stability, and bridge loading formula rather than the more obvious characteristics enforceable by an inspector in the field at the moment. This will require considerable research into truck performance in order that appropriate methods are available to determine whether a vehicle with a given set of physical characteristics meets the performance criteria laid down. This research will need to be in the area of dynamic stability, braking, driver reaction and off tracking of truck combinations.

Advances in electronics will also allow more diversity in route selection for the larger combination vehicle. Provided that automatic means of enforcing selected routes near major population centres are available we may see multi-articulated vehicles on major line haul routes.

However, we should not over-emphasise line haul vehicles. Greatest economic benefits could lie in the urban road freight distribution area. We have come a long way towards optimising line haul vehicles and they are relatively well suited to the roads on which they operate. In the urban situation, economic benefits will depend on a better road network allowing more deliveries per day. With automated commodity handling at freight depots, we will see a move towards aircraft type containers and hence a move away from van type vehicles back to the flatbed types. Size and weight trends of these delivery vehicles will depend on a number of factors, but some increases appear likely on the basis of improved traffic flow and hence daily delivery task and a move towards dedicated on-board equipment for loading and unloading.

Having looked at heavy vehicle fleet changes we must also note that a trend to containerise and modularise loads on road freight vehicles will extend to the railways. With updated materials handling procedures the railways will also benefit from the advantages of lower costs related to loading time. This will tend to further shift the focus from long haul road freight operations to the urban freight task.

The truck itself, currently a set of propriety frame rails serviced by a myriad of second manufacturers, will become an integrated structure to reduce tare weight. Design standards for braking, stability, ride comfort and road protection will need to be met with better braking systems and suspensions. The role of research is to make sure that suitable performance criteria are established and that requirements are coordinated. Current difficulties with some areas of tyre performance need to be overcome with a new generation of tyres, for improved stability, braking and road stressing characteristics. However, all these vehicle improvements will require developmental costs of such an order that industry rationalisation is likely in terms of fewer manufacturers. At the same time, international harmonisation of axle loads and design rules will be needed in order to pave the way for the truck of the future.

With predicted changes in heavy vehicles there is sure to be some social backlash against speeding juggernauts, particularly as cars continue to become lighter. These problems will be partly offset by hardware improvements in truck safety and intrusiveness, as have already been mentioned. However, major changes in understanding of truck behaviour will be needed to implement measures to assist truck drivers and to better train them. While this research can be carried out in the field to some extent, a truck driving simulator would pay off in terms of developing electronic driver aids, the only solution when the driver has only a tenuous mechanical link to the greater part of the mass he is required to control. This is becoming increasingly important with larger combination vehicles. Safety is, and will remain, a major issue.

Problems of a different kind will need to be faced with respect to the road network. The road pavement damaging effects of higher axle loads, different axle groups and tyre types need to be better assessed. A good start on this research has been made already, especially the accelerated loading facility. This research will be needed to service periodical reviews of mass and dimensional limits as well as to provide the basis for road cost recovery from heavy vehicle users. This could become much more realistic with the use of electronic tachographs to automatically register load and distance travelled.
It is perhaps worth noting in closing that the fourth power law relating pavement damage to axle load has been in use for 20 years now and has seen much use and misuse. Despite its shortcomings it is a fine example of something we shall see a lot more of in future research involving heavy vehicles. It is what the French call the technico-economic approach, and has two key elements: a language which scientists and policy makers have in common; and a series of technical considerations each relevant to economic concerns. The aim is therefore to bring together technical findings from various scientific disciplines under a systems approach, using a common language. This does not produce an optimisable model, which is unrealistic, but at least ensures that factors such as pavement effects, safety, operating costs and environmental effects are all taken into account when investigating changes in the Australian heavy vehicle fleet.

P.F. Sweatman, Ph.D., B.E.(Mech.), Chief Scientist, Australian Road Research Board

Peter Sweatman is a Chief Scientist at ARRB in the area of heavy vehicle impacts. He is particularly interested in the interface between vehicle and road and much of ARRB's research in this area is applied to truck regulations.

Peter attended the University of Melbourne.

Apart from research activities in trucks and road trains, he has served for ten years in the Australian Design Rule process. NAASRA truck size and weight investigations (ERVL/RORVL) have also been a constant theme in his work.

