LARGER HEAVY VEHICLES - BALANCING THE COSTS AND BENEFITS

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ABSTRACT: *In light of changes in the technology of and limitations on heavy road vehicles, such as B-Doubles and Road Trains, and the economic attractiveness of these larger vehicles, their potential role in the movement of goods is increasing. In examining the possible community benefits of these vehicles, many economic, social and environmental factors need to be considered by the road transport industry and other interested parties, as well as those Government instrumentalities charged with assessing and balancing the various interests.*

The roles of larger heavy vehicles in different areas of freight operation are briefly reviewed. Three areas are identified in which unique, complementary and competitive freight task roles are discussed for these road vehicles and rail. It is suggested that some recent developments highlight how the two modes can work in a complementary way to a much greater extent than in the past, for the benefit of all concerned. However, the further development of this complementary role may well require a change in traditional attitudes of both road and rail transport operators, with a realistic appraisal of the limitations of both modes. In exploring the potential for increased use of larger road vehicles, a need is identified to ensure that traffic flow and safety are not compromised.

Recent examination of these issues in New South Wales is discussed with conclusions drawn on the implications for road transport operators and the traffic, road and rail authorities.

LARGER HEAVY VEHICLES

INTRODUCTION

Transport costs have a significant impact on the cost of many Australian products, both for domestic use and for export, and this provides the motivation for Government to seek improvements in the efficiency of transport services. Manufacturers and producers are similarly motivated, for the purpose of containing transport operating costs. Against a background of the traditional road/rail transport system, attention is focussing on those sectors in which economic gains may be improved.

In road transport, the use of various heavy vehicle combinations larger than regulation freight vehicles has long been recognised as economically attractive for long-haul transport of many types of goods. "Road Trains" have been operating in Australia for many years, their operation being generally confined to sparsely populated and lightly trafficked areas.

As concern for transport efficiency increases, there have been increasing calls from industry for an extension, towards the more developed regions, of the areas in which such large vehicles are permitted to operate. Recent years have also seen the development of new medium-length vehicle configurations, such as "B-Doubles", and there is mounting pressure for their widespread use within both developed and rural areas.

While such proposals promise some economic advantages, there are also potential additional costs - in terms of effects upon roads, traffic, the environment, the community, and rail freight transport. In NSW these concerns are being addressed with a view to identifying the net benefits that might be realised and to whom they might accrue. Under the auspices of the Traffic Authority, the current use of these larger vehicles is being examined and their possible future operations are being considered.

It is the purpose of this paper to set out the issues being considered in assessing the costs and benefits of larger vehicle operation and, in the light of recent developments, to point to important implications for both Government, industry and the wider community.

BACKGROUND

In recent years, two major studies have addressed the broad issue of freight transport in Australia. It is instructive here to refer to the relevant findings and recommendations of those studies which set the foundation on which further operation of larger heavy vehicles is being considered by the States and Territories.

The National Road Freight Industry Inquiry (May, 1984) recommended, among many other matters, the relaxation of truck mass and dimension limits and the establishment of a revised method for the recovery of road costs.

The Review of Road Vehicle Limits (RORVL) was undertaken by the National Association of Australian State Road Authorities (NAASRA, 1985a) to:

"review the mass and dimension limits and associated regulations applying to vehicles using Australian roads with the objective of enabling the Road Transport Industry to improve its economic viability".

Several options were considered for increasing vehicle limits; in particular gross vehicle mass, from the existing 38 tonne limit to recommendations ranging from 41 to 44 tonne, with associated increases in axle load limits.

RORVL and Beyond

In the ERVLS study (NAASRA 1976) which preceded RORVL, a freight role had been clearly identified for "medium combination" vehicles (MCV's) of greater length (and mass) than regulation vehicles. Industry desire for one such type of vehicle, the "B-Double", was acknowledged, and treated in some detail, in the RORVL study.

The study concluded that B-Doubles up to 23m in length should be allowed to operate under permit on selected routes from terminal to terminal, and in accordance with guidelines set out in Technical Supplement Volume 7 to the main report (NAASRA 1985b), which cover route selection criteria, mechanical requirements and other operating conditions. B-Doubles were preferred to other MCV's because of greater mobility, better tracking, less pavement damage and greater suitability to line haul operations.

The possible introduction of B-Doubles adds a significant dimension to the consideration of future directions for freight transport in Australia. From the industry point of view these vehicles have substantial benefits as indicated by reductions in the cost per tonne of payload carried. From the road construction and maintenance point of view there may be little, if any, increase in costs associated with these vehicles provided there is no increase in axle loadings or any substantial increase in the road freight task carried by the vehicles. Much of the work required to assess these aspects has already been completed through the RORVL studies, but it was stressed in the RORVL Report that further work was necessary to monitor and develop the guidelines for B-Doubles operation, particularly with regard to urban areas.

Subsequent to both the RORVL study and the Inquiry, the Federal Minister for Transport directed the Interstate Commission to establish cost recovery procedures for interstate road freight transport.

While the road freight industry was keen to have the higher axle loadings introduced, Governments had to assess the likely costs of this development on the community.

In late 1986 a meeting of the State and Federal Ministers for Transport at the Australian Transport Advisory Council decided that uniform introduction of the greater vehicle mass limits recommended by RORVL was not possible. NSW and Victoria decided to retain a maximum gross vehicle mass (GVM) of 38 tonne but indicated that they would be prepared to review these limits in the light of further analysis and consultation, with the road freight industry, on the matter of cost recovery.

Development of these matters is indeed necessary if the potential benefits from larger heavy vehicles such as B-Doubles are to be clearly identified and fully realised.

Community, Industry and Government Interests

The benefits of such vehicles becomes less clear, and the question of costs to the community arises, when additional factors are considered. The issue of road safety in relation to heavy vehicles is a matter of concern not only to Governments and the community generally, but also to the road transport industry. The NSW Parliamentary Standing Committee on Road Safety is presently investigating heavy vehicle safety.

