ECONOMICS OF SUPER HIGHWAYS

AN INDUSTRY VIEW

P F OLSEN - JUNE 1994

The term Super Highway is unusually construed to mean a public road configured and constructed to allow trucks with greater length and higher gross loadings than current Class I roads.

1. a) The use of overwidth trucks with above Class I loading on off-highway roads has often been noted as the key to reduced costs of cartage of logs on roads engineered specifically for medium speed on good load bearing pavements of wide formation. The reduction of "driver" and "public" elements in design have meant safe operational standards are obtained at a lower capital cost per kilometre than like roads of the public use category.

   b) To introduce a similar philosophy to public roads we need to note that the deployment of capital in both road construction and trucks requires some ingenuity to ensure that public roads built for large trucks of gross loads in excess of 44 tonnes do not demand unjustifiable levels of expenditure. The truck design needs to be flexible for both off and on-highway use and should consider configurations compatible with both log and other package/board type cargoes.

   Road planning has to consider the identification of routes to which adequate log flows can be channelled and accumulated to meet acceptable threshold cost/benefit ratios to justify Transit funding of super highways.

2. <u>Traffic Levels</u>

   Log flows are characterised by volatility both in total and in regions.

   a) Forecasts for 1992 and 1993 national log production were both exceeded by the actual production of 14.2 million m^3 and 15.4 million m^3 in 1992 and 1993 respectively from planted forests. These compare with NEFD data for the current lustrum 1991-95 forecast to total 13.661 million m^3/annum. Even with this expected variation for planning purposes, the regional spread of forecast production gives an adequate indication of where major roading requirements will be of the highest priority for forest produce.

   From Table 1 it can be seen that currently the Central North Island supplied a dominant 76% of the current lustrum projection for the North Island. It is still 68%, 60%, 57% and 57% for the next four lustra to 2011-2015. It should be noted that the two main pulp and paper plants demand 6 million m^3 of this CNI total production.

TABLE 1

Regional Wood Supply Forecasts from Plantation Forests (average annual recoverable volumes 000 m^3/yr).

Wood Supply Region	Percentage of Regional Plantation Forest Area Used in Forecast	Lustrum (Five Year Average) 1991-95	1996-00	2001-05	2006-10	2011-15
Northland	86.5	538	818	1 606	2 284	2 306
Auckland	93.1	696	1 061	1 274	1 314	1 326
Central North Island	96.7	8 380	8 006	10 022	10 109	10 283
East Coast	96.4	237	484	1 238	1 511	1 475
Hawke's Bay	87.3	695	827	1 534	1 474	1 482
Southern North Island	74.4	492	628	1 183	1 185	1 ,187
North Island Total	**92.5**	**11 038**	**11 824**	**16 857**	**17 877**	**18 059**
Nelson/ Marlborough	98.0	1 203	1 785	2 382	2 438	2 521
Canterbury	90.5	370	509	691	738	717
West Coast	78.4	126	269	374	376	416
Otago/ Southland	88.0	924	1 318	1 812	1 869	1 795
South Island Total	**90.1**	**2 623**	**3 881**	**5 259**	**5 422**	**5 449**
New Zealand Total	**91.8**	**13 661**	**15 705**	**22 116**	**23 299**	**23 508**

Source: Ministry of Forestry. NEFD 1992 Wood Supply Forecasts

b) If for non-conventional on-highway cartage we used a regional ranking or threshold production level of 1.8 million tonnes/annum the CNI is the only region of NZ which reaches this level of production until another 10 years have elapsed. It is therefore in the CNI region that we should examine the case for the super highway mode on public roads.

c) There are few truck routes where a sufficient volume is likely to be generated by log traffic alone.

In the Kinleith and Kaingaroa cases the mix of large load, low cost, off-highway cartage either direct to the mill or for transfer to competitive rail with compatible log user/market links, is most cost comparable with a super highway public road mode. A case could possibly be made for a specific route Kaingaroa to Waipa as an increasing proportion of FCNZ log production is processed at Waipa.

However the major factor affecting log flow direction is the market shift from a single port for regional export of unprocessed logs, to a wider dispersed location of many domestic conversion units. Each log producer now has a wide range of local markets to supply with monthly or even weekly demand fluctuating rapidly. It is this volatility which undermines the case for other than a very limited number of dedicated routes or super highways which generally would be State Highways and not District roads.

d) The NZFOA road study showed that traffic increases expected would be greatest on State Highways as shown in Table 2.