Peter is active in promoting industry involvement in research and international co-operation.
J.B. Metcalf,  
B.Sc., Ph.D., F.G.S., F.I.E.Aust., F.I.C.E.,  
Deputy Director,  
Australian Road Research Board

John Metcalf graduated from Leeds University with a B.Sc. in Civil Engineering, followed by a Ph.D. in Soil Mechanics in 1958. His interest in roads was reinforced when his first employer seconded him to work at TRRL on soil stabilisation, full-scale pavement performance trials and the properties of fillers in bituminous concrete. An interest in travel, which continues undiminished, led him to Queen's University, Kingston, Ontario, as a National Research Council of Canada Post Doctorate Research Fellow in close association with the Ontario Department of Highways. From Canada he joined CSIRO where early studies of the engineering properties of typical Australian soils took him to all parts of Australia and no doubt helped to build the interest and experience which led him to Queensland as Materials Engineer of the Main Roads Department in 1964.

John's research interest in quality control is balanced by a strong personal commitment to research education and training for developing countries. His activities have led to further involvement by ARRB and ARRB staff in research and training for development. He is actively involved in Road Engineering Association of Asia and Australasia activities as the Board's usual representative on the Council, and is Chairman of the Permanent International Association of Road Congresses Technical Committee for Roads in Developing Regions.
6. ROAD TECHNOLOGY ISSUES

J.B. Metcalf

The principal concern of the road technology area over the next 25 years will be maintenance and rehabilitation or reconstruction of the physical infrastructure of roads rather than the development of new routes and major new construction. Given the size of the network and the achievable rate of resealing and rehabilitation — some 2 per cent of the surfaced network per year — change must necessarily be slow. This is not a volatile area, but it is where State and Local Authorities spend your money.

It is likely that substantial new construction on rural arterials will slow down in the wake of the Bicentennial program — though the new length so built will require substantial provision for maintenance. We can perhaps see adequate capacity on major rural routes but, to achieve acceptable condition over the whole network, must achieve the maintenance targets. The urban arterial/freeway network may perhaps receive greater new construction and major reconstruction funding — perhaps especially for truck routes. Increased traffic will require minimum delay and disruption to reduce costs and maintain safety, requiring in turn both increased life and reliability of the existing infrastructure and, rapid effective maintenance procedures on low trafficked rural roads. Old sealed surfaces are difficult to maintain and improvements in vehicle suspension, dust sealing and air conditioning, reduce some of the pressure for dust free surfacing. There will continue to be major efforts in traffic management in residential streets relying on passive road furniture provision.

Thus the performance of roads, in the widest sense, will need to be linked to traffic, construction and maintenance costs in a systems approach to better define needs and priorities and to answer social and political questioning of the place of roads and road transport. Looking to the road technology issues this will call for a comprehensive and up-to-date inventory with road condition rating using valid and calibrated condition measures for pavements and for traffic control infrastructures. The data base must be capable of servicing econometric models of road needs, of developing priority listings, and of revealing interactions between condition, costs and, eventually, safety and social impact factors.

Initiation and maintenance of the data base calls urgently for the further development of highway speed (but speed independent) monitoring technology, for ride comfort and skid resistance to answer users primary interests and, for rutting, cracking and deflection to serve the engineers' needs (Fig. 26). A stable, user accepted, set of tolerable standards will be needed for pavements and possibly also for the traffic control infrastructure of signs, markings, signals, etc. to satisfy social, economic and, quite probably, legal needs for defensible limits to what can be built, operated and maintained.
Smaller cars will call for ride comfort and quietness, larger trucks will call for stronger pavements, the mix of large and small vehicles will call for uniformly high levels of skid resistance and the larger numbers of vehicles will call for less, and quicker, maintenance.

The systems approach will allow assessment of the provision of stronger, longer lived, pavements at a higher first cost against more frequent maintenance/rehabilitation or stage construction options.

However, as the greater part of the network is in place now there must be a pressing need to improve maintenance methods and materials. Methods must be quick and safe, capable of application with limited construction access. Materials must be tolerant of difficult working conditions and independent of climatic effects.