The question of cost recovery from the vehicles is clearly of concern, not only in terms of funding road maintenance, but also in considering whether the road authorities could be faced with significant expenditure increases if the vehicles were permitted on roads which would require upgrading in the short term.

In regard to the potential impact of these vehicles on other traffic, there are many questions concerning level of service, bunching and overtaking, intersection negotiation and clearance, and traffic management measures, which need to be addressed by road and traffic authorities.

While the improved efficiency would benefit the road transport industry as a whole, there appears to have been little analysis, addressing the possible rationalisation within the industry that might occur with the introduction and widespread use of B-Double vehicles. The difficulties that many owner drivers have faced over recent years in obtaining freight rates sufficient to cover operating and maintenance costs, as well as an adequate income, are well known. The larger road freight companies could well be the main long term beneficiaries of the introduction of larger heavy vehicles.

Yet a further factor for consideration is the use of Road Trains. While some sections of the road transport industry wish to see road trains used in areas with significant traffic volumes and unsuitable terrain characteristics, there is indeed an argument for the use of more efficient road transport vehicles, especially where there is an inadequate, or non existent, rail service.

Finally, consideration must be given to the impact of larger heavy vehicles on the operations and finances of the rail networks,

especially so since considerable public investment has been made in upgrading rail infrastructure in recent years.

To expect that governments would countenance a significant loss of revenue while paying for direct and indirect community costs, in addition to there being some uncertainty as to whether reduced freight rates would in fact be passed onto consumers, would indicate a lack of appreciation of a need to balance the various interests involved. It is a role of Government to determine where the balance can be achieved.

LARGER HEAVY VEHICLE OPERATIONS

Larger heavy vehicles of different types and configurations have been operating in various freight roles, both in Australia and overseas, in some instances for many years. Assessment from the literature of how well they have been integrated with other regular traffic, especially in terms of safety effects, is often confounded by confusion as to the actual types of vehicles being discussed. It is appropriate therefore to clearly define the types of vehicle being considered in Australia, in comparison with those used elsewhere.

Vehicle Configurations

A complete categorisation of heavy vehicle combinations using Australian roads is given in the RORVL Report and its Technical Supplement (NAASRA 1985a, 1985b). In the context of the present paper, it is necessary to draw a clear distinction between regular articulated vehicles, B-Doubles and Road Trains. The general configurations of these are shown in Figure 1. (Numbers of axles in the various axle groups may of course vary; other combinations involving rigid trucks hauling trailers, within the regular overall length of 17m, are also common.)

The terminology "B-Double" owes its origins to experience with such double-articulated vehicles in Canada where they are known as B-Trains. The use of this term in Australia has often served to confuse the distinction between such vehicles and Road Trains.

An important difference is that the B-Double combination incorporates two turntable couplings; it is an articulated vehicle hauling a semi-trailer, whereas in the Road Train case the articulated vehicle tows a trailer (or more) via a drawbar. Road Trains are also much longer than B-Doubles.

Road Trains incorporating a semi-trailer and trailer(s) as shown in Fig. 1 may also be referred to as "double bottoms" and "triple bottoms" - or more simply "doubles (or "twins") and "triples". The latter terminology is the general practice in North America, where further differentiation identifies "Western Doubles" (length about 20m) and a longer version known as the Rocky Mountain Double.

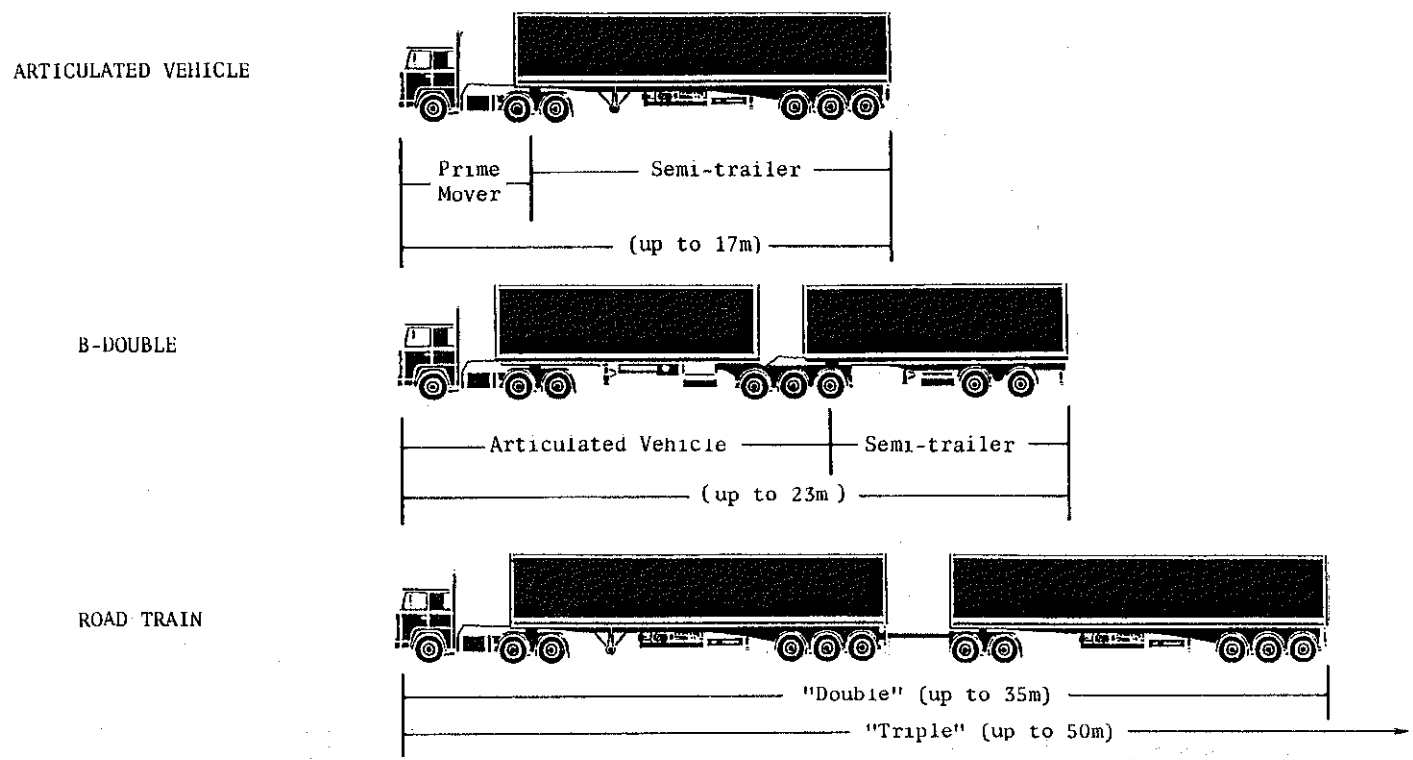

Figure 1 - Configurations of heavy vehicles.

