

ECONOMIC COMPARISON OF TRUCK CONFIGURATIONS

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Figure 1 - 6x4 + 4 axle convertible; now able to load to 44 tonnes under the new regulations

ABSTRACT

An economic comparison of log truck rig configurations was conducted by calculating on-highway cartage rates using the LIRO TRUCKAAI costing model. The effect of the recent 20 metre - 44 tonne truck trailer policy on log cartage is discussed, as are operational considerations of truck configuration selection. A 6x4 truck with four axle trailer operating at 44 tonnes under the 20 metre policy was found to be the most cost

efficient shorts rig, while the 8x4 with three axle trailer was found to be the most effective longs rig. Convertibles were found to require cartage rates 6%-7% higher than single mode rigs, when compared at the same utilisation.

INTRODUCTION

Since the last LIRO comparison of truck configurations (Taylor, 1989) there have been legislative changes, which have altered the cost relativity between rig

types, as well as capital and operating cost changes.

The 1989 report examined the effect of the change in the transport legislation which allowed four axle trucks (8x4) with three or four axle trailers to attain 44 tonnes gross combination mass (GCM). This type of rig was identified as the most economic at the time, and has become a popular configuration. Three axle trucks (6x4) towing three or four axle trailers were limited to 42 tonnes GCM until the introduction of the 20 metre - 44 tonne truck trailer policy last year. This policy allows three axle trucks towing four axle trailers to increase GCM to 44 tonnes. The policy also contains provisions for truck and trailer units to operate at 20 metres overall length, increased from the previous limit of 19 metres.

Changing operational demands in recent years have also influenced the make-up of the log truck fleet. This is particularly evident in the prevalence of convertible, or interchangeable rigs, which are capable of carrying long or short logs.

This report presents an economic comparison of the various log transport rig configurations in on-highway operation, and discusses the impact and features of the 20 metre - 44 tonne truck trailer policy.

TRUCK COSTINGS

All costings summarised in this report were calculated using the LIRO truck costing model, TRUCKAAI, which uses an average annual investment method (Goldsack, 1988). Truck purchase and resale prices are based on current market values for new and used trucks. The cost of on-board scales has been added to the new truck and trailer costs. Tare weights reflect typical figures for current models of trucks and trailers. Three axle trailer costs and tare weights are based on

11R22.5 tyres, while four axle trailers are based on low-profile 22.5 tyres. Input cost data was obtained by surveying truck contractors and manufacturers. All costings are based on three 90 km hauls per day, plus a "to and from" work distance, giving a total annual distance of 138,650 km, with 90% of operation on highway and trailers assumed piggy-backed for all empty running.

As the costings use average values for each configuration type, and common assumptions across all configuration types, the relative rates calculated between rig types will not necessarily reflect the differences in cost between any two particular trucks of different configuration. Absolute rates will also vary from those calculated according to operating conditions. Separate costings would be required to compare any two particular trucks or to calculate a rate for any particular operating environment.

Tables 1 and 2 summarise the costs calculated for the various rigs. Arrows above the stanchions in the Table diagrams indicate a convertible rig.

Standing costs include:

- interest
- insurance
- depreciation
- registration
- overheads (added into truck component only).

Market rates for interest and insurance have been used.

Operating costs comprise of:

- tyres
- repairs and maintenance
- fuel and oil (truck only)
- wages (added to truck component)