Equipment will become more automated, with wider use of electronic controls. An area deserving more attention is the linking of rapid non-destructive 'on-the-run' testing procedures giving better process control and quicker specification acceptance.

Plant will become both larger and smaller; for high output, full width 'one pass' construction and better uniformity and, for easier portability and use in confined 'one-lane' width sections under urban traffic for instance (Figs 27-28). One pass recycling or resurfacing will also become more common at both scales. An important need will be for more effective temporary traffic control signing and marker materials.

Material resources will be constrained, and thus there is an urgent need to define material 'durability' and to redefine other material properties in rational terms linked to new pavement design procedures and to performance. This will provide for rational definition of marginal materials and allow more confident adoption of new, stabilised, treated and, recycled materials or combinations. Changes in bitumen sources and availability of additives modifiers will also require investigation to maintain quality and performance of sealed roads — 90 per cent of the surfaced network.

Mechanistic pavement design will allow for material and construction variability. The effects of real dynamic traffic load spectra will be incorporated replacing reliance on methods correlated to static weight and power law equivalency approximations. Material characteristics and design development will allow for new materials and new configurations such as the 'upside down' pavement and more rational treatment of flexible or rigid overlay practice.
These needs are encompassed by the current pavement research program centred on the accelerated loading facility (ALF) (Fig. 29). ALF allows for accelerated and higher load testing and is supported by theoretical modelling, laboratory materials characterisation and long term full scale pavement monitoring, using the systems data bank. There could be a case for an 'ALF II' to allow alternative suspension and wheel configurations to be tested at higher speeds.

Environmental factors will also demand more study. As construction technology, especially potential geotextile applications, becomes more sophisticated, more knowledge will be needed on soil moisture/water movements in relation to the provision of drainage and the prevention of soil movement.

The traffic management infrastructure, signs, signals and markings will also need to be built and maintained to higher and more uniform standards. The user and the law is likely to be less tolerant of malfunction. For urban areas provision of active and interactive management control, possibly including route finding and road pricing developments will substantially increase the electronic content of construction and maintenance activities.

Thus we can perhaps foresee the following broad technology research needs to support foreseeable changes:

- a pavement management system model with:
  * a pavement and materials performance data bank,
  * robust cost/condition models.

- condition monitoring technology:
  * high speed, speed independent,
  * and user tolerable limits.

- mechanistic design and materials characterisation:
  * dynamic load spectra,
  * robust performance linked materials parameters.

- better understanding of bitumen (and polymer) chemicals:
  * evaluation of changes in sources,
  * use of new materials and new combinations of materials.

- methods and materials for maintenance:
  * high speed climate independent repair under traffic,
  * for pavements and traffic management devices.

- automation of construction plant:
  * higher output, more uniformity with one pass recycling,
  * automated non-destructive construction control testing.
7. DISCUSSION

M. Muspratt, Chisholm Institute of Technology

The problem as I see it is that Australia's economy is declining considerably, and that this will effect Australian industry and its ability to complete effectively. This will affect the amount of money available for road construction and the development of high technology. Unfortunately, the appropriate action to be taken is very strongly nationalistic and this diverts the attention of the general population away from the economic situation. New Zealand is probably in an even worse situation.

In other words, the main background issue affecting all that was said today is, in my opinion, the demise of the competitiveness of Australian industry? Would the panel care to comment?

M. Wigan, Australian Road Research Board

It is difficult to answer that question. However, I would point out that, in New Zealand there has actually been an overall increase in real wealth per head, though slow, over the last 20 or 30 years, and these trends can be reasonably expected to continue. The world is becoming more efficient, a more integrated economy. It is no longer so important which part of the world you're in, although there are always fluctuations. I agree that we are on the edge of a new round of investment in Australia, certainly in manufacturing technology — if not we certainly are in trouble. Historically some countries develop faster than others, but generally they appear likely to all end up in the same sort of regime in the long run.

D. Berry, Road Construction Authority, Victoria

We look back and we look forward, but the one thing we really got wrong in the 1960s was the population estimates. That has led to problems in projecting requirements of power generation, education, roads, transport, hospitals, etc. and that seems to be the great challenge in planning forward. I don't know how we solve this problem, but I suspect that we'll have to look at things in a much more incremental way, and build things to serve much shorter-term needs.