Overseas Experience

Large heavy vehicle combinations, in various configurations of "double trailers" and "truck-trailers" have been operating in North America, and in some parts of Europe, for many years. B-Doubles, in particular, have long been in use in Canada, particularly in the Western Provinces (NAASRA 1985b).

The economic advantages of larger combination vehicles are generally acknowledged (Polus & Mahalel 1985, NAASRA 1985a) and Polus (1984) has demonstrated their superior economic performance - based on payload-to-cost relationships - in Western Canada.

In the USA, doubles were operating primarily in the west and midwest States until 1982, when Federal Government restrictions on their use in Eastern States and on interstate highways were lifted. This gave rise to considerable concern regarding the impact such vehicles might have on traffic safety (Glauz & Harwood 1985, Chirachavala & Cleveland 1985).

During the last decade there has been considerable published literature examining the accident involvement of trucks in general, and larger combination vehicles in particular - especially with regard to the American experience. However, the effects on safety are far from clear.

Review articles (eg. Polus & Mahalel 1985, Chirachavala & Cleveland 1985) point to conflicting findings from various studies: some claim that doubles have relatively greater accident involvement than singles, whereas others claim very little difference. Carsten & Campbell (1986) emphasise the analytical intricacies in examining the issue, and Glauz & Harwood (1985) have uncovered shortcomings in previous major studies (eg. Valette et al 1981) of the problem. A recent study (Stein & Jones 1986) unreservedly claims a greater accident experience for doubles. The relative instability of double-trailer combinations is often quoted as a contributing factor.

Chirachavala & Cleveland (1985) indicate that the relative crash involvements of different heavy vehicle configurations depend in large part on the specific style of vehicle (van, tanker, flat-bed, etc.) and their areas (urban, rural, roadway type) of operation. Polus & Mahalel (1985) draw the conclusion that large vehicles can be operated with an acceptable level of safety, provided appropriate attention is paid to controls aimed at drivers, vehicles and freight movement characteristics. These studies suggest implications for some form of control over the freight roles fulfilled by larger vehicle combinations and over their operation in certain areas.

It is pertinent to note here that the studies cited above refer to vehicle configurations primarily of the double-bottom type rather than to B-Doubles. Since the latter are acknowledged as inherently more stable (NAASRA 1985 a,b), the results of such studies are of limited use in assessing any future impact of B-Doubles.

LARGER HEAVY VEHICLES

Australian Experience

Large combination vehicles of the Road Train type operate in western, central and northern regions of Australia and have done so for many years. The operation of medium combination vehicles such as B-Doubles is more recent. While road Trains are confined generally to outback areas, some B-Doubles are operating across a range of conditions including some metropolitan areas (NAASRA 1985b). All of such B-Double operation is under special permit.

B-Doubles have initially been operating under various "trial" conditions in several States, and the limited information available suggests that no major problems have so far been encountered. It is not clear, however, how rigorous such trials have been or indeed what they have been expected to indicate.

Trials in Western Australia commenced in 1983, and have led to a document (MRD 1985) summarising the experience and setting out specifications and conditions for future B-Double operation in that State. Similar documentation of any "trials" in other States does not appear to be available. However, in the light of experience with B-Doubles in South Australia since 1984, specifications for further operation in that State have recently been published (HDSA 1987). Further trials impacting the urban area of Adelaide are being planned.

It is pertinent to note here that the experience in WA relates to B-Doubles of overall length around 18m - considerably shorter than the 22 to 23m configurations being used and proposed elsewhere. The results of the WA trials must therefore be interpreted carefully.

In New South Wales, Road Trains up to 35m in length are permitted to operate in remote areas west of a line extending from Mungindi on the Queensland border to Wentworth on the Victorian border, as shown in Figure 2. The extension of the previous line to include roadways leading into Nyngan has recently been approved. The use of Road Trains outside this area is prohibited, except for the movement of livestock under emergency drought conditions. This provision is continually invoked. There is also a demand from producers and road freight operators for further extension of the area to the east and south, as indicated on the map.

B-Doubles are permitted to operate within the declared Road Train area. Over the last few years there have been many applications for B-Double operation on a variety of routes outside the declared area - covering both rural and urban areas in all regions of the State. Several have related to the southwest region where an extension of Road Train operation is being demanded.

In acknowledgement of the economic advantages promised by B-Doubles, consideration was given to their wider use in New South Wales. In the absence of documented objective trials in other states, a case for their trial operation in New South Wales was identified. The Traffic Authority resolved that such a trial should be undertaken, and this commenced mid-1986. It is outlined below.