Table 1 - Truck Owning and Operating costs and Data - Short Log Trucks

TRUCK CONFIGURATION	Capital Cost (\$000)		Tare Weight (tonnes)		Gross Weight (tonnes)	Payload (tonnes)	Standing Costs (\$/yr)		Operating Costs (\$/yr)		RUC (\$/yr)		Cartage Rate \$/tonne.trip
	Truck	Trailer	Truck	Trailer			Truck	Trailer	Truck	Trailer	Truck	Trailer	
	240	52.5	9.8	4.65	44	29.55	55154	8999	128492	8614	31109	11624	11.71
	264	52.5	10.7	4.65	44	28.65	59743	8999	130154	8560	24021	9190	11.92
	240	52.5	9.8	4.65	43	28.55	55154	8999	127678	8614	31109	10345	12.02
	264	48	10.7	4.0	44	29.3	59743	8320	130873	7456	30809	13046	12.11
	233	78	8.6	6.9	44	28.5	53761	13714	126876	15043	22649	15948	12.34
	240	52.5	9.8	4.65	42	27.55	55154	8999	126865	8614	31109	9190	12.35
	240	48	9.8	4.0	42	28.2	55154	8320	127564	7557	31109	17682	12.44
	246	59.5	10.3	5.4	44	28.3	56349	10065	129254	9720	31109	11624	12.44
	233	69	8.6	6.3	44	29.1	53761	12267	127115	13042	26580	22942	12.46
	270	59.5	11.2	5.4	44	27.4	60937	10065	130917	9666	24021	9190	12.67
	270	51.5	11.2	4.5	44	28.3	60937	8760	131636	8428	30809	13046	12.71
	246	59.5	10.3	5.4	43	27.3	56349	10065	128441	9720	31109	10345	12.78
	233	62	8.6	5.6	44	29.8	53761	11117	127838	12735	36287	31147	12.99
	246	51.5	10.3	4.5	42	27.2	56349	8760	128327	8529	31109	17682	13.08
	246	59.5	10.3	5.4	42	26.3	56349	10065	127628	9720	31109	9190	13.16
	248	48	10.6	4	39	24.4	56175	8320	130129	7557	23823	10697	13.76
	238	71.5	8.9	5.5	39	24.6	54628	13064	123124	6697	36287	8398	13.97
	233	51.5	8.6	5.1	39	25.3	53761	9423	122032	12999	36287	16797	14.09

Table 2 - Truck Owning and Operating costs and Data - Long Log Trucks

TRUCK CONFIGURATION	Capital Cost (\$000)		Tare Weight (tonnes)		Gross Weight (tonnes)	Payload (tonnes)	Standing Costs (\$/yr)		Operating Costs (\$/yr)		RUC (\$/yr)		Cartage Rate \$/tonne.trip
	Truck	Trailer	Truck	Trailer			Truck	Trailer	Truck	Trailer	Truck	Trailer	
	261	46	10.5	4.1	44	29.4	58985	8338	129810	6925	27215	15212	11.89
	237	46	9.6	4.1	42	28.3	54429	8338	126974	7203	36287	15212	12.45
	261	37	10.5	3.2	42.2	28.5	58985	7037	129353	5595	34828	16615	12.56
	261	35	10.5	3	40.8	27.3	58985	6634	128009	4832	34828	11418	12.71
	237	37	9.6	3.2	37.4	24.6	54429	7037	123620	5595	36287	16615	14.05
	237	35	9.6	3	36	23.4	54429	6634	122630	4832	36287	11418	14.32

Tyre life has been varied according to configuration and the fuel consumption varied from 51 to 57 litres/100km according to gross weight. Truck repairs and maintenance (R&M) estimates of between 10 and 12 cents per km have been used, as an average over the first five years of a truck's life. Trailer R&M figures range from 3.5 c/km (2 axle longs jinker) to 7.6 c/km (4 axle convertible), again averaged over the life of the trailer. For convertible rigs, a small extra amount of R&M is allowed for both the truck and the trailer, as industry experience indicates a higher maintenance cost for these rigs.

20 METRE - 44 TONNE TRUCK TRAILER POLICY

The 20 m - 44 tonne policy introduced last year allows most truck and trailer rigs which qualify for operation above 39 tonnes to operate at 20 metres overall length. For 6x4 trucks with four axle trailers this has the effect of allowing 2nd to 7th axle spacing sufficient to attain a 38 tonne loading for that axle group, which combined with the six tonne front axle gives a total GCM for these rigs of 44 tonnes. Three axle trucks with three axle trailers remain restricted to 42 tonnes, but can operate at 20 metres. Trucks specifically excluded from the policy are any form of jinkers, and trucks or trailers with any triaxle groups.

