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High Productivity Vehicle Costs and Selected Freight Policy Implications

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Abstract

Jurisdictional freight strategies seek (among other matters):

- increased road freight efficiency to best utilise existing road assets
- increased freight utilisation of the [remnant] long distance rail network, and
- promotion of inland freight routes.

The compatibility of these distinct policy objectives seems to be assumed.

The 2015 ATRF High Productivity Vehicle (HPV) Access and Commodity Characteristics paper demonstrated the importance of commodity flows and logistics on potential freight route diversions which changes the evaluation of HPV infrastructure investments.

Another important matter is the impact of HPV operator costs on competing freight routes with different HPV and mass limit access. Operator cost models should have sufficient sensitivity to differentiate freight commodities, HPV types and routes.

This paper describes the development and application of a bespoke HPV road freight operational model (RFOM) for two long distance corridors. It was developed using 2015 capital and 2014/15 operational data from manufacturers, suppliers and a small number of medium road freight operators. This overcame the commercial in confidence issue.

The paper also outlines RFOM tests. It contrasts selected performance measures of different HPV types, and one of four freight commodities/ trailers with the RFOM results.

Use of the RFOM allows the potential road freight operator response to distinct freight policy positions to be assessed more thoroughly. The RFOM results for Performance Based Standard level 2B (PBS2B) A-Double use on a long distance coastal route at General and Higher Mass Limits are stated. These results are contrasted with higher order HPV types on a competing inland freight route. The implications for the coastal rail route are discussed.

This research has implications for the three above freight policy matters. This includes HPV type productivity, jurisdictional cost recovery of infrastructure investment for increased HPV access and HPV access and long distance freight road and rail competition.

1. Introduction

1.1 Policy context

The road transport industry considers that increasing HPV access generally reduces road freight operator costs, as do many jurisdictional policy advisors. If so, HPVs may be a road utilisation improvement. Austroads Research Report AP-R465-14 (Austroads 2014) *Quantifying the Benefits of High Productivity Vehicles*, was released in July 2014. It outlines the direct and indirect benefits of increasing HPV access up to PBS level 3 on major freight routes in Australia, with particular emphasis on the Brisbane, Sydney, Melbourne and Adelaide road freight corridor.

Direct benefits examined include safety, productivity, fuel and environmental savings. Indirect benefits of HPV adoption were also estimated, including the stimulated economic flow-on benefits, lowering community freight exposure, and slightly lowering infrastructure maintenance costs. Some key findings of the Austroads 2014 were:

- *'For serious and major accidents by articulated HPVs, there were 76 percent fewer accidents when compared to conventional articulated vehicles;*
- *Estimates for productivity savings will see HPVs performing the articulated freight task on national routes exampled with 37 percent fewer trucks and kilometres; and*
- *An eight per cent switch to HPVs on highways would be equivalent to removing five per cent of trucks off the highway.'*

However, road Managers are cautious about extending access as longer and heavier trucks are not popular with their asset managers or other road users. Many jurisdictions use the *PBS Scheme – Network Classification Guidelines*, July 2007 by the National Transport Commission, approved by the Australian Transport Council on October 2007. These are now managed by the National Heavy Vehicle Regulator (NHVR). Whether this guideline achieves efficient HPV access while preserving asset life and user safety is not this paper's subject.

Evaluation techniques for road investment are of longstanding. Austroads provides selected parameters to facilitate national consistency. Where an increase in HPV access along a route or corridor has a positive evaluation, some policy advisors consider that the road investment costs may be able to be recouped through increased charging of the higher order HPVs that benefit. Austroads Research Report AP-R490-15 (Austroads 2015) '*Identifies opportunities where direct investment in public road infrastructure can be made