Table 2

Logging Traffic 1990 projected to 2000
(million tonne kilometres)

	1990	**2000**	**Increase**
State Highway	125.4	330.1	204.7
Local (District) Roads	41.5	116.7	75.2

The areas where greatest percentage increases are expected are Whakatane, Gisborne followed by Northland. These latter two districts have notoriously difficult soils for roading and would generate discouragingly high construction costs for super highways.

3. Design

We should now examine the demands that super highway configurations of trucks should satisfy.

a) Our current configurations are set out below:

FIGURE 1

TRUCK CONFIGURATIONS (WITH MAXIMUM AXLE LOADINGS)

Truck & Trailer

(42 - 44 tonne G.W.)
Max log length = 2 x 8m

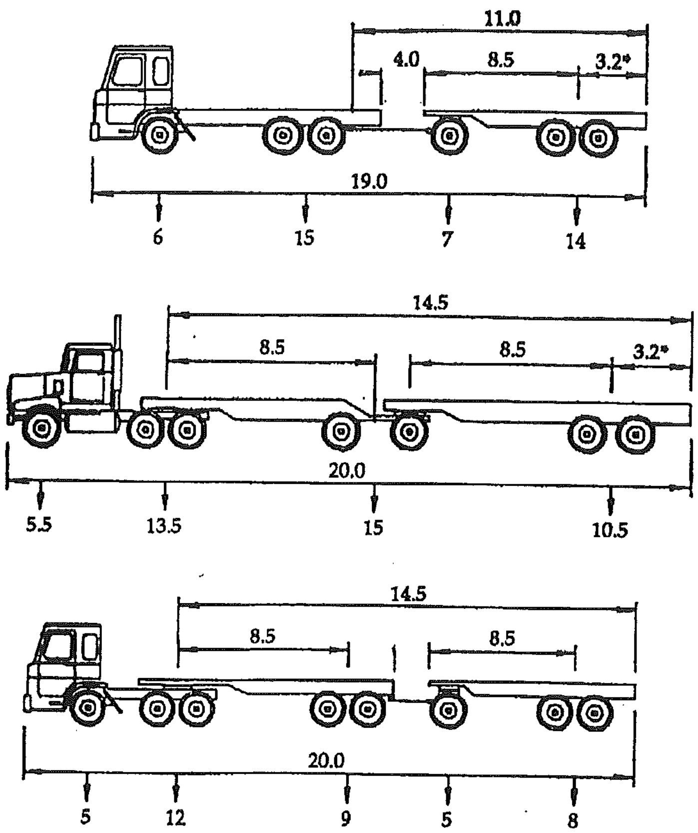
Variations of truck and trailer represents 80 percent of the present logging truck fleet.

B Train

(44 tonne G.W.)
Max log length = 2 x 7m

A Train

(39 tonne G.W.)
Max log length = 2 x 7m



b) To assess the load increases the designs can tolerate we need to consider axle loadings as separate from all up weights, with of course consideration of payload increases as tare for standard rigs reduces. None of the designs attempts to achieve the over-width accepted in off-highway rigs. Most concerns are with extending the present maximum length of 20 metres and best use of the maximum twin tyre axle load of 8.2 tonnes. For logging traffic on bush roads, traction demands may preclude optimum designs to reduce Road User charges and thus most rigs are single steer with a maximum of 6 tonne front axle load.

The mix of log size and length in the total production will produce a possible skew in the carted log population and demand special rigs. The common Bayley Bridge design with the concomitant penalty in high tare weight is an example of this compromise design.

We could design with a specific aim of meeting all present restrictions. These as advised in a recent Transport News are 20 metres maximum length, requiring a turning circle of 25 metres while maintaining a minimum of 400 mm between trailers in a turn of 270°. Most find this easily achieved as a turn lock of 9 metres is commonly available. Generally logging rigs are expected to have a two or three position drawbar for (a) short (b) long and (c) piggy back trailer modes. For trucks and trailers single or double axles are allowed.