In its published (interim) form the 20m-44 tonne policy contains clauses which restrict the ability of the logging industry to take full advantage of the efficiency gains which were the intent of the policy. Clauses in the policy require a 1.6 metre spacing between the truck and the trailer, or their loads (inter-vehicle spacing - IVS), and ban adjustable or multi-position drawbars on 20 metre truck trailer configurations.

These original requirements restricted convertible rigs from operating at 20

metres in shorts mode (drawbar clauses), and made it difficult to load two packets of 8.1 metre logs within the 20 metre limit due to the IVS requirement. The policy has been under revision, and although at the time of writing, an updated version of the policy has not been released, changes to the administration of the policy have already been implemented, and proposed amendments will address the remaining concerns of the log transport industry. It is proposed that adjustable drawbars will be permitted subject to some conditions. Convertible rigs have already been issued with permits to operate at 20 metres in shorts mode, while still restricted to 19 metres (and therefore a lower GCM for 6x4 + 4 rigs) for longs operation. It has also been proposed that the IVS be reduced to 1.4 metres, with evaluation by a computer simulation to be available to assess operation at IVS of less than 1.4 m if required. With careful design, the computer evaluation option should allow IVS of 1.1 to 1.2 metres.

Another proposed relaxation is the increase of rear overhang on 6x4 trucks to 65% of wheelbase, while for 8x4 trucks 70% is proposed. The current maximum of 3.7 metres will remain for both configurations. This will allow for shorter wheelbases to be used on 6x4s to achieve the 2nd to 7th axle spacing required for a GCM of 44 tonnes, while maintaining load deck length. On 8x4s, the measure is aimed at clearing up problems associated with the different wheelbase definitions that have been used within the industry.

RESULTS AND DISCUSSION

Short Log Cartage

On a straight cost basis (as calculated), the recent change in the regulations has made a 6x4 truck with four axle trailer (6x4 + 4) shorts rig at 44 tonnes the most cost effective rig.

This is closely followed by the 8x4 with four axle trailer shorts rig, and then a 6x4 + 4 at 43 tonnes gross. There are, however, other operational factors which will influence the decision between rig configurations, particularly between 8x4 and 6x4 trucks; these are discussed in a later section.

Seven axle B-trains, which have gradually become more numerous in the logging industry, are nearly 7% more expensive than the most cost effective rig. This is mainly due to higher road user charges (RUC) and trailer operating costs created by operating with the front trailer on the road 100% of the time. Eight axle B-trains have lower RUC, and thus come in at 5% more expensive than the most economical rig. A six axle B-train, although it has the highest payload of all the configurations costed, is disadvantaged by high RUC and is 11% more expensive than the cheapest rig. Disadvantages across all B-trains are the inability to split weigh, an inability to carry two packets of 8.1 metre logs legally, and generally poorer bush performance. However for fleet operators, they offer flexibility for the tractor unit to hook up other trailers and cart different goods.

"Bailey bridges", both folding and normal, and 6x4 trucks fitted with a tag axle and towing a three axle trailer, are approximately 20% more expensive than the cheapest rig for highway cartage.

The 6x4 with four axle trailer rigs is costed out at three different gross weights. At the old limit of 42 tonnes, this configuration is 5.5% more expensive than the same rig at 44 tonnes, while at 43 tonnes it is 2.6% more expensive. Most 6x4 + 4 rigs that were originally set up for 42 tonnes will only require a new drawbar to achieve 43 tonnes GCM, costing around \$1,200, plus \$135 for the 20 metre permit. At a cartage rate of \$12 per tonne, this modification would be paid for in eight weeks, and thereafter create extra revenue at negligible extra operating

cost. As explained below, the trade-offs to get a conventional cab 6x4 + 4 rig to 44 tonnes would probably not be worthwhile. For a cab-over rig, a wheelbase reduction and drawbar extension may cost as little as \$3,500, which would be paid for by the revenue from the extra two tonnes of payload in only ten weeks. This indicates that for those currently running a 6x4 + 4 rig at 42 tonnes, it would definitely be worthwhile to consider increasing the gross weight rating of their rig, particularly if they intend keeping the rig for more than another six months.