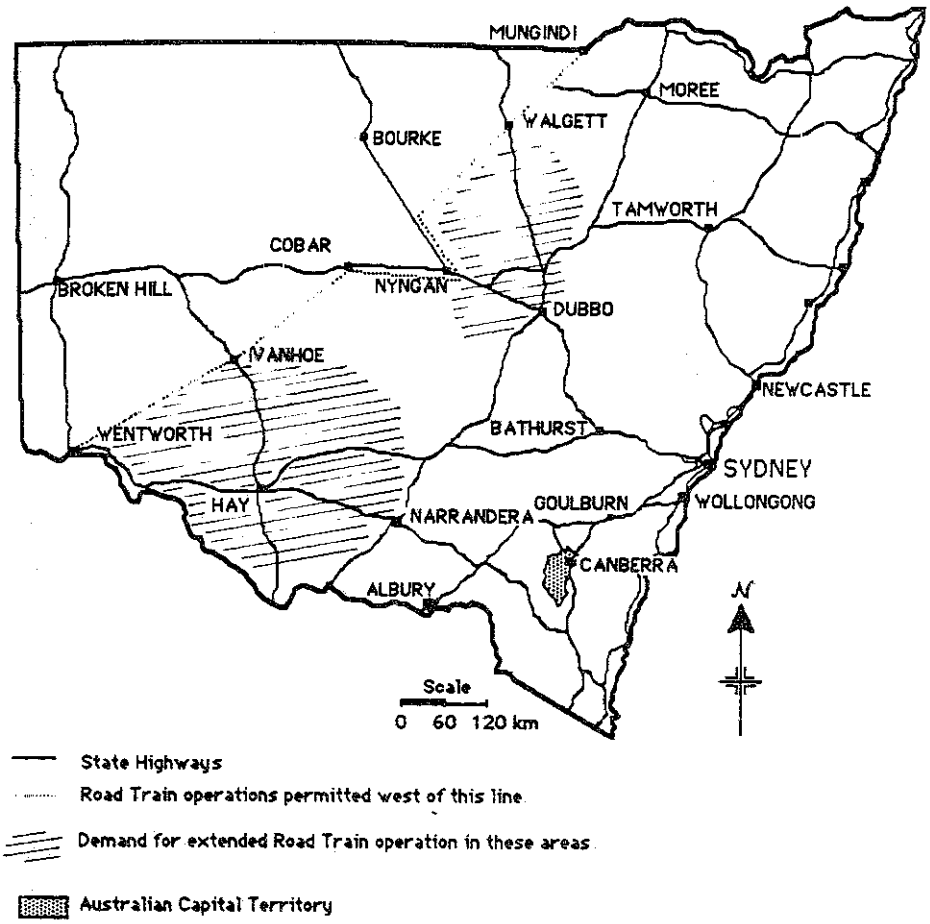

Figure 2 - Road Train Operations in N.S.W.

BENEFITS AND COSTS OF LARGER HEAVY VEHICLES

Potential Benefits

The increased efficiency of larger heavy vehicles in terms of reducing an operator's costs can readily be demonstrated. The Australian Road Transport Federation has estimated likely operating costs for B-Doubles compared with six axle articulated general freight vehicles (NAASRA, 1985a). For various types of operations the overall increase in unit capacity achieved was 47 per cent compared with an increase in unit operating costs of only 18 per cent. Using these figures the RORVL study estimated an overall fleet reduction of 23 per cent and an estimated cost saving of 17 per cent.

It is often claimed that such a reduction in the number of freight vehicles using the roads would reduce the potential for accidents involving such heavy vehicles, so that a benefit in terms of crash and casualty savings may be identified. However, this takes no account of the fact that larger capacity vehicles might enable a given quantity of a particular commodity to be transported in a shorter period with no reduction in the heavy vehicle density on the roads during that period. The argument also assumes no substantial change in the amount of freight being transported by road. As acknowledged in the RORVL report, the estimate of fleet reduction "does not account for changes ... likely to occur due to the transfer of freight from other modes, such as rail, or due to the generation of new freight resulting from lower freight rates". It was expected that the additional amount of converted traffic from rail to road after a five year period would be of the magnitude of 3 million tonnes per annum.

Other estimates by the authors (using the Austway Data Commercial Road Transport Costing System) have indicated that even for short haul operations unit operating costs per tonne of payload can be reduced by 15 per cent. This improvement is primarily related to the higher payload-to-tare ratio of B-Doubles when compared with regulation articulated trucks - with fewer axles per tonne of payload required.

	Axles (A)	Payload (P)	Tare (T)	P/T	A/P	P/A
38T Articulated	6	23T	15T	1.53	0.261	3.83
54T B-Double	8	34T	20T	1.70	0.235	4.25

The higher payload per axle indicates an improved efficiency, for the same permitted axle load.

Significant consequences of such improved efficiency for bulk tanker trials in New South Wales would be:

(i) increased fuel efficiency - fuel consumption per tonne kilometre can be reduced by some 16.5 per cent;

(ii) reduced tyre costs - tyre costs per tonne kilometre can be lowered by some 8.1 per cent;

(iii) reduced repairs and maintenance - costs reduced by some 16.5 per cent.

These types of benefits are based on national highway, depot to depot, operation with very little in urban conditions. Clearly, as the proportion of urban operation increases (other than on freeways) in the total trip distance, these efficiency gains will be reduced.

With reduced benefits in urban operations the question of breaking the vehicle down at depots on the urban fringe arises. The costs associated with breaking the vehicle down into two separate trailers for delivery in an urban area are small - in the order of $200. Such costs are marginal when compared with the large benefits outlined above.

It is in the rural environment where the benefits of B-Doubles can be most clearly identified. Because of improved load distribution B-Doubles can carry heavier gross loads than currently permitted in New South Wales without any increase in axle loads. Whereas only one heavy container can presently be carried by a 38T vehicle, two such containers (eg. for wool tops) could be carried by a B-Double. Similarly, it is perceived in some quarters that there is potential to resolve the "volumetric loading" problem for livestock transport. While one or more pens in some livestock crates must remain empty to conform to existing axle loads, increased numbers of livestock could be carried in B-doubles without the need to introduce volumetric loading and the associated higher axle loadings.

To place the potential benefits of B-Doubles in perspective, one possible use that has been suggested is that of coal exports. A 15 per cent reduction in unit operating costs could reduce the transport component of costs by about $1 per tonne for a typical haulage operation mine to port - compared with a coal export price of some $50 per tonne. That is, a 2 per cent improvement in revenue could result.

Nonetheless, the question of who ultimately benefits from these improved efficiencies needs to be addressed.

