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The impact of tare weight on transportation efficiency in Australian forest operations

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Introduction

Transportation is an important cost of operations, representing about 15% of the total wood value. One of the greatest opportunities to reduce transport cost is through increased payload, where every kilogram increase in payload represents between $5 and $10 savings per year. Improving payload reduces cost, and can also decrease the fuel use and carbon emissions from a fixed freight task by 3% to 5% for every tonne increase in payload. Under the load-restricted conditions of transport on public road networks, once the largest configuration is in use with good load management, the only way to legally increase payload is to decrease the tare weight of the vehicle by using the lightest design available. In some instances tare weight can be reduced by changing the specifications of the vehicle, i.e. by using lightweight bullbars, completely removing bullbars, or using lightweight material (aluminum over steel) for trailer construction.

For this analysis, five companies provided one year of weigh-bridge data including vehicle identification, tare weight, gross weight and time of each load. This report is limited to examining the tare weights and focuses on the opportunity to reduce costs, fuel use and carbon emissions by improving the fleet to the lightest current vehicle design available.

Parameters for analysis

- Capital costs (salvage)
  - Semi-trailers $190,000 ($32,000)
  - B-double $255,000 ($39,000)
  - Pocket and road-trains $285,000 ($24,500)
- Interest rate of 10%
- Salary $25/hr +20% on-costs
- Operating 12 hr/day 230 days/year
- 100km haul distance (95% public roads)
- Fuel price $1.35/L
- Maintenance cost of $0.35/km to $0.40/km
- Fixed costs of $26,000/yr
- Profit/risk margin on costs 8%

Results and discussion

Figure 1 shows the tare weights observed across the five companies for the four different configurations examined. A significant range of tare weights was observed within each configuration type. Semi-trailer and road-train tare weights ranged by over 6 tonnes, B-doubles ranged by over 8 tonnes and pocket-trains ranged by over 12 tonnes.

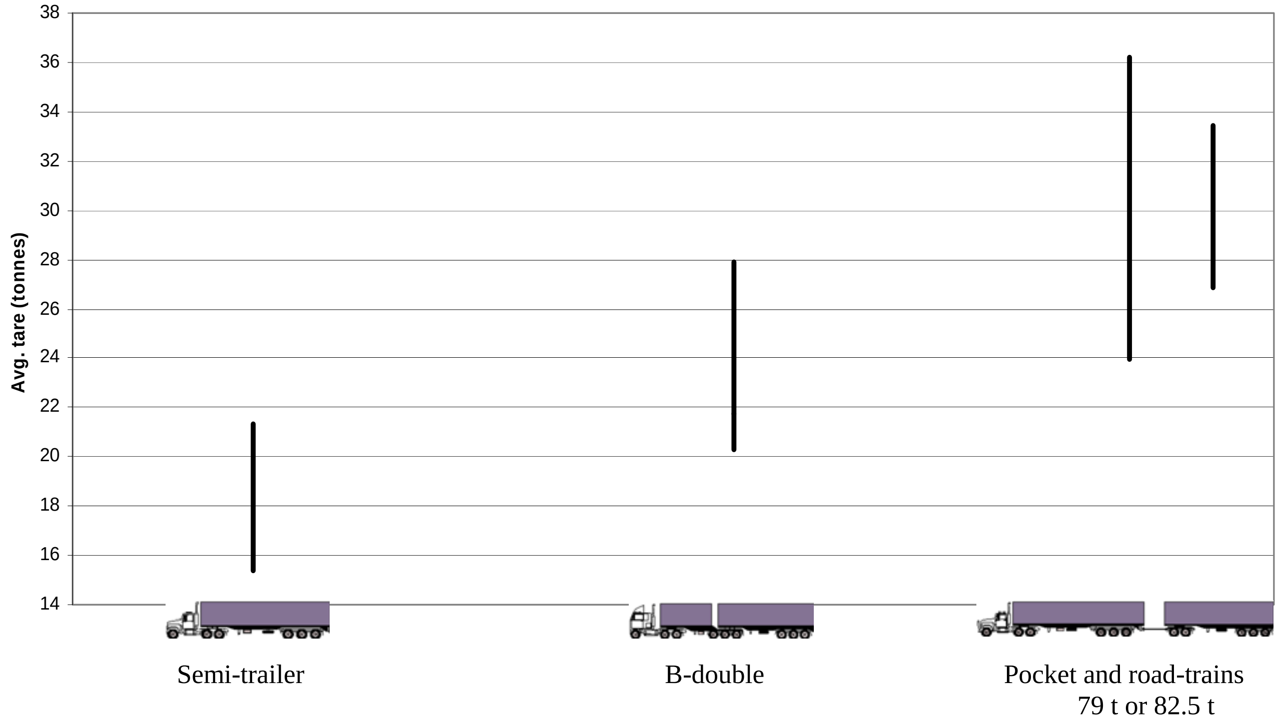

Figure 1: Fleet tare weight ranges

Table 1 uses five scenarios to evaluate the potential impact on costs, fuel use and carbon emissions per tonne transported. The five scenarios evaluated for each configuration type were: lightest vehicle, heaviest vehicle, average of the lightest 20% of vehicles, average of the heaviest 20 % of vehicles, overall average vehicle.