Convertibles

The costings in Table 1 reveal that at the same utilisation and percentage loaded running, convertibles require a significantly higher cartage rate than the same axle configuration rig in a dedicated shorts unit. This is mainly due to the higher tare weight and the resultant lower payload, and to a lesser extent the higher capital cost and slightly higher operating costs of convertibles. To reduce the cartage rate of convertibles to meet that of a dedicated shorts rig of the same axle configuration, the utilisation in terms of tonne-km per year needs to be increased (by increasing the annual distance travelled, or increasing the percentage of loaded running). Using the data for the 6x4 + 4 axle at 44 tonnes configuration as an example, the percentage loaded running needs to be increased from 45.8% (as costed) to 50.5% to reduce the cost per tonne of the convertible to the same rate as the dedicated shorts rig. At a similar percentage loaded running for both rigs, the annual distance needs to be increased from 138,650 km to 165,860 km.

Cab-Over versus Conventional Cab Trucks

To achieve maximum log transport efficiency, truck (and thus capital) utilisation must be maximised. To help

achieve this, flexibility to cart all log lengths is required. In this respect, cab-over trucks offer advantages over conventional cab rigs in being able to cart two packets of 8.1 metre logs, which is not legally possible with conventional trucks. In fact, it is not possible to carry an 8.1 metre log on most conventional cab trucks because of the 11 metre overall length limit on a rigid truck.

To attain 44 tonnes with a 6x4 + 4 configuration, it is necessary to extend the rearmost trailer axle back as far as possible, and to reduce the truck wheelbase. However, if this is done on even the shortest cab conventional truck, the available load length is reduced such that even a 7.4 metre log cannot be carried legally due to excessive rear overhang (even with 65% wheelbase measure), and little more than a 7.4 metre log can be carried on the trailer. At axle spacings to give a GCM of 43 tonnes, it would be possible to set up some conventional trucks to carry a maximum of 7.4 metre logs on the truck, and 8.1 metre on the trailer. However, this may require longer wheelbase trailers than is currently the norm (to avoid excessive trailer front overhang), and this could cause problems in being able to piggy-back the trailer when unloaded. Shorter trailers would result in GCM dropping to 42 tonnes when carting 8.1 metre logs on the trailer.

In contrast, it is possible to set up most cab-over units to cart all shorts combinations at 44 tonnes, except two packets of 8.1 metres, which would be carted at 43 tonnes. In addition, a convertible set up in this way would be able to carry longs at 43 tonnes within 19 metres length. Thus, conventional cab trucks limit both the flexibility and the efficiency attainable by 6x4 trucks under the 20m-44 tonne policy.

6x4 versus 8x4 Trucks

Although the costings summarised in Table 1 show the 6x4 + 4 at 44 tonnes to be the most cost efficient rig for carting short

logs, the 8x4 + 4 is only 1.8% more costly on a per tonne basis, and has some operational advantages. As explained above, a 6x4 + 4 set up for 44 tonnes GCM will in almost all instances have to drop one tonne in order to cart two packets of 8.1 metre logs. If more than one half of the 6x4s loads are 8.1 metre logs, then the advantage of the 6x4 + 4 is lost and the 8x4 + 4 becomes more economical. Also in the case of convertibles, 8x4 rigs do not have to reduce vehicle length to cart longs, as they are easily able to attain adequate axle spacings for 44 tonnes within the 19 metre length limit set for long log cartage. The most at which a 6x4 + 4 convertible can legally carry longs is 43 tonnes due to the 19 metre limit restricting axle spacings. Thus in the convertible case, an 8x4 + 4 is the most economic rig if the combined number of long log and 8.1 metre loads are greater than half the work.