Distribution of Benefits

It is important to consider the structure of the road transport industry in assessing the likely impact of the widespread introduction of B-Doubles. In 1982-83 an estimated national total of some 165,000 businesses operated some 280,000 trucks with tare weight of 2 tonnes or more, employing full time about 260,000 people. Some 72 per cent of businesses operated only one truck, 17 per cent operated two trucks and 11 per cent operated more than two trucks. (BTE 1986).

The industry can be considered in terms of such characteristics as:

- short or long haul (short haul 100 kms or less);
- ancillary or hire and reward;
- owner-driver or fleet;

Particular industrial sectors often have one or more of these characteristics which predominate. For example, in the petroleum industry some 90 percent of drivers are employees, as part of ancillary, mainly short haul, operations.

(a) Current Arrangements

There appears to be a wide variation in the reported profit/loss figures for 'hire and reward' operators (BTE 1986). Some 17 percent of these operators who responded to a BTE survey reported a loss in 1982-83, with 88 percent of those reporting a profit achieving less than $25,000 profit. Because of wages being included in the reported profit of some smaller operators this assessment could well reflect an optimistic view of the profit/loss distribution in the 'hire and reward' sector.

While 13.8 percent of single truck 'hire and reward' businesses earned less than $20,000 per truck, only 1.8 percent earned more than $120,000. In contrast, only 1.5 percent of businesses with twenty or more trucks earned less than $20,000 per truck and 22.4 percent earned $120,000 or more per truck. That is, the larger fleet owners are in a far better financial position to purchase and maintain vehicles, given that average lease payments at the time of the survey were close to $1,000 per month, or $12,000 per annum.

'Hire and reward' and owner drivers tend to concentrate more on long distance and interstate haulage than ancillary drivers (BTE 1986). It is in this area of long distance operations that the introduction of larger heavy vehicles could be expected to have the greatest impact.

Of the 9,500 million vehicle kilometres (mvk) travelled in 1982-83 some 4,700 mvh were performed by 'hire and reward' operators including 850 mvk by owner drivers. Overall, 22 pecent of vehicle kilometres were performed on long distance, intrastate routes and 17 percent on long distance, interstate routes. 'Hire and reward' operators were concentrated on the long distance routes and performed 75 percent of the long distance vehicle kilometres and only 33 percent of the short distance travel. That is, some 2,800 mvk were performed by long distance 'hire and reward' operators and some 900 mvk by long distance ancillary operators.

(b) Implications

The implications of the introduction of larger heavy vehicles in ancillary operations as compared with 'hire and reward' are quite different.

With ancillary operations accounting for some 25 percent of the long distance vehicle kilometres, a large proportion of the operations could potentially be transferred to B-Doubles, assuming that the financial resources of the companies involved were sufficient. Reduced operating costs would lower the transport component in the total cost of the product. This could result in a reduction in the price of the product, a containment in further price increases, an increase in profit levels, or a combination of these. But clearly, in terms of the total cost components of a product the benefits are not overwhelming, though they are certainly significant. As a broad indication, if the transport component of total product costs are of the order of 5-10 percent then a 15 per cent reduction in transport costs through the introduction of B-Doubles could achieve 1.5 percent reduction in the cost of products. Of course there would be significant variations depending on the type of product, haulage distance involved and other factors. Even if this price reduction did not eventuate the reduced transport costs could assist in containing prices.

However, in the case of 'hire and reward' operators the distribution of potential benefits is far from clear. With 75 percent of long distance kilometres it is in this area that the main beneficiaries of larger heavy vehicles would likely be found, at least, in the first instance.

Of the 4700 mvk performed by 'hire and reward' operators in 1982-83 the following freight types and distances could possibly be transferred to B-Double operations, if no other constraints existed.

FREIGHT	Distance Travelled by 'H and R' (thousand vehicle kms)	
	Total	Est. Long Distance
Non bulk containers	243,500	142,700
Refrig. containers	59,500	34,900
Refrig. vans	194,900	114,200
livestock	210,000	123,000
Bulk solid	528,400	309,600
Bulk liquid	269,300	157,800
Total	1,505,600	882,200

(Based on BTE 1986, Table 4, 5, p.54-55).

Adding to this estimated long distance figure a pro-rata of 18.4 percent empty vehicle movements gives 1,045 mvk or 22 percent of 'hire and reward' operations that could conceivably be transferred to B-Double operation. In addition, there is some 1,684,900 mvk of non-bulk, non-containerised haulage (including an estimated 977,200 mvk long distance). Including this haulage as well as the percentage of empty vehicle movements results in some 2,200 mvk or 47 percent of 'hire and reward' that could be converted to B-Double operation.

With the 1982-83 BTE survey finding 3940 owner driver trucks employed in long distance haulage averaging 112,300 kilometres per annum, some 442,500 mvk could be transferred to B-Double operation, subject to the availability of finance for owner drivers. Depending on whether these long distance owner drivers obtained B-Doubles, and on the type of freight permitted to be hauled, as little as 20 percent or as much as 47 percent of 'hire and reward' haulage could well be transferred to B-Doubles.

There are many reasons why not all this long distance haulage would transfer, including:

- some is already performed by existing road trains;
- terrain characteristics might be prohibitive;
- divisible cargoes and commodity types might not allow full efficiency gains to be made.

On the other hand, a small percentage of short haulage operators would want to partially convert to B-Double vehicles, especially in the bulk commodity, line haul situation. For the purpose of the above estimates it is assumed these two countervailing effects would approximately cancel each other out.

(c) The Future

The extent to which the transfer to B-Doubles is realised, and the rate at which it progresses, will depend on a number of considerations. Firstly, the higher capital cost of such vehicles will likely place even greater financial pressure on long distance owner drivers. It is doubtful if owner drivers will achieve any significant financial improvements from reduced operating costs, once freight rates are adjusted. However, in the short term while freight rates are not reduced there will exist a financial incentive for owner drivers to obtain finance to purchase the larger heavy vehicles. The rate at which owner drivers (and others) will purchase B-Doubles will of course depend on a number of factors.

