HIGHER PRODUCTIVITY FREIGHT VEHICLES: LESSONS OF HISTORY – A CASE STUDY OF B-DOUBLES IN AUSTRALIA

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Bob Pearson commenced work with the Country Roads Board of Victoria after graduating in engineering from the University of Melbourne. In 1976, Bob was appointed to assist with implementation of the Economics of Road Vehicle Limits Study (ERVL), a pioneering study aimed at achieving national uniformity of truck size and weight. In 1981, Bob undertook a study tour of the United States and Canada which resulted in recommendations for trials of Canadian B-trains in Australia, where they became known as B-doubles. Bob is a former Director Technical Standards at the National Road Transport Commission and is presently Director of Pearsons Transport Resource Centre, a small specialist transport consultancy based in Melbourne.

Abstract

B-double is the name used in Australia to describe a prime mover hauling two semi-trailers, a configuration that is called a B-train in some other parts of the world. Over a period of 10 years, B-doubles were gradually introduced into each Australian State and Territory. 2009 marked the 25th anniversary of the first B-double to be granted permission to operate on the populated east coast of Australia. We therefore have a significant period of history to examine the original claims about the performance of B-doubles as well as the prophecies of impending doom from opponents. This paper examines the operation of B-doubles over the last 25 years and presents the factual situation about their impacts as a case study of the introduction of higher productivity freight vehicles.

Keywords: Heavy vehicle, B-double, B-train, case study, freight vehicle, road safety

1. Introduction

In many parts of the world, debate continues about the advantages and disadvantages of higher productivity freight vehicles, a debate that raged in Australia for a number of years about B-doubles. B-double is the name used in Australia to describe a prime mover hauling two semi-trailers, a configuration that is called a B-train in some other parts of the world.

It is easy to proclaim that higher productivity freight vehicles will cause problems in the future, because no-one can be proven right or wrong until the future becomes the past. Opponents of higher productivity vehicles often proclaim that proponents must prove that proposed vehicles are as safe or safer, less polluting and reduce truck travel. Such proof is, of course, impossible until the vehicles actually have a period of operational experience.

2009 marked the 25th anniversary of the first B-double to be granted permission to operate on the populated east coast of Australia. We therefore have a significant period of history to examine the original claims about the performance of B-doubles as well as the prophecies of impending doom from opponents.

This paper examines the operation of B-doubles over the last 25 years and presents the factual situation about their impacts as a case study of higher productivity freight vehicles.

2. Background

Australia is the sixth largest country in the world. It is about the same size as mainland USA and 50% larger than Europe. More than 80% of its 22 million population live in the eastern coastal fringe including the major cities of Sydney and Melbourne which combined have a population of more than 8.4 million. On average Australia has the lowest population density in the world.

Source: Geoscience Australia, 2010

Figure 1: Australia showing States, Territories and major roads

Australia is a federation of six States and two Territories, each responsible for road transport laws, although the Federal government assumed responsibility in the 1980s for some aspects of interstate road transport. Highway funding comes from both State and Federal sources and the process of funding allocation can be quite controversial.

Australia in the late 1970s had a clear divide in allowable vehicle configurations between the large road trains of outback Australia and the standard six axle articulated vehicle which was the workhorse for long distance road transport in the eastern States. A number of options had been suggested as an intermediate vehicle but none were considered satisfactory. Australian road transport was, and still is, characterised by the high density of its freight, with trucks frequently reaching maximum mass limits before reaching cubic capacity.

In 1979, Shell Australia requested permission to operate a "B-train", a Canadian invention that had been operating in western Canada for a number of years. After a trip to Canada to investigate these vehicles, the author recommended that trials of this new configuration be held in Australia. Since the mid-1980s, the configuration had been called a B-double in Australia to differentiate it from the much larger road trains.

3. Gradual introduction

With States and Territories having control of road transport regulation, B-doubles were introduced at different times and with different degrees of restriction in Australian States and Territories. The first trials were held in Western Australia, which long had a history of innovation and road train use, but these first B-doubles were still no longer than the standard single articulated vehicle, then 17 metres.

B-doubles were introduced without trial in South Australia and the Northern Territory and were introduced following trials of about 2 years in Western Australia, Queensland and New South Wales. Significant opposition to their introduction was encountered in Victoria and Tasmania, both States that did not allow road trains at that time, even though Victoria was the first State to allow a B-double longer than 17 metres.

Table 1 is a brief chronology of the introduction of B-doubles into Australia.

