Session 2 Paper (a) Neil Wylie - Gareth Jones
Economic Comparison Of Log Truck Configurations
1994 LIRO Forestry Transport 2000 Seminar

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

ABSTRACT

LIRO recently published a paper on the economic comparison of log truck rig configurations (Jones 1993) which 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 (providing maximum loading is able to be achieved), 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. This paper uses much of the content from Jones's publication, but adds further comments on recent developments.

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 (figure 1) to increase their GCM to 44 tonnes. The policy also contains provisions for truck and trailer units to operate at 20m overall length, increased from the previous limit of 19m. Further discussion is underway with the Land Transport Safety Authority (LTSA) to fine tune the 20m regulations to enable a 44 tonne GCM to be obtained by a wider range of vehicles.

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. An increase in specialised equipment has also been seen with vehicles being constructed to cart specific log lengths, (ie 8.2m and 3.7m logs) or to be able to cart a range of products including logs, sawn timber, and general freight. This allows a higher loaded percentage, and vehicle utilisation.

This paper 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 255-70r22.5 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)

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 20m - 44 tonne policy allows most truck and trailer rigs which qualify for operation above 39 tonnes to operate at 20m overall length. For 6x4 + 4 this has the effect of allowing 2nd to 7th axle spacing sufficient to attain a 38 tonne loading *on most cab over vehicles, with most conventional vehicles obtaining 37 tonnes over this group.* Combined with the six tonne front axle load this gives a total GCM for these rigs of *43 or* 44 tonnes. Three axle trucks with three axle

Table 1 - T. k Owning and Operating Costs and Data · ort Log Trucks

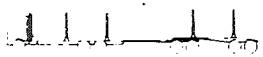
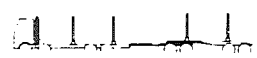
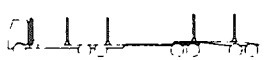
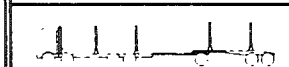
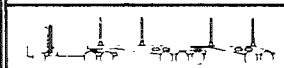
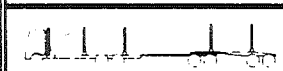
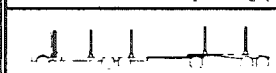
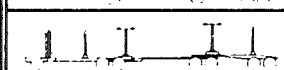
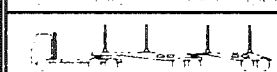
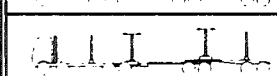
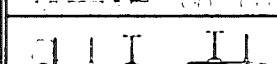
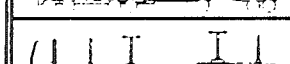
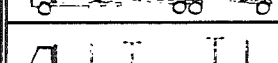
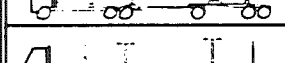
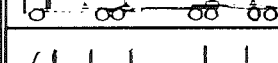
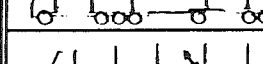
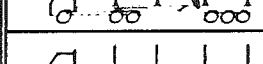
TRUCK CONFIGURATION	Capital Cost ($000)		Tare Weight (tonnes)		Gross Weight (tonnes)	Payload (tonnes)	Standing Costs ($/yr)		Operating Costs ($/yr)		RUC ($/yr)		Cartage Rate $/tonne.trip
	Truck	Trailer	Truck	Trailer			Truck	Trailer	Truck	Trailer	Truck	Trailer	
	240	52.5	9.8	4.65	44	29.55	55154	8999	128492	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

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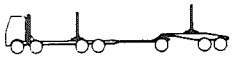
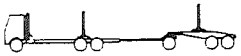
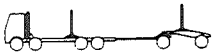
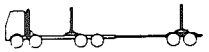
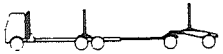
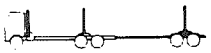
Table 2 - Truck Owning and Operating costs and Data - Long Log Trucks

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

trailers remain restricted to 42 tonnes, but can operate at 20m. Trucks specifically excluded from the policy are any form of jinkers, and trucks or trailers with any tri-axle groups. LIRO is working with Industrial Research and the Land Transport Safety authority to have Tri-drive trucks allowed to operate above their present limits of 19m and 39 tonnes. If Tri-drives are allowed to operate at 20m and 44 tonnes, they will then (based on their economic performance) be very similar to 8x4 vehicles. The traction ability and off road performance of these vehicles may also affect their positioning, placing these vehicles very high on the list. To date there are ten Tri-drive vehicles on the road with some of the older vehicles now getting up to 300,000km

The restrictive 1.6m inter-vehicle spacing (IVS) of the original policy has since been modified to allow vehicle combinations with an IVS less than 1.6m having a computer performance evaluation requiring a 25m, wall to wall, 270deg turn performed. Compliance is achieved if the vehicle combination dimensions are within the regulations, and a minimum distance between the logs during this manoeuvre never falls below 400mm. This allows most cab-over vehicles carting two packets of 8.2m logs with an IVS of approximately 1,150mm to comply.