While the BTE found that the average lease payment in 1983 was about $1,000 per month, the devaluation of the dollar and other influences have seen substantial increases in the value of lease finance commitments (RFTIC, 1986). Finance industry sources have indicated that a 50 percent increase in monthly repayments could be expected when comparing a 50 percent higher purchase price of a B-Doubles as against 38 tonne rigs. It is quite possible that repayments on a B-Double could amount to $10,000 per month, or a lesser amount, perhaps $8,000, depending on the value of a trade-in. Clearly, the ability of new operators to obtain larger heavy vehicles will be extremely difficult, and not substantially easier for existing owner drivers.

Larger operators who have greater financial resources will be far better placed to purchase the vehicles, and accordingly be able to pass on at least some of the reduced operating costs by way of lower freight rates. In this scenario owner drivers with 38 tonne rigs will either not be able to compete, or alternatively could lower their

costs by keeping vehicles longer or reducing maintenance, with potential safety implications. In the alternative scenario, if the larger operators do not reduce freight rates, profitability would improve, with little direct benefit to customers.

Potential Costs

(a) Road Impact

Since axle loads for B-Doubles will be required to be within the same limits as for general freight vehicles, it is not expected that there will be any greater rate of pavement wear than is normally the case. Indeed, it is apparent (NAASRA 1985b) that B-Doubles will generally have less damaging effects on pavements than do other heavy vehicle combinations. Continued experience with B-Double trials will reveal if there are any peculiar pavement damage effects in practice.

Another source of concern is for damage to pavement edges that might arise through the potential for greater tracking variability in double-articulated vehicles generally. However, it is apparent that lateral deviation in B-Double trailers is less than for other similar vehicles (NAASRA 1985b) and observations of B-Doubles on trial in NSW certainly indicate that the vehicles track very well at highway speeds. Nevertheless there are potential costs in ensuring that routes on which B-Doubles are to operate do have adequate pavement width. This is of particular concern in urban areas, where greater variability in B-double off-tracking at the lower speeds affects the negotiation of intersections and driveways.

With regard to gross vehicle mass, there is concern for the structural capabilities of bridges and culverts. The structural requirements of bridges and culverts is a major factor in assessing a route for B-Double operation, and costs may well be incurred if their refurbishment is required to render a route acceptable.

(b) Traffic Management

The introduction of B-Doubles has the potential to affect both traffic flow efficiency and traffic safety. These two concerns are often inter-related.

Because B-Doubles are longer than regulation freight vehicles, their introduction into the traffic stream will lead to increased overtaking times (and distances) and this could increase the potential for accidents. Further, if the performance (speeds) of the longer vehicles, particularly on grades, is noticeably different from that of other heavy vehicles, then the need for overtaking monoeuvres will increase. The combination of this and limited opportunities for overtaking leads to bunching in the traffic stream, which in turn increases the likelihood of rash overtaking manoeuvres and the potential for accidents.

Thus the introduction of B-Doubles could influence the following characteristics of the traffic stream:

- distribution of vehicle speeds
- bunching of vehicles
- overtaking behaviour
- accident experience

While some of these concerns may be addressed through speciication of vehicle requirements, route selection criteria must include reference to appropriate traffic management measures.

The need for special consideration of freight vehicles in urban traffic management has been clearly identified by Ogden & Bowyer (1985). The introduction of B-Doubles in urban areas would provide an important extension to such considerations. An adequate level of service must be maintained, and attention must be given to the provision of sufficient through lanes, turning bays and intersection control. Geometric considerations are particularly important for these larger vehicles particularly with respect to intersections, roundabouts and driveways.

(c) Safety Considerations

In rural areas, the overtaking problem is of particular concern. This was clearly recognised in the National Inquiry (May 1984) which noted that overtaking plays a disproportionate role in fatal truck accidents. Some 47 percent of fatal truck accidents involved vehicles engaged in overtaking manoeuvres and vehicles which crash into each other from opposing directions. In rural areas these type of collisions accounted for 55 percent of fatal truck accidents. Since articulated trucks have far higher accident rates than rigid trucks, this problem is of even greater concern if the widespread use of B-Doubles is contemplated.

It has been claimed (NRMA 1986) that B-Doubles do represent a hazard on 2 lane roads because of the additional time needed to overtake them; and further, that this hazard is compounded if the road is narrow and/or has poor alignment - features that are common on many rural arterial roads in N.S.W.

The RORVL study compared a 23m B-Double and a 17m general freight vehicle and concluded that the average increase in total overtaking time is about one to one-and-a-half seconds. It is important to note, however, that this increase occurs during the period when the overtaking vehicle is in the opposing traffic lane (typically 3 sec) and therefore constitutes a large proportional increase in the period when exposure to danger is greatest.

Accordingly, those roadways on which B-Doubles can be overtaken most safely are those where the terrain provides long sight distances for much of the roadway length or where there is adequate provision of overtaking lanes.

The National Inquiry recommended that the provision of overtaking lanes be given higher priority by road authorities. Any increase in the requirement for overtaking lanes because of widespread B-Double operation would impose additional costs. This would further stretch the already limited funding available for a programme of overtaking lane construction. At currently envisaged levels of funding, the construction of overtaking lanes where warranted on three major NSW highways would entail a ten year programme (Bliss 1987).

Clearly, subsequently increased funding would be required to construct overtaking lanes on other major routes, but this funding does not appear to be available from existing sources. Alternative sources of funding would need to be considered.

Since the road transport industry would financially benefit from the introduction of B-Doubles this funding could be based on the "user pays" principle.

(d) Loss of Rail Freight

Freight revenue is the major source of income for the rail systems in Australia. Clearly rail is particularly suited to the haulage of bulk commodities over long distances. In the absence of other transport technologies such as conveyors or pipelines, rail has a unique freight task role in this regard. However, in other areas of operation the ability of rail to compete with larger heavy vehicles on the basis of freight rate alone is limited.