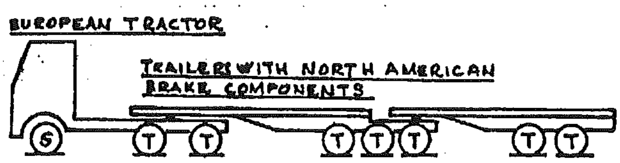
c) The many designs we would like to import from Europe USA or Australia incorporate triaxle trailer axles with a tandem drive. These usually are engineered for a 10 tonne axle loading with up to 76 tonne gross capacity. The diagram below describes this:

(A) as within the manufacturers rating but incurs penalties from R.U.C. calculations. It compares with the maximum by axle groups which accumulates a gross above the current Class I maximum;

(B) Within NZ regulations by axle groups but exceeds Class I maximum load.

(C) The typical on-highway 44 tonne legal operation which does not incur excessive Road User charges. The attempts to minimise R.U.C. imposts distort otherwise efficient designs.

FIGURE 2



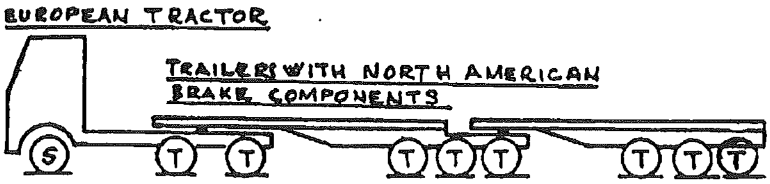
A	6	20	30	20	= 76 Tonne
B	6	15	18	15	= 51 Tonne
C	5·5	12·5	14	12	= 44 Tonne

A = Typical manufacturer's rating
B = New Zealand regulations by axle groups
C = Typical actual on-road axle weights because of road user charges and 44 tonne gross combination mass limit of regulations

d) If we seriously intend to cater for super highways we should move directly to a 25 metre standard length with a 13 metre rear trailer. This latter could be used as a stand alone unit for Class I road alternative cartage.

The diagram below shows this unit which could achieve 63 tonne gross within the present 7 tonne axle limit by use of triaxle on semi and trailer.

FIGURE 3



6	15	21	21	= 63 Tonne

The attraction of this design is that it can meet the demands for Class I operations when operated as a tandem drive semi-trailer and thus enables maximum use of present truck fleet capital. The drawback is the requirement for bridge changes as it breaches the 13.5 metre spread design criteria for most long span bridges.

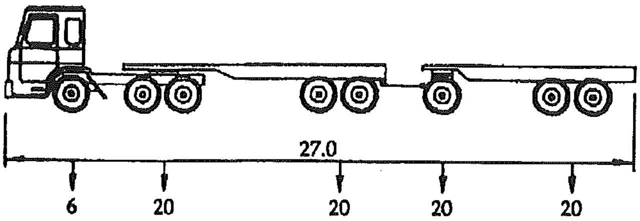
e) The next step considered by many operators is to take advantage of the built-in design capacity of European and US trucks for 10 tonne axle loadings. Lambert (1994) points out that many manufacturers have suspension and braking design at this level. Figure 2 A shows this 76 tonne unit. Figure 4 unit could be therefore considered capable of 86 tonne gross.

FIGURE 4

Possible Configuration

Potential with 10 tonne axle
(86 tonne G.W.)
Max log length = 2 x 11m

As with A Train above the gross weight will be restricted.



4. Economic Impacts

In considering the range of design alternatives I have taken three types which can give a fair comparison of cartage cost as perceived by the forest owner and truck operator.

a) Those used are:

i) A single steer tandem drive with triaxle semi and tandem axle trailer which can carry a gross of 54 tonnes for a length of 20 metres within a 7 tonne axle limit (Denoted A)

ii) The unit described in 3 (d) above, a single steer tandem drive with triaxle semi and trailer for 25 m length and 63 tonne gross load. (Denoted B)

iii) Standard Class I with single steer and tandem drive semi and trailer axles, 20 metre length and 44 tonne gross load (Denoted C).

Units A and B are presumed to require 500 hp tractors and have a capital average fleet unit cost of $210,000. Unit C is well engineered of light tare with capital cost of $140,000. Table 3 compares these units costs of operation for loads of 50 km and 100 km.