LIRO is working with the Land Transport Safety Authority, and the Road Transport Association to have two drawbar operating positions allowed. This will allow 6x4 + 4 vehicle combinations (if required to cart 8.2m logs) to obtain their maximum GCM. To prevent excessive front overhang when carting 8.2m logs, all convertible trailers and most shorts trailers used in this combination require the drawbar length to be shortened. This also shortens the 2nd to 7th axle spacing which drops the maximum allowable load for this group, (and the GCM) by 1 tonne.

The increased rear overhang on 6x4 trucks to 65% of wheelbase, and 70% for 8x4 trucks now allowed up to a maximum of 3.7 metres 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. 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, higher road user charges (RUC) and trailer operating costs created by operating with the front trailer on the road 100% of the time (this disadvantage is reduced if the loading percentage is increased), the inability to split weigh, an inability to carry two packets of 8.1 metre logs legally, and generally poorer bush performance, *combined with the added difficulty of reversing B-trains for long distances.* 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, are approximately 20% more

expensive than the cheapest rig for highway cartage.

The 6x4 + 4 rigs are 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 20m 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 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 8.2m logs, which is not legally possible with conventional trucks. In fact, it is not possible to carry an 8.2m log on most conventional cab trucks because of the 11m 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 7.4m log cannot be carried legally due to excessive rear overhang (even with the new rear overhang allowance of 65% of the truck wheelbase), and little more than a 7.4m 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 7.4m logs on the truck, and 8.2m on the trailer. However, this may require longer wheelbase trailers than is currently the norm (to avoid excessive trailer front overhang). This is not practicable for interchangeable trailers, and on shorts 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 8.2m 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 8.2m, 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 19m length. Thus, conventional cab trucks limit both the flexibility and the efficiency attainable

by 6x4 trucks under the 20m-44 tonne policy. In both cab-over and conventional cab 6x4 trucks, where a four axle trailer that has a wheelbase of less that 4.8m is required to cart 8.2m logs, the GCM must be reduced by 1 tonne, unless Ltsas allow two operating positions in the drawbar. With the two operating positions this 1 tonne reduction in the GCM would only occur when log lengths above 7.4m are being carried.

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 8.2m logs. When carting two packets of 3.7m logs, on the four axle trailer it is difficult to obtain a full payload of logs before the volume limits the loading of more logs. One way of obtaining maximum loading with 3.7m logs is to have a four bolster trailer that enables two packets to be carted on the trailer. An 8x4 has an advantage here as a greater weight can be loaded onto the truck making a 44 tonne GCM with two packets of 3.7m logs easier to obtain. If more than one half of the 6x4s loads are 8.2m or 3.7m 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 19m limit restricting axle spacings. Thus in the convertible case, an 8x4 + 4 is the most economic rig if the combined number of long logs, 8.2m logs and 3.7m logs 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 consumption's 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 20m - 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 8.2m 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

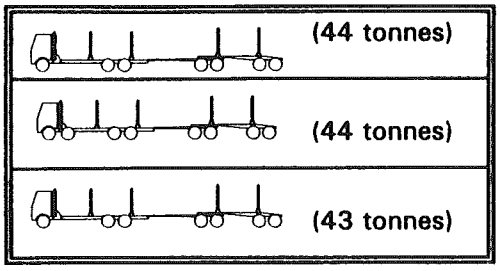
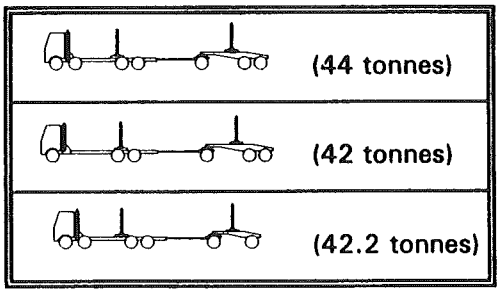


Table 4 - Three best long log rigs



It is impossible in one paper of this length to consider all the operating scenarios and the danger of ranking the vehicle as we have done is that people buying new vehicle combinations will use this data, ignoring their own site specific circumstances. Because of the large sum of money involved in putting a new vehicle combination on the road (approx $300,000), it is worth running the details of your specific operation through the LIRO TRUCKAAI program (This spreadsheet program is available from LIRO at a cost of $12.00 for members $120.00 non members). The program is able very quickly to give you the economic performance of each individual vehicle combination thereby assisting the purchaser to select the optimum vehicle combination based on the figures supplied.

The site specific figures required that will determine your ultimate vehicle combination are:

1. *What length logs will I need to cart? (ie longs 10 - 12m, Shorts 3.7 - 8.2m)*
2. *What percentage of time will I need to be able to cart each log length?*
3. *What other work will be available if I can cart other log lengths? This can effect both the loaded percentage by backloading, or provide you with work when you would normally be parked up*
4. *Is there a need to future proof this decision by selecting a versatile vehicle?*
5. *Company policy?*
6. *Hours of operation?*
7. *Percentage of highway running?*
8. *Need to self load?*

These questions determine ultimate vehicle combination. Further questions need to be asked regarding the vehicle specification, which will be covered in more detail by the next speaker Mr Derek Dumbar.

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.