Table 1: Brief chronology of the introduction of B-doubles into Australia

Year	Total B-doubles in Australia	Event
1979	-	Shell Australia requests permission to operate B-doubles in Victoria
1981	-	Tour of USA and Canada includes study of Canadian B-trains
1982	1	First B-double, a 17 metre vehicle in Western Australia
1983	2	Second B-double, another 17 metre vehicle in Western Australia
1984	4	First B-double in Victoria and first longer than 17 metres First B-double in South Australia
1985	9	Trial operations commence in Queensland
1986	11	Trial operations commence in New South Wales
1987	32 (only one crossed a state border)	Full operations approved in Queensland
1988	82	Full operations approved in New South Wales Major campaign against B-doubles in a Melbourne newspaper

Year	Total B-doubles in Australia	Event
1989	220	B-doubles permitted across the tip of Victoria to facilitate travel between South Australia and New South Wales
1990	295	Victorian trials commence
1991	500	Full operations approved in Victoria First B-double on the Hume Highway between Melbourne and Sydney, Australia's major cities

It took 10 years for the B-double to be accepted in all mainland States and it was not until 1992 that the island state of Tasmania commenced trial operations.

During the 1990s, innovation in design and regulatory changes saw a rapid increase in the numbers of B-doubles. Today, there are more than 10,000 B-doubles in Australia and the B-coupling concept of the B-double has been extended to other vehicle configurations, as outlined later in this paper. While in the early days, B-doubles operated under individual permits they now operate under legislation with allowable routes specified in Gazette notices.

4. Difficulties encountered

The main opposition to the introduction of B-doubles into Australia came from interests associated with rail, although there was significant opposition from some sections of local government (local councils) and even from some bicycle lobby groups.

Rail interests saw B-doubles as a major competitor due to the productivity gains and the resultant reductions in unit freight costs. Rail unions in particular were concerned with the impact on their members, while some sections of the community believed that all long distance freight should be reserved for rail and not carried by road. The opposition from some bicycle interests could not be attributed to anything other than hatred of trucks generally due to their creation of greater air turbulence than cars.

The media played a major role in the opposition, sensationalising reporting and ignoring facts. Some examples of media reporting are given below, ranging from major metropolitan to small provincial newspapers.

A major Melbourne newspaper led the way with an article headlined "*Road monsters are heading our way*". The half page article, in addition to relating many emotive and misleading arguments about the dangers of big trucks, discussed false but often quoted material about trucks not paying a fair share of road costs and being subsidised by about $33,000 annually. Some research into the crash record of US short twin trailers was quoted, research that was not relevant to a B-double.

The article was followed up with editorial comments in various newspapers such as:

> Let the answer to those who want these road monsters be clear, firm and prompt: No way!
>
> Allowing these huge vehicles to operate in relative isolation in South Australia and Western Australia is one thing; allowing them on the heavily-used roads of Victoria is a prospect that will do nothing for the already jangled nerves of the average motorist.
>
> The B-doubles may have a sizeable impact on our road systems, necessitating costly modifications to some inner roads, roundabouts, parking areas and freight depots. The B-doubles cannot go backwards and need a large turning circle.

Anti-truck feeling in a provincial newspaper resulted in another article, some extracts of which are given below.

Big trucks are just sheer murder

> If ever there was a way for legal murder, the …. Government in NSW has just unleashed it. The Government has approved the use of B-doubles on the State's roads – or some of them anyway.
>
> B-doubles are trucks about 23 metres long, carrying 60 tonnes compared with the current 40 tonnes limit, and travelling faster (if that is possible) with about twice the noise output of existing road transports.
>
> The whole plan smacks of gross hypocrisy. On one hand, the Government says the monsters will not be permitted to travel on suburban streets where it is not safe, forgetting that for country people the roads that are facetiously referred to as highways are our back streets.
>
> The Government, too, has dismissed out of hand research that indicates that double trailers had two to three times more accidents that single trailers. It is all right to kill country people, but not those who live and drive on suburban streets in Sydney.

Many local governments opposed B-doubles, due largely to ignorance fuelled by the media opposition but also in some instances with genuine concerns about the impact of B-doubles on local roads and bridges. Opposition was greatest within metropolitan councils and lowest within rural councils that understood their reliance on road transport. Typical of the view of metropolitan councils was:

> I think these vehicles are potentially dangerous. In any case, what they are transporting should be on the railways.