My other comment relates to economic activity, which was mentioned by each member of the panel. It was mentioned that we'd be looking at trucks to make more movements than today, but will we be looking at the same measures of effectiveness we looked at through the 1960s and 1970s and are still using? Will we be looking at the need to get travel times consistent, because industry will be looking to get inventory costs down, and that's what trade movements are going to be about. I wonder whether we'll have to think more in relation of the need for our urban roads to operate consistently in terms of maintenance, incident management, traffic management and design.

M.G. Lay, Australian Road Research Board

As David Berry mentioned, we got our concepts of future population totally wrong; we said that everything would grow by 10 per cent. What is the 'article of faith' that we use today that people in 25 years time will say was totally wrong?

P.F. Sweatman, Australian Road Research Board

Regarding David Berry's point about consistency, the other side of it is the need for more flexibility in freight operations, so that trucks don't have to arrive at the depot by a certain time. That would have a big effect as well, but certainly the time taken to get around the urban roadwork is a problem at the moment.

A.T. Fry, Road Traffic Authority, Victoria

The question of cost recovery and road pricing was mentioned and I'd like to believe that we'll progressively move to the achievement of a 'user pays principle' in our road transport operations. I recognise the political difficulties associated with this philosophy as we've recently evidenced in Victoria through the proposal to remove the toll on the West Gate Bridge. However, I rather wonder whether this is because of the inequity involved and I think the challenge is open to us as researchers to come up with an equitable system of road pricing policies. At the present time we have through the SCRAM signal system an extensive network of detectors which will continually grow over the next few years. We already have the technology available for vehicle detection which is capable of tracking movements throughout the road network. This information could be stored and processed through the computer system and, instead of road users receiving a bill for motor registration, they could be billed for road usage. I believe there is a need for work on the development of an appropriate system as a more equitable means of raising the funds that will be necessary for road transport expenditure.
M.R. Wigan, Australian Road Research Board

I think it is very important to note that with urban freight delivery there are a huge numbers of deliveries and a large numbers of vehicles. They aren't very big deliveries, but there is increasing pressure to provide more vehicles to meet tighter time constraints, especially for foods and perishable goods, which in fact includes clothes. Because the pressures are high, access to freight depots and in time reliability is cash. I think that a greater appreciation of this is needed in planning: we've known it for ten years or more, but understanding it may take another five, before we can do much about it. The same applies to road pricing. I did a major study of it in Britain 12 years ago, and basically the same technology is being used in Hong Kong now. It is not what technology can do for us, it is how prepared we are to use it, and what barriers we choose to set on our experiments generally. What Tony Fry has done is underpin what I said: "that the capital is now in place", even though the decision to use it in a particular way is a marginal one. Pricing is a very hard decision to make; it could take a year, and it could take 50. I think it will come.

J. Crowe, Deputy Commissioner, Department of Main Roads, New South Wales

One point raised was the opportunity to adjust demand through pricing. That has not yet been tackled in any real way and the question I was going to ask is "Where do we really see that first appearing?" I think we ought to be trying to look at what area will be attacked first.

D. Lovatt, Road Research Unit, New Zealand

I think one area where we have an opportunity for adjusting price for usage, and which is related to the road user and urban traffic, is parking. We have not heard any mention of parking, either the assemblage of vehicles or getting the parked vehicle off the road in order to make even better use of the available road space. I see a considerable future in manipulating parking by extending the user pays system. It is possible to vary the charging rate by day, time of arrival, length of stay, and time of departure. After that maybe we can extend further, out of parking, and actually on to the road users of vehicles using similar principles which by then would be more acceptable.

M.G. Lay, Australian Road Research Board

Recently I reviewed a fairly radical report from South Australia about how they might stop the motor car in Adelaide. The strange thing was that there was no mention of parking pricing, and that would seem to me the simplest method. The Director General replied that parking control would be politically unacceptable.