Based on the RORVL estimate of 3 million tonnes of freight being transferred from rail to road with the introduction of B-Doubles, and using an average rail freight revenue of $14 per tonne the rail authorities in Australia could lose some $42 million in revenue per annum.

It is in the area of longer distance bulk haulage that rail achieves its greatest efficiency. In N.S.W. some 54 million tonne of freight is moved by rail, with over 70 percent bulk commodities. With continuing improvements in the handling of bulk commodities it is doubtful if a significant proportion of this rail haulage would be converted to B-Double operation.

The extent to which rail might lose general freight is not easy to estimate, and will depend on the ability of rail to reduce its charges and costs in this area. If this cannot be done, the potential for losing certain freight is significant.

OPERATIONAL ROLES OF HEAVY VEHICLES

Freight Task Roles

As indicated above it is useful to identify three areas where both road and rail operate - in unique, complementary or competitive sectors of the land freight market. Of course this market itself may expand or contract subject to the state of the domestic economy, level of exports, and the degree of competition from sea and air freight. However, for the purposes of discussing the potential freight task roles of the two modes these other aspects are excluded. It is also assumed that other technologies such as pipelines and conveyors are not available.

(a) Unique operation

The 'unique' sector of land freight can be broadly identified for rail as long distance, bulk haulage (say over 300km); and for road, as short distance, general freight (say up to 100km), and long distance haulage where rail does not exist.

While there may be occasional exception to this definition (eg. suburban rail parcels service) the concept provides a useful categorisation. For rail authorities, planning of infrastructure and services is free of competing technologies. For road transport operators the opportunity to use larger heavy vehicles for short distance haulage is very limited. However, where rail (and other technologies) are not available the economic benefit of larger heavy vehicles, such as road trains, have clearly been of importance to many outlying centres. It would appear that there are some operations where B-Doubles are being preferred, even in preference to 35 metre road trains, because of lower operating costs.

(b) Complementary operation

The 'complementary' sector can be identified quite readily in many combinations of road/rail applications, but usually involving short distance road haulage feeding into a long rail journey. Examples of this include:

- road haulage of bulk commodities such as coal or wheat (usually up to 50 km) from mine or farms to a loading facility for transport by rail (usually more than 150km) to the seaboard;

- pick up and delivery of containers at both ends of long distance rail journeys. The introduction of interstate rail 'super freighter' services in recent years has shown the success of this type of complementary, inter modal transport.

(c) Competitive operation

Trying to define the bounds of a 'competitive' sector is more difficult. It could be defined as an area where the difference in cost per tonne kilometre for road and rail haulage is usually in terms of some proportion rather than an order of magnitude. In cases where delivery time is the prime consideration rather than cost, air freight would often be used. However, even where there is a significant difference in freight rate (of 20 percent or more) many other factors influence the choice of transport mode and operator. Such factors as reliability, ease of use, availability of credit, terms of payment, customer service, security of consignment, loading and unloading costs and facilities all have differing significance depending on commodity type, haulage distance and other factors. In addition, there are government imposed constraints that require a particular mode to be used in certain circumstances; for example, limiting heavy road haulage in residential areas, or requiring rail haulage of bulk commodities for environmental reasons.

Potential for Larger Heavy Vehicles

In terms of the above three sectors the introduction of larger heavy vehicles can have significantly different implications.

In the 'unique' sector larger heavy vehicles will not disadvantage existing rail operations. However it is possible that the reduced operating costs would make the construction of rail facilities less attractive. The main impact here is the increased competition between road hauliers, essentially in those areas where adequate rail services cannot be provided or, more likely, where there is no rail service at all. The 'outback' areas of Australia are the most obvious examples. The sources of potential costs can be readily identified and are usually limited to road upgrading and maintenance. There is generally little problem in terms of traffic management and adequate precautions can be taken to reduce road safety hazards, if adequate pavement surface and lane width is provided. The main problem to be overcome is that of financing any road upgrading and maintenance necessary to ensure that road safety is not compromised. The likelihood of financing such road works (perhaps through user-pay levies) could be significantly increased if a limited number of heavy vehicle routes were identified, with upgrading funds being focussed on those routes.

There are more considerations in the 'complementary' sector where, in addition to road upgrading and maintenance, terrain and traffic volumes can cause road safety problems, especially through difficulties with vehicles overtaking. Since the complementary road-rail operation usually involves the use of each mode in its more efficient haulage range, improved economy in either leg of operation will provide a smaller percentage improvement to the total transport operation. For example, the typical cost of export coal haulage to port by road-rail in NSW of $10-12 could be reduced by some 50 cents.

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For a coal mine producing 2 million tonnes per annum the reduced transport cost could amount to $1 million. In such a situation there is considerable scope to provide a contribution to any road works that may be required to overcome road safety problems through road widening or the construction of overtaking lanes. Because the 'complementary' sector includes some of the major export commodities such as coal and wheat even a 5 percent reduction in transport costs to the seaboard can amount to a large saving. It is for this reason that expenditure on road works in such circumstances could warrant a high priority in relation to other possible heavy vehicle routes, especially if the likelihood of environmental impact is minimal.

Difficulties clearly arise when considering the operation of larger heavy vehicles in the 'competitive' sector, where they would be competing for existing rail freight. Not only does the question arise concerning the loss of revenue for the rail systems, but it is also necessary for the road transport industry to carefully assess where the potential of larger heavy vehicles can best be achieved. For example, it might well be poor investment to attempt to use B-Doubles for interstate container movement. The success of the 'super freighter' rail container service has substantiated the ability of rail to provide efficient services, other than in bulk commodities. The 'super freighter' service has been so well patronised that some road haulage operators have experienced a 70 per cent decline in interstate container haulage. Technological improvements might well improve the efficency of 'super freighter' operations even further.

All the potential costs outlined previously - road upgrading, operational restrictions because of traffic management requirements, and traffic safety effects - need to be taken into consideration. In terms of an assessment of cost-benefits it is in this sector that the costs of larger heavy vehicles are likely to be at a maximum while the benefits, and beneficiaries, depend very much on the type of road haulage operation -'ancillary' or 'hire and reward'. While the total effect of each individual operation would be difficult to quantify (and with little to be gained), overall the impact of larger heavy vehicles in this sector of the freight market would at best produce marginal net benefits, and quite likely would result in significant unquantifiable costs, particularly in urban areas. This would increasingly be the case if restrictions on vehicle operations were gradually removed.