Within Melbourne, a group of Councils banded together to oppose B-doubles and produced material such as this:

> The introduction of B-doubles, which would constitute a 50% jump in maximum payloads and 53% increase in maximum length, would create an intolerable environmental impact on our community. Imagine 64 tonnes (or 65,000 litres) of petroleum or toxic chemicals exploding on the Tullamarine Freeway or South Eastern Freeway engulfing road users and adjacent residences. Imagine being passed in your car or on a motorcycle by one of these at 120 km/h – trucks frequently exceed speed limits.

The numbers were completely inaccurate, probably intentionally.

At that time, the attitude of some sections of the trucking industry to laws was flexible at best and there is no doubt that trucks tailgating, speeding and exhibiting other similar behaviour allowed opponents of B-doubles to successfully argue that drivers of larger trucks would engage in similar behaviour.

Other difficulties arose from arguments about cost recovery, such as the article quoted earlier that trucks were subsidised by large amounts. Only in the 1990s was the cost recovery argument put to bed in Australia.

5. Innovation and evolution with Australian B-doubles

Australian transport has a long history of innovation, dating back to the first road trains in the 1940s. These innovative skills were used to transform what started as a general copy of Canadian designs with 7 or 8 axles into the best performing vehicle on Australia's roads with

9 axles. Figures 2 and 3 show early B-doubles that utilised existing equipment modified for trials.

Figure 2: Second Australian B-double at 17 metres long, with tandem axles (incl. steer)

Figure 3: First B-double longer than 17 metres, also with tandem axles

Figure 4 is the first South Australian B-double, which adopted the Canadian configuration of a triaxle in the centre between two tandem axles.

Figure 4: First B-double to use the Canadian concept of triaxle in the middle

In 1988, the first major design change to B-doubles was to develop a triaxle at the rear rather than in the centre, which allowed a further significant productivity gain. Previously, each trailer was of approximately equal length (about 9 metres each) and only one 20 ft container

could be carried on each trailer, as shown above in Figure 4. The triaxle at the rear concept allowed a 6.1 metre (20ft) lead trailer and a 12.2 metre (40 ft) rear trailer. Now, three 20 ft containers could be carried or one 20 ft and one 40 ft container, as well as three bays of 6 metre logs as shown in Figure 5.

Figure 5: An early triaxle at the rear B-double

1993 and 1994 saw the introduction of the 9 axle B-double with two triaxles, (Figure 6). The allowable length was increased from 23 metres to 25 metres to allow full axle weights on each triaxle while extending the spacing between triaxles for bridge protection.

About that time, another innovation was the "pocket" B-double which went back to tandem axles but was no longer than standard articulated vehicles and able to operate unrestricted, whereas standard length B-doubles were constrained to travel only on approved roads.

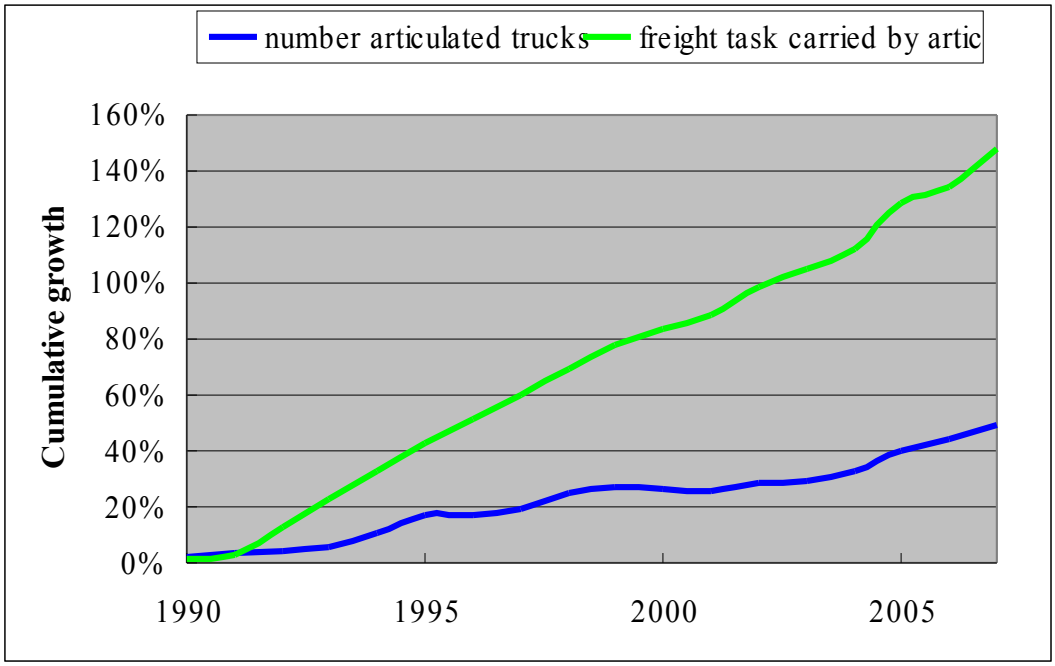
Figure 6: Early B-double with two triaxles