D.P. Bowyer, Australian Road Research Board

I'd like to pick up Max Lay's last point, and come back to what Tony Fry suggested about the possible increased emphasis on equity - a more equitable system in the future. It seems to me that equity has been an objective which all governments include in a list of nice things, but the cold reality is that if you pursue equity you are going to cause a shift in opportunities for certain groups and particularly groups of strong influence. If governments are going to pursue more equitable systems in the future then we are going to see a highly volatile process of change in the freight area that Marc Wigan and Peter Sweatman were talking about. If governments introduce controls on freight vehicles, such that we get more reasonable use of the road space or pricing of the road space, then there's going to be a backlash and politicians are sensitive to that. My suggestion is that governments will espouse equity as a desirable objective in the future, but it will lead to a much more volatile climate of change. Maybe researchers are going to have a big job trying to track where its going to change to next.

D.R. Axup, Victoria Police

There was some mention regarding litigation and the fact that we are becoming a more litigious society. The general feeling amongst the Police is that engineering is always ahead of changes in regulations; for example, the work carried out at Monash University on frangible poles. How do researchers see this increase in litigation affecting them, particularly in the management field, where we tended in the past to look at physical constraints with respect to traffic management? Bearing in mind that regulation tends to lag behind research, will more research be required into driver behaviour in management areas, and what changes might occur over the next 25 years? We are seeing a drastic change in our methods of operation. For example, when we attended a motor car collision, it principally involved an argument between people who had broken a certain regulation. Now there is a tendency away from the criminal field towards the civil field. We are being asked to give opinions on the suitability of road furniture, for example, and sometimes we lack sufficient training to give such opinions.

M.G. Lay, Australian Road Research Board

Local street management measures is one of the areas were regulations on law and engineering seem to be incompatible at the moment.

D.F. Glynn, Formerly Executive Director, Australian Road Research Board

Since the oil crisis in 1973, there have been a sharp change in the ratios between the prices of labour, energy and capital. Do we know enough about what those ratios mean to forecast some of the things that Marc Wigan and John Metcalf were talking about?

B. Jenney, Chisholm Institute of Technology

One of the central variables which did not come out to me strongly enough was the move towards integrated systems, and I consider this to be of prime importance. Over the last 25 years we have seen a revolution in a significant part of the sea transport industry with the advent of containerisation. This also has influenced the move towards integration in transfer of the standard sized containers between road, rail and sea.

Another aspect which proves 25 years is quite a long time is with respect to how forecasts can go
wrong. You might find it mildly amusing to recall the famous Beeching Report concerning the rail system of the U.K. where they carried on the wartime strategem into peacetime by appointing a 'captain of (private) industry' to overlord a public utility. Two of the assumptions in compiling the Report were that intercity travel was a non-starter because of the advent of the short lift and take off aircraft, and that there was no justification for any railways north of Edinburgh except, possibly, a single line system to Perth. The development of high-speed trains going from heart-of-the-city to heart-of-the-city may well have been on the drawing board even at that time, although the discovery of North Sea oil was truly an unforeseen joker in the pack.

Reverting to integration, particularly in the Melbourne area, I suspect history will accord the first Cain Government a guernsey for the integrated passenger system and I hope that more freight can be handled on the feeder configuration.

**J. Crowe, Deputy Commissioner, Department of Main Roads, New South Wales**

Perhaps the panel's assumptions with respect to freight movement are not as valid as they would like to think if we talk in terms of complementary, rather than competing, freight modes. Even though I'm from a State Road Authority I do wonder at the high percentage of freight that moves Sydney to Melbourne on the Hume Highway, which is paralleled by an underutilised railway line. Some discussion on the robustness of the prediction in the freight area might be useful.

**M.G. Lay, Australian Road Research Board**

With public transport we believed that fixed rail and fixed track public transport and roads are complimentary systems, and we didn't think that was a matter of debate. Freight is a different issue, so our presentations assumed that there was a place for fixed public transport modes.
8. SUMMARY

M.R. Wigan, Australian Road Research Board

I think that there are a few points to be made. Probably the first place where we could see any road pricing technology used would be in parking facilities; and a lot of money is spent on parking, much less on the relevant research.

The second point I would make is regarding freight systems. People often ignore the fact that the interchange costs are extremely high and, for much of inter-city transport or rail, we find that most of the costs are incurred in the changeover to rail or the final legs of the trip (by road).