Nonetheless, the introduction of larger heavy vehicles has the potential for changing a haulage operation from a 'competitive' to a 'complementary' one, and improve overall efficiency. For example, where a road haulage operation is comparatively expensive (due to the terrain, for example) but still cheaper than rail, a shorter road haulage over an upgraded route to an efficient rail loading facility (like a balloon loop) could reduce the total transport cost.

A recent development in the changing roles of road and rail from competitive to complementary is the proposed rationalisation of wheat haulage in NSW. To reduce wheat transport costs to the seaboard by up to 25 percent the closure of a number of low volume, high cost branch lines is being proposed by the State Rail Authority. This proposal would lead to road haulage not only from the 'farm gate' to local silos as at present, but would extend the haulage to major silos, where unit trains would operate to the seaboard. Such road haulage could be undertaken far more effectively with B-Doubles than existing articulated trucks, provided adequate consideration was given to the need for road conditions and traffic safety.

IMPLICATIONS

There are several implications for the community in general, and for Governments, industry and public authorities, in particular, if larger heavy vehicles are to be used more widely.

Government

Governments clearly have the responsibility to decide what role, if any, larger heavy vehicles should have in transport. If it is decided that such vehicles will be permitted, then it is a question of determining the types of operations which are considered to offer the best range of benefits when compared with the potential community costs. In the 'unique' and 'complementary' roles there is likely to be little argument, provided minimum acceptable criteria are met. However, in the 'competitive' sector, achieving a balance between the benefits and costs could well prove to be an extremely difficult task. There would appear to be little net benefit to the community if B-Doubles were permitted to compete with an efficient rail haulage operation (such as coal), especially if it resulted in a significant impact on local communities and a major loss of revenue. There would be little likelihood of larger heavy vehicles being accepted if industry were to obtain all the direct benefits while the general community paid all the associated costs.

Industry

The benefit to industry in general is the primary attribute which makes larger heavy vehicles attractive. For the road transport industry in particular, the benefits are clear through reducing costs or increasing profit margins. However, there are some, particularly owner drivers, who are unlikely to obtain a significant proportion of the benefits when compared with the extra costs they would incur.

There are also some in industry who accept paying a marginally higher freight rate to ensure adequate capacity availability, reliability or other requirements. However, for those industries that could obtain significant benefits the option of contributing to road upgrading could well be a worthwhile investment.

Such differential effects of any substantial adoption of B-Double operation might well lead to some rationalisation among sectors of the road freight industry.

Public Authorities

It is the public authorities which have the responsibility for assessing in some detail the potential impact and costs of the wider use of larger heavy vehicles. These considerations include road upgrading and maintenance, traffic management and safety, and in the case of rail, the potential loss of business. Since it is unlikely that all these could be determined and brought together for each individual permit application, there is a need to identify the characteristics of those heavy vehicle operations that could be considered for permits. It will be of considerable assistance to industry and the authorities involved to have the minimum acceptable criteria detailed, so that all aspects can be considered by haulage operators prior to an application being made. The current trial of B-Double vehicles is proceeding towards that end.

In determining appropriate routes and conditions for road freight transport by large heavy vehicles, road and traffic authorities need to consider the different roles that might best be taken on by B-doubles and Road Trains. In some areas both B-Double operation and extended Road Train operation have been requested. If the freight tasks could be carried out by B-Doubles rather than Road Trains one could expect a lesser impact on roads and on other traffic in those areas. Road Trains operation might best remain confined to the more remote areas where the vehicles are less intrusive.

The procedures established by transport authorities for assessing routes and issuing permits should include a mechanism for adequate consultation with local and regional authorities in the area concerned. This is considered essential to ensure that community concerns for safety and amenity are properly addressed.

A prime area for consideration by road authorities is the need for roadway upgrading on routes otherwise deemed appropriate for B-Double freight operation. One possibility in this regard might well involve the declaration of designated "road freight routes", with the establishment of special funding provisions for meeting their additional construction and maintenance costs. Initial funding by road authorities might be recouped by some form of route permit fee.

Rail authorities face the potential loss of a proportion of their largest income source - freight. However, the overall impact is unlikely to be dramatic. Nonetheless, for certain commodities and haulage tasks where rail is least efficient, the impact might well be significant. The extent to which this is permitted will be determined in part by the ability of rail to develop "complementary" services which can improve the overall efficiency of the haulage task.

CONCLUSION

Clearly there are some economic advantages in using larger heavy vehicles for road freight transport. If these are to play a role in future freight operations, then there is a need to ensure that all the benefits and costs associated with their introduction are clearly identified. Further, all sections of the transport industry should recognise and appreciate the other needs and concerns involved.

Developments in freight operations, such as the emerging role for B-Double vehicles, should not occur in an unfettered way. Some element of control must be exercised to ensure that the most appropriate roles for such vehicles are determined, consistent with sound economic management of the freight transport system, and maintenance of safe and efficient traffic operations.

The current trial of B-Double operation in N.S.W. has been established in this context and is aimed at formulating appropriate guidelines and procedures for possible future operation of these vehicles in the State.

Opportunities have been identified for vehicles such as B-Doubles to be utilised in unique and complementary roles, rather than a competitive role, with existing efficient rail freight operations. Implications for road and traffic authorities, to ensure that safety is not compromised, have also been identified.

Government is the focus for determining the most appropriate balance between those sectors of freight transport operations that would be affected by the widespread use of B-Double vehicles. Striking a balance involves capitalising on efficiencies, maximising benefits, minimising costs and preserving safety and amenity. In instituting the necessary regulatory measures to address these factors, while ensuring equitable contribution to costs by beneficiaries, consultation with, and the cooperation of, the freight industry will be necessary.

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