6. Lessons of History

6.1 Fleet reductions

Throughout history, the amount of freight moved has increased steadily. A factor in this historical increase is the consolidation of production facilities, resulting in goods being moved over longer distances. Another factor is the increased efficiency of our transportation systems, which, inter alia, allowed perishable freight to be moved quickly to point of sale in refrigerated equipment without significant damage.

Australia has exhibited this freight growth for many years. Since 1990, the freight task carried by articulated vehicles (measured by tonne-kilometres of freight) has increased by nearly 150%. In the same time, the number of articulated vehicles in Australia has increased from 50,000 to 75,000, only 50% as illustrated in Figure 7. Articulated trucks include single articulated vehicles (about 60,000), B-doubles (about 10,000) and road trains (about 5,000).



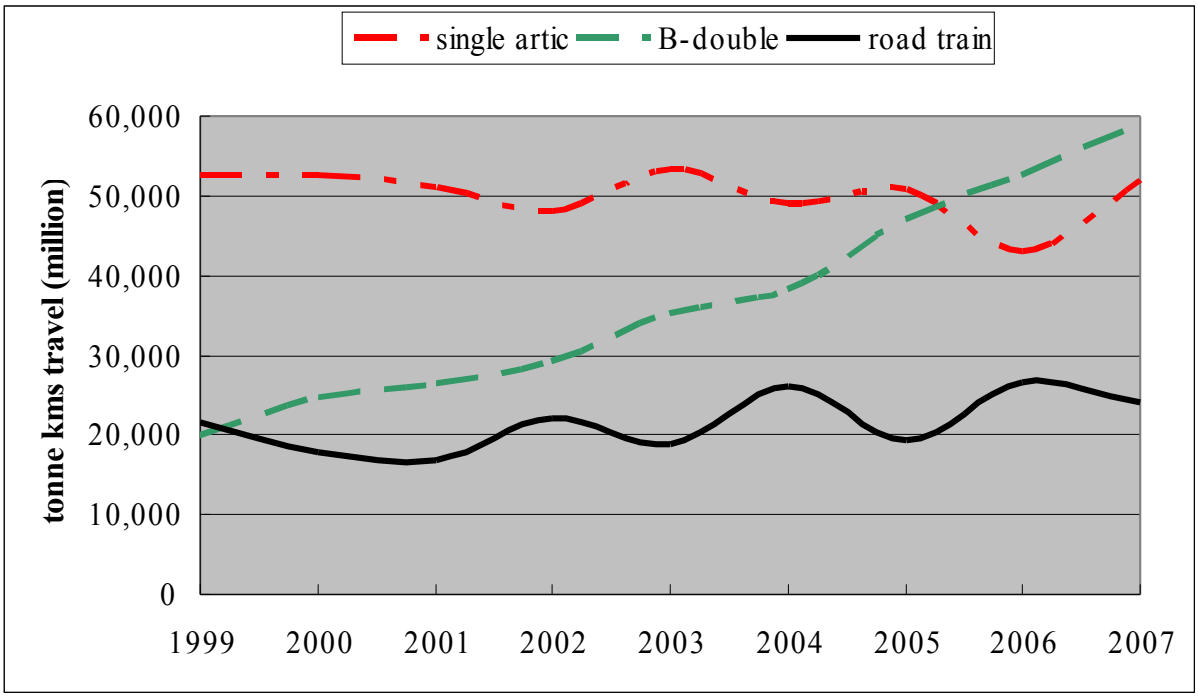
Source: BITRE (2009)

Figure 7: Growth in the Australian freight task and articulated trucks since 1990

A range of factors have contributed to the greater efficiency of articulated vehicles in those years, including improvements in trucks, industry practices and road networks. However, without doubt the greatest influence was the widespread introduction of B-doubles from 1990.

Figure 8 shows the freight task carried by articulated vehicles from 1999 to 2007, separated into single articulated vehicles, B-doubles and road trains. The graph only starts at 1999 as that was the first year that B-doubles were separately identified.