The last point I would like to make is that the 1960s U.K. inter-city working party in which I was involved with was absolutely dead right with respect to high speed trains taking a very large share of the market; forecasting can work when on a sound footing. The reason here was because there was an integrated approach with a model of the market run against a model of the technology and sources to be provided — very unusual for a travel projection then. I think I would like to point out that unless you have both the demand and market determinants and the technological capabilities both represented in a projection of a system into the future, you cannot expect to get it right.

J.R. McLean, Australian Road Research Board

I'd just like to pick up three points very quickly. With regard to Murray Muspratt's point on Australia's economic position, I think GNP per capita is a poor indicator of overall well being. For example, I work in America, I get paid a large salary but I don't get vacation until I've worked in a job for three years. Then I get one week's leave. My house needs painting, so I pay someone to paint it, and I've contributed to the GNP. In Australia, I get paid a lower salary, but I get lots of recreation leave. I take a week off and paint my own house and I've contributed nothing to GNP.

Regarding Dave Berry's point about where we went wrong in the 1960s with growth predictions. I think one of the problems was that planners and engineers only talked to planners and engineers. We wanted to believe we were going to get a 10 per cent increase in the population per annum because it suited us to believe it: we could build more dams and more power stations. I think this is where the need for greater transparency and accountability has come from; there are people other than planners and engineers who want to have a look at what is being done these days, and possibly its a good thing.

On the role of the law, I believe that the increase in litigation reflects changing social attitudes. We now expect to be able to socialise our losses, and civil law is one way of doing it. The normal defence for the public agencies has been 'what is good practice', but our mechanisms for determining good practice are something which evolve slowly through professional consensus. It appears that the courts are moving faster than the profession, and I really don't know what the answer is to that one.

P.F. Sweatman, Australian Road Research Board

I note that I was not challenged with respect to my predictions about the long-term increase in the size and weight of trucks. With respect to integration of road and rail, I think that it is a highly desirable move, but I feel that if we see an increase in the size and weight of trucks over the next five to ten years, then that's certainly going to take a lot away from rail; it's going to take a lot to get it back on the road.

J.B. Metcalf, Australian Road Research Board

We have talked at length about some of the rapidly changing vehicular/traffic issues, but we have 860,000 km of road now and one thing we do know is that people don't want less. The public is prepared to spend money on roads and if anything they will want better standards. Unless we can get enough effort into the system that exists, it will deteriorate. If current funding declines further, we will spend all our money on keeping the present network intact. We will not have money to provide new infrastructure, even though there will be fluctuation and change in vehicle fleets, social demands etc. A final point is that we have to be careful with employment in road construction, because public works are often used on a regional economic level. If you put in advanced and sophisticated maintenance methods and reduce rural employment, there could well be problems.

M.G. Lay, Australian Road Research Board

The negative thing, I think, is a point Dave Berry raised — about being wary about putting too much faith into predictions. Let's keep whatever we do flexible and our options open. I think that one of the lessons of the last 25 years is to have alternative strategies prepared for us. Planning predictions in England since the war have found that by and large you would have been better to assume that nothing had changed, rather than to have believed anything the planners predicted. As Marc Wigan pointed out, much of the future is visible now if only we are prepared to look at it. Let's look at it with open eyes and see it there; let's be aware of what's going on and let's see it all as part of a wider community than we saw it 25 years ago; let's see it with more of the communities' eyes.
APPENDIX A — RESEARCH PERSPECTIVE

Version 6

The 1977 Version 5 of the ARRB Charter (Lay 1977) set out the formal roles of ARRB and discussed research needs and directions under the broad headings of the community, construction and the operating road. This revision, prepared by the ARRB Steering Committee reviews the context within which roads and road transport may develop and, after reviewing the national background and the road system, takes a broad scale approach to the role of ARRB — a future scenario.

Readers seeking other views on the future for road research should consult 'Towards 2010 — an ambit for road research' (Metcalf 1985). Details of the research program are also given each year in the Three Year Research Development and Information Strategy published in the Australian Road Research December issues.

This future scenario is not a statement of Board policy nor of research plans but is intended to provide discussion and canvass opinion on the role of ARRB in the national research environment and the broad direction of future research.