Table 3

Truck Type	A		B		C
Load distance off-highway	8	8	8	8	8
On-highway	42	92	42	92	42
Payload	36	36	43	43	30
Rate per tonne	6.44	11.94	5.50	10.22	7.22
Rate per tonne (km)	0.1288	0.1194	0.1099	0.1022	0.1444

b) To compare the savings (benefits) for the forest owner with highway capital and maintenance required (costs) the level of Road User Charges generated is used as the first indicator with the acknowledgement that RUC's do not necessarily fully reflect the depreciation and maintenance of highways due to heavy loads.

i) Savings for the forest owner for a full years trucks operation are set out in Table 4 compared to standard on-highway conventional configuration for a 50 km load.

Table 4

Payload	Savings for above 30 tonne payload	
	Tonne/Km	Truck Trip Reduction in Nº
36 tonnes	0.0156	17%
43 tonnes	0.0345	30%

The gross savings for 30,000 tonnes carted per annum are $23,400 for 36 tonne payload truck and $51,600 for 43 tonne.

ii) The generation of Road User charge revenue is assessed for the two alternatives in the superhighway category for 50 km and 100 km leads in Table 5 below.

Table 5

Road User Revenue to Road Transport Fund
30,000 tonnes carted

Distance	Payload				
50 km	36 tonne	43 tonne	100 km	36 tonne	43 tonne
Total Km	76,394	63,168		98,370	82,357
RUC$	$40,019	$34,529		$51,532	$45,019

Among the benefits to the public are the reduced truck movements. As an example from 1000 trips for 30 tonne to (i) 833 for 36 tonnes and (ii) 700 for 43 tonnes. Lower road congestion with associated noise will result, in built-up areas. However the industry acknowledge that log trucks have in the public perception, a more "menacing" profile on the road than other truck cargoes. These other types could be a key component in specific corridors such as Hamilton/Auckland which are of less interest to log truck operators. Traffic movements of other forest products have been studied and the perception of non-rail mode movement is of a similar degree of diverse start/finish journeys as with domestic log cartage. This is further discussed in para 5 below.

For a 50 km lead, savings in better payloads amount to a reduction of $0.78 and $1.72 per tonne which means $390 or $860 per hectare increase in royalty for 36 tonne and 43 tonne payloads respectively while for 100 km load the increase in royalty is greater at $1.49 per tonne and $3.21 per tonne and totals $745 per hectare and $1605 per hectare respectively

c) The comparison of cost/benefit for the forest owner for the increased payloads of 36 tonne and 43 tonne is shown in Table 6.

Table 6

Cost/Benefit - 30,000 tonnes Carted

Payload (tonnes)		36	43
Gross Forest Revenue gain over 30 ton load	Lead 50 km	$23,400	$51,600
	Lead 100 km	$43,200	$96,300
Gross Road User Charge	Lead 50 km	$40,019	$34,529
	Lead 100 km	$51,532	$45,019

It should be noted these benefits accrue on the basis that there is a reduction in road user charges due to decreased road use.

5. Conclusion

From the simple example given above there is obviously a major economic benefit available to forest owners by extending truck limits to the maximum length of 25m and maximum gross weight allowable to 65 tonne while still observing the current axle load maxima. The cost to the roading authority is likely to be primarily in replacing bridges of pre-1970 vintage.

There could also be a case for raising maximum axle loads to 10 tonnes which would result in higher payloads. However, the cost of extra pavement strengthening and possibly more extensive bridge rebuilding would need to be quantified for routes which may be seen as justifying this capital.

We have made a preliminary estimate of the possible traffic originating from forest produce conversion plants in the Bay of Plenty. The most significant item is the large bulk of finished products which are carried by rail. Together with export log cargoes, this exceeds 4 million tonnes.

There is only a marginal contribution to traffic levels on major corridors such as Hamilton-Auckland. Therefore any case to increase axle loads to 10 tonne with consequent heavier road capital and maintenance costs will need to supplement forest wood flows with other produce flows. These will need to be relatively stable flows to justify consideration of this mode of super highway.

References:
Lambert, D: Transport News April 1994, 34-36
Olsen, PF & Co: Forestry Logging Traffic on NZ Roads 1992; NZ Forest Owners Association
Ministry of Forestry: Forestry Road Funding Report 1993
Ministry of Forestry: NEFD 1992 Wood Supply Forecasts