It can be seen that B-doubles carried the entire increase in the freight task in that period, with the tonne kilometres of travel by single articulated vehicles and road trains being relatively constant. B-doubles now carry more freight than any other vehicle configuration in Australia.



Source: Pearson (2009)

Figure 8 : Australian freight task carried by articulated vehicles, 1999 to 2007

Some lower bound estimates of fleet reductions have been made by taking the number of B-doubles (around 10,000) and suggesting that as one B-double carries the load of 1.6 single articulated vehicles then the fleet reductions are in the region of 0.6 times the number of B-doubles, i.e. 6,000 vehicles. On the other hand, it could be postulated on the basis of Figure 8, that as the freight carried by 10,000 B-doubles and 60,000 single articulated vehicles is about the same, it would take another 60,000 single articulated vehicles to carry the present B-double freight. The latter number would clearly be an overestimate.

However, the changes in pricing, loading and logistical practices that have resulted from the introduction of B-doubles means that single articulated vehicles are now better utilised than previously. Using a range of possible scenarios, it is estimated that the fleet reductions until the end of 2008 have been in the order of 15,000 to 20,000 large vehicles, or about 17% to 20% of the potential heavy vehicle fleet without B-doubles. The Review of Road Vehicle Limits Study (NAASRA 1985) estimated fleet reductions would be in the order of 14% to 23%, remarkably accurate estimations.

B-doubles are now relatively more attractive due to increases in gross mass from the additional triaxle and the Mass Limits Review carried out in the 1990s, as shown in Table 2.

Table 2: Increases in gross mass since 1990

Time	B-double gross mass	Single articulated gross mass	Increase for B-double over single articulated
Early 1990s	59.0 tonnes	42.5 tonnes	38.8%
1994 on	62.5 tonnes	42.5 tonnes	47.1%
1998 on	68.5 tonnes	45.5 tonnes	50.5%

Note: In all cases, B-doubles are restricted to approved routes and 45.5 tonne single articulated vehicles are also restricted to approved routes.

6.2 Road trauma savings

Although crashes between cars and heavy vehicles often result in significant fatalities for car occupants, research has shown that truck drivers are responsible for only a proportion of these types of crashes. As outlined in TIC & CVIAQ (2004):

> ….of crashes between a car and an articulated truck, the truck driver is only responsible for between 20% and 30% of the crashes whereas the car driver is responsible for the remainder, between 70% and 80% of these crash types.

ATSB Monograph 15 (ASTB 2003) stated that "Articulated truck drivers were assessed by coroners as being either fully or partially at fault in about 25 per cent of multiple vehicle fatal crashes involving articulated trucks in 1999".

The main advantages from a road safety perspective from the introduction of B-doubles are the reduction in exposure and the stability advantages of the B-double configuration, particularly the roll coupling between trailers.

The only study of crash rates for single articulated vehicles and B-doubles was undertaken in Victoria by VicRoads for crashes between 1994 and 2003. The statistics are reported in TIC & CVIAQ (2004) and are reproduced in Table 2.

Table 3: Comparison of crash statistics for single articulated vehicles and B-doubles (Victoria), 1994–2003

Year	Fatal		Serious Injury		Other Injury	
	Single artics	B-doubles	Single artics	B-doubles	Single artics	B-doubles
1994	36	0	163	0	236	1
1995	31	0	145	0	246	0
1996	33	0	131	1	274	0
1997	26	0	101	2	300	0
1998	30	0	150	0	278	3
1999	34	0	144	1	316	1
2000	31	1	141	0	276	2
2001	35	0	145	5	247	6
2002	41	0	144	3	230	5
2003	32	1	156	1	229	2
Total	329	2	1420	13	2632	20

Source: TIC & CVIAQ (2004)

Although the period of the study included the early days of B-doubles, by 2003 there were about 7,000 in Australia so they were no longer rare vehicles. Unfortunately, however, the statistics do not include crash rates so estimates of road trauma savings arising from the introduction of B-double relied on a range of assumptions. ATSB (2003) gives the fatality rate per million kilometres travelled by articulated trucks as reducing from 0.046 to 0.033 from 1991 to 2001 but numbers of B-doubles and the distance travelled had to be estimated.

Nevertheless, it was calculated that more than 350 lives have been saved since 1990 by the introduction of B-doubles into Australia. As 150 fatalities Australia-wide resulted from

articulated vehicle crashes in 2008, the savings in human terms are substantial. If a ratio of 10 serious injuries to 1 fatality is used, about 3,000 serious injuries would have been saved.