Your comment is invited.

J.B. Metcalf

ROADS AND ROAD-BASED TRANSPORT — A FUTURE SCENARIO

The Australian Road Research Board's Steering Committee offers for discussion and debate the following scenario on road and road-based transport. It summarises a position proposed in early 1985 and is seen as the starting point for continuing assessment. In publishing this statement we strongly request continuing reader responses to ensure our assessment remains representative over time.

The views expressed are published by kind permission of the Directors of ARRB but are those of the Committee and do not necessarily represent those of the Board.

National Background

This document provides a long term — three to ten year — perspective for the continued development of roads and road research in Australia. It assumes that there will be no major changes in Australian society in the next decade. The changes that will occur can be put into three categories:

- demographic
- financial
- technological

which will result in social, economic and environmental consequences.

In a demographic sense, the total population will increase only slowly, though in some areas rapid growth may occur by population shifts. The population will have aged and the nuclear family unit will play a diminishing role. Unemployment will continue at about current levels. More multiple-worker and part-time jobs will arise. There will be changes in attitudes to work. Career and job changes will be more frequent and job retraining more common. Increased discretionary incomes amongst those at work, social security support for the unemployed, infirm and elderly and changing social attitudes will provide many people with more opportunity to choose a variety of lifestyles.

A relative increase in service industry employment will reduce locational constraints on an increasing number of jobs. Other jobs will also decentralise, due in only a minor part to the new information technology (see below).

Recreational and elective travel will increase and become the peak capacity criteria for some routes. This will be highlighted by the presence of more retired people with vehicle access and the desire to drive. However, work and industry travel demands will also continue to increase, particularly for freight transport, resulting in spreading congestion.

Hence, we can expect to see changes in work and peak travel demands, both in space and in time-of-day and day-of-week.

Changing community needs and increasing responsiveness in Road Authority attitudes will see a growth in community awareness of and support for adequate roads.

In a financial sense, there will be increasing alternative demands for public funds, particularly for social services. Governments will, indeed, be increasingly concerned with the deficit funding of their social programs. This will cause continued pressure on Road Authorities to manage their available resources in a constrained situation. Furthermore, increasing percentages of funds will be required for maintenance and operations on an ageing road network and thus less funds will be available for construction to improve and expand the system.

Increases in the cost of road travel are not likely to differ markedly from those of other goods and services, except where urban congestion and/or taxation policy has a specific effect.

The new information technology will not have a significant effect on journey-to-work travel, although there is a minority view that the opposite will be the case. New products and services will be developed and applied at an increasing rate. This will particularly apply to the introduction of micro-electronics and information technology into the control and operation of vehicles.

There has been some community disenchantment with technological innovation and development and yet still a dependence upon advances to maintain living standards. Any research increasingly must include consideration of the community reaction to its application.

In order to make decisions about the future we will need to place increasing emphasis on the creation and use of data bases of relevant information and on the development of analytical skills, particularly in economics, to permit deductions to be made from the data collected.
Road System

The key characteristics of road-based transport are that it provides a service which is:

- door-to-door
- individual and personalised
- adaptable to new needs and technologies
- financed in significant part from public funds
- used for various non-road public and private purposes.

There appears to be no foreseeable alternative to the road system, except in segments involving the mass haulage of people or commodities. It will continue to play a major and irreplaceable role in the social and economic affairs of Australia. Usage is expected to grow at about the same rate as the national economy. However, truck operations outside of or between urban areas are expected to grow more quickly.

The vehicles which use the road system are in private hands. Trucks will increase in size and number. More efficient urban delivery vehicles will be developed. The 'average size' of private vehicles will decrease and they will be better fitted to their purpose. Ownership levels per head of population will continue to rise. Recreational vehicles will increase in number.

Permanent or temporary separate facilities for trucks, emergency vehicles, pedestrians and cyclists will require continued attention.

Australian cities did not pass through a stage of extensive freeway construction and so they rely heavily on the arterial and sub-arterial system to provide an operating network. This will place a considerable emphasis on the need for high performance traffic operations facilities in saturated flow conditions. There is a likelihood of increasing community recognition that blanket freeway restraint policies of the 1970s have not led to workable urban solutions. Demands for better urban and suburban travel facilities will continue.