Table 1: Analysis of tare weight impact on costs, fuel use and carbon emissions

Configuration	Tare weight scenario	Average tare (Kg)	Per tonne transported		
			Cost	Fuel (L)	CO2 (kg)
Semi-trailers (42.5 t GVW)	Lightest tare	15,374	$16.76	3.65	9.87
	Lightest 20%	16,597	$17.62	3.88	10.47
	Average	18,432	$19.13	4.27	11.53
	Heaviest 20%	20,060	$20.70	4.67	12.62
	Heaviest tare	21,343	$22.07	5.03	13.58
B-doubles (62.5 t GVW)	Lightest tare	20,272	$11.96	2.97	8.01
	Lightest 20%	21,107	$12.23	3.04	8.22
	Average	22,651	$12.76	3.20	8.64
	Heaviest 20%	24,679	$13.54	3.43	9.26
	Heaviest tare	27,907	$14.96	3.85	10.41
Pocket-trains (79 t GVW)	Lightest tare	23,976	$10.77	2.71	7.32
	Lightest 20%	25,834	$11.19	2.84	7.68
	Average	29,205	$12.06	3.11	8.41
	Heaviest 20%	32,947	$13.19	3.46	9.35
	Heaviest tare	36,188	$14.30	3.80	10.27
Road-trains (82.5 t GVW)	Lightest tare	26,830	$10.48	2.83	7.63
	Lightest 20%	27,194	$10.56	2.85	7.70
	Average	29,450	$11.08	3.02	8.17
	Heaviest 20%	31,924	$11.70	3.23	8.72
	Heaviest tare	33,409	$12.10	3.36	9.08

Using the parameters for analysis provided earlier, the cost per tonne for each configuration type was calculated based on the potential payload of the vehicle under the five tare weight scenarios listed above. Basic fuel consumption prediction formulas were used (excluding any impact of differences in engine design or driver techniques) to calculate fuel use. In these calculations it was assumed that vehicles that lowered their tare weight would be able to move more wood each trip for the same amount of fuel. Carbon emissions were estimated based on each litre of diesel fuel burned producing 2.7 kg of carbon dioxide.

Just considering the impact of tare weight alone, savings of $1.5 to over $5 per tonne are possible depending on the configuration class, without reducing margins for the contractor. In addition, fuel and emissions savings are also possible. Importantly, these savings are possible without a major shift in technology by simply moving the entire fleet towards the current lightest vehicle design or specification. While this may be easier said than done, it does not involve the risks and issues associated with introducing new technology that may have uncertain benefits.

Table 2 represents the differences in cost, fuel consumption and carbon emissions between the lightest and the heaviest vehicle in each configuration class when carrying one million tonnes of freight. While the costs calculated include fuel, they do not include the costs associated with carbon emissions in a future business environment that includes emission trading schemes. An indication of the potential impact of carbon emission costs is included in the last column of the table on the basis of $20/tonne for CO_2.

Table 2: Differences in the cost, fuel use and carbon emissions between the lightest and heaviest vehicles in each configuration class with a 1 million tonne freight task

Configuration	Difference between lightest and heaviest tare for 1 million tonne freight task			
	Cost	Fuel (L)	CO2 (t)	Cost incl. CO2 @ $20/t
Semi-trailers (42.5 t GVW)	$5,309,787	1,376,716	3,717	$5,384,129
B-doubles (62.5 t GVW)	$3,000,512	885,838	2,392	$3,048,348
Pocket-trains (79 t GVW)	$3,534,776	1,090,410	2,944	$3,593,658
Road-trains (82.5 t GVW)	$1,617,955	537,397	1,451	$1,646,974

Considering that the cost of carrying a million tonnes of freight can vary by up to $5.3 million within a configuration class, the potential cost associated with having heavier vehicles than necessary is huge. In areas like the Green Triangle, where the freight task will increase by nearly 3 million tonnes over the next three years, reduction in vehicle tare weight and the associated increase in pay load could result in savings of millions of dollars, less vehicles on the road and less carbon emissions. If a less aggressive fleet change was adopted of moving from a fleet of the heaviest 20% to a fleet of the lightest 20% in the study, on a similar 1 million tonne freight task, savings in the order of 60% of those stated above are still possible.

Actual company fleets are usually a mixture of at least two different configurations, for example 20% semi-trailers and 80% pocket-trains or 80% B-Doubles. Table 3 presents the actual potential savings reported back to each of the five companies when their actual fleet performance is compared with the same freight task being performed by either the lightest vehicle in each configuration class in their fleet, the lightest vehicles in each configuration class across the five fleets and the average of the lightest 20% of vehicles in each configuration class across the five fleets.

Table 3: Actual individual company results based on their freight task

Company	Annual financial impact if loaded to legal limit compared to:		
	Lightest in company	Lightest in class	Average of lightest 20%
A	$61,030	$121,158	$39,135
B	$110,995	$220,046	$64,775
C	$455,651	$455,651	$275,241
D	$204,171	$682,516	$452,002
E	$1,074,393	$1,051,541	$741,314

Take-home messages

- Current forestry transport fleets exhibit a wide range of tare weights within each vehicle configuration indicating there is potential for massive savings in transport costs by simple management of tare weights.
- The potential magnitude of savings can be quickly determined by a simple analysis of readily available weigh-bridge data.
- This analysis can assist in identifying within-fleet options that provide a template for achieving the greatest gains.
- Once the potential is quantified and the star fleet performer is identified, real life verification of the predicted gains is critical in achieving contractor buy-in.
- To ensure a commitment to continuous improvement:
  - real life gains should be equitably shared by all parties
  - changes in contract rate payments should be appropriately phased in
  - if gains are substantial, companies could consider offering financial support to enable equipment changeover.

Organisations supporting this research

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More information

CRC for Forestry website: http://www.crcforestry.com.au/research/programme-three/index.html
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