On the truck performance side, 8x4 trucks can have lesser traction and gradeability than 6x4 trucks when unloaded due to the lesser proportion of the weight carried by the driving axles. When loaded, gradeability should not be significantly different between 8x4 and 6x4 rigs if the drive axles are loaded to the same weight.

Long Log Cartage

For long log cartage, the 8x4 with three axle longs trailer comes in at the cheapest rate, followed (5% up) by the 6x4 with three axle longs trailer. The next best is an 8x4 with a two axle (spaced) longs trailer, followed closely by the convertibles, 8x4 + 4, 8x4 + 3, 6x4 + 4 at 43 tonnes (6x4 + 4 cannot cart longs at 44 tonnes). The flexibility of the convertibles may make them preferable to the 6x4 + 3 axle and the 8x4 + 2 axle dedicated longs rigs which are marginally cheaper. The 8x4 + 3 axle longs rig appears to have a place still, being nearly 7% cheaper than the convertibles.

Effect of the Percentage of Highway Operation

The primary factors determining the relative cartage rates between different rig configurations are the cost of RUC and the payload that is able to be carried. Thus as the percentage of highway operation in a haul is reduced, the relative rates between rigs may change. As an example, taking all other cost and operational factors as the same, if the percentage of highway operation is reduced to 50%, and the on-seal portion is reduced to 60%, the order of the first five rigs becomes, 6x4 + 4 @44, 6x4 + 4 @43, 8x4 + 3, 8x4 + 4, 6x4 + 3. Rigs which have higher RUC but can carry higher payloads become more competitive as the proportion of highway operation decreases.

Cost Changes Since 1989

Since the last report interest rates have dropped significantly, while trailer and truck prices have risen only slightly. The cost of diesel has also dropped, mainly due to the removal of eleven cents tax in 1991, and truck fuel consumptions have reduced with improving engine technology. In addition, the R&M figures used are significantly less than those in the last report, while the wages figure in this report is higher. The annual distance costed is 25% higher than in the previous report, and payloads have increased with reduction in tare weights, particularly for trailers. Taken together, these changes have reduced the cartage rates calculated by approximately 5%-8% on those used in the 1989 report.

CONCLUSIONS

Tables 3 and 4 show the best three rig configurations (on straight economic basis) for carting short and long logs respectively. The 20 metre - 44 tonne truck trailer policy has made 6x4 + 4 at 44 tonnes a more economic shorts rig configuration than the 8x4 44 tonne shorts rigs that existed prior to the policy. However, a need to reduce gross weight to 43 tonnes when carting 8.1 metre logs on

the trailer will negate the benefit this rig has over the 8x4 + 4 rigs if this load configuration is carted more than 50% of the time.

Table 3 - Three best short log rigs

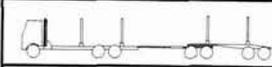
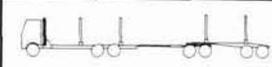
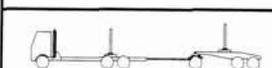
	(44 tonnes)
	(44 tonnes)
	(43 tonnes)

Table 4 - Three best long log rigs

	(44 tonnes)
	(42 tonnes)
	(42.2 tonnes)

The 20 metre policy will allow most existing 6x4 + 4 rigs to attain 43 tonnes with a relatively inexpensive drawbar modification, and this will reduce the cartage rate required to cover costs by 3%. Cab-over trucks offer advantages in flexibility and efficiency over conventional cab trucks operating under this policy.

Convertible rigs, because of their lower payloads and higher costs, are more expensive than dedicated shorts rigs at the same utilisation, and require a 10% higher proportion of loaded running, or 20% higher annual mileage to match the rates required by a dedicated shorts rig.

For long log cartage, an 8x4 with three axle trailer is the most cost effective rig, with convertibles approximately 6%-7% more expensive per tonne.

REFERENCES

- Taylor, P. (1989) : "Log Truck Axle Layouts - 1989", LIRA Report Vol. 14, No. 4.
- Goldsack, R. (1988) : "Costing Handbook for Log Truck Contractors", LIRA.

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