To adjust to changing community needs and perspectives we will see some changing structures in associated road organisations, reflecting the need for a consistent treatment of traffic, transport, safety and accessibility issues.

A rising new group of issues requiring attention relates to public accountability, legislative provisions and developing legal practices. The effects of these changes are evident in many areas of road and road transport, for example in contractual provisions, environmental compensation and legal accountability in regard to the road infrastructure.

The Australian road system differs from that in the rest of the world in that our long distances and relatively sparse population mean that we must always place due emphasis on low capital cost, low user volume, low maintenance systems in both our planning and our research. One corollary will be a continuing need to use materials currently considered to be sub-standard. Pavement technology will also need to be improved to manage the increased truck traffic predicted above. Measures to improve the level of service of rural roads are also needed.

Techniques will need to be developed to better define the requirements placed on motorists — e.g. a better indication of speed limits and devices for speed control — and to control the use made of residential precincts by motorists. These will be physical, educational and planning-oriented.

There will be an increased need to monitor travel and commodity movements, the use made of the road network and the operational condition of that network. Tools for traffic generation prediction need further improvement.

The Role of ARRB

This future scenario may well affect ARRB, particularly as the responsibilities of its Members change, and could require review of ARRB's Charter. For instance, a need will exist to recognise the interests of road transport, safety and traffic authorities not directly linked to ARRB. This could need a broadening of ARRB's field of interest. A greater role in undertaking research and providing information to assist member authorities in formulating policy could be desirable, but the primary task must be scientific and technological research, especially when funding is limited. ARRB could perhaps move to a combination of basic funding and specific accountable project funding. Any changes should preserve ARRB's independence, seen as one of its greatest assets.

The search for a proper balance between inhouse and external research and between longer-term fundamental work to develop expertise and support shorter-term studies must continue.

The scenario suggests a need for continuing road transport research at a viable level but not at the expense of research on road technology and road traffic safety, which should remain at least at current levels.

Specific research areas not implied above and arising from the review are:

(a) the need to maintain and enhance community support for an efficient road system by continued research into the quantification of benefits and alleviation of the disbenefits of the road system;

(b) a need to study new policies and procedures — e.g. related to road pricing and parking — which can be used to manage travel demand and thus more efficiently use the available supply of road space;

(c) the need to maintain a research interest in the link between travel demand and information/telecommunications technology;

(d) a similar need with respect to vehicle and traffic control and information/telecommunications/microelectronics technology; and

(e) The adaptive and individualised nature of the road system and its economic and social implications strongly implies a need for continuing associated research.

More emphasis will need to be placed on continuing education and training. There will be increased research emphasis on communications of all forms, as they affect both knowledge transfer and the demand for roads. The interdisciplinary nature of road expertise will increase.
The members of the ARRB Steering Committee at 1 June 1985 are:

**Chairman:** Professor B.L. Cole,
Department of Optometry,
Melbourne University

**Deputy Chairman:** Mr J.G. Crowe, Deputy Commissioner,
Chairman: Department of Main Roads, N.S.W.

Dr D.A. Hensher,
Associate Professor, Economics,
Macquarie University

Professor O.G. Ingles,
Foreshore Road, Swan Point, Tasmania,
Mr D.G. Morton, Deputy Commissioner,
Main Roads Department, Qld

Dr D. Scrafton,
Director-General of Transport,
Department of Transport, S.A.

Mr R.T. Underwood, Chief General Manager — Planning and Design,
Road Construction Authority

Mr N.A. Waslin,
First Assistant Secretary (Roads Division),
Department of Transport, A.C.T.

Mr A.T. Fry, General Manager,
Road Traffic Authority, Vic.

Mr B.S. Heaton, Dept of Civil Engineering,
Newcastle University

Mr I. McCallum, Product Manager,
ACI Computer Services, Vic.

Mr M.F. Cullinan, Group Manager — Information & Networks,
Road Construction Authority

Mr A. Machlin, City Engineer,
Perth City Council

Mr D.R. Lovatt,
Senior Planning and Research Engineer,
National Roads Board,
Wellington North, N.Z.