According to NAASRA (1985), the introduction of B-doubles would save 16 lives per year. For the 20 years from 1990 until 2008, that equates to 288 lives, again remarkably accurate.

6.3 Savings in costs and emissions

Estimates have also been made of other savings from the introduction of B-doubles until the end of 2008 as follows (Pearson 2009):

- saving in road transport costs of at least AUD 12,000 million, plus another AUD 2,000 to 3,000 million in road trauma savings;
- reduced emissions of greenhouse gases by at least 11 million tonnes (which equates to a saving of about 50% of one years emissions from the heavy vehicle fleet)

Estimates made by NAASRA (1985) were for transport savings of $180 million annually in 1984/85 dollars, which when summed and corrected for inflation amount to about $6,500 million to the end of 2008.

6.4 Flow-on benefits

In Australia there have been significant flow-on benefits by the use of the B-double coupling concept in road trains. Traditionally, road trains were either double at 36.5 metres long (an articulated vehicle hauling a dog trailer consisting of a dolly and a semi trailer) or a triple, an articulated vehicle hauling two dog trailers which is excess of 50 metres and a gross mass over 120 tonnes.

However, superior configurations are possible using the B-coupling on some or all trailers:

- a B-triple, a prime mover hauling 3 semi-trailers;
- an A-B triple, an articulated vehicle hauling a B-double; and
- a BAB quad, two B-double trailer sets joined by a dolly as shown in Figure 9.

Using standard B-double components, the combination lengths are about 35 metres (B-triple), 42.5 metres (A-B triple) and 51.5 metres (BAB quad). At full axle weights, the BAB quad can gross up to 135 tonnes.

Figure 9: A BAB quad, two B-double trailer sets joined by a dolly

6.5 Implementation strategies

As outlined earlier, trials were undertaken in many jurisdictions and the trials worked particularly well in evaluating the concept and overcoming community concerns. In the few instances where difficulties were observed or reported, early action resulted in better outcomes. Trials do not need to have particular objectives, and in fact such objectives are generally impossible to establish. Trials are an opportunity for all parties, including responsible operators, to understand any real world problems of a new vehicle configuration.

In one typical instance, the operator of an early trial was required to report monthly for 12 months to a meeting of government representatives (including Police and each council through which the trial B-double ran) to present information on vehicle speed etc and address any complaints by the public. After a few months, no council representatives bothered to show up and there was not one complaint from the public in the 12 months.

B-doubles were introduced into Australia under the watchful eye of a national committee of government experts with a long history of involvement in vehicle operations. Where necessary and advisable, this committee consulted industry participants (including owners and drivers) and infrastructure experts. They monitored the operations of B-doubles throughout Australia and provided advice to local committees as necessary. The committee was established in 1978 by NAASRA (the forerunner to Austroads) to co-ordinate all road vehicle limits matters.

It must not be forgotten that experienced drivers are a valuable source of information about the handling of any trial vehicle.

6.6 Overcoming opposition

The main opposition to B-doubles was in the State of Victoria. The main industry body, the Victorian Transport Association, formed the Transport Industry Taskforce in response to anti-truck sentiments. The Taskforce, with great support from different industry segments, was given a full B-double, made a 6 minute video, printed factual material, wrote articles for magazines and organised workshops and demonstrations for stakeholders throughout Victoria. This most professionally organised single issue campaign was successful in countering some, but not all, opposition. An important part of the campaign was to differentiate the responsible elements of the transport industry from the poor performers in the industry who had given it such a bad name.

6.7 Regulatory attitude

Because of the obvious advantages of B-doubles, regulators were willing to make changes to ensure that they remained an attractive alternative to standard articulated vehicles. An example is the additional 2 metres agreed to in the early 1990s to allow the second triaxle to become feasible, leading to the dominant position of the B-double in Australia's fleet today.

As B-doubles needed to be restricted to suitable routes (including for bridge protection) it became a valuable investment strategy and priority to modify geometry and strengthen bridges to allow B-double routes to be expanded. As an example, there was one bridge on the principal route between Melbourne and Brisbane (2000 km) that could not support B-doubles and it was strengthened as a priority project. The State of Victoria used upgrades of bridges on B-double routes to assist with facilitation of B-double access and today has probably the highest proportion of roads available to B-doubles.

7. Conclusion

The introduction of B-doubles into Australia has shown that controlled and gradual introduction of high performance freight vehicles into regular service can be achieved with significant benefits in fleet reductions, road safety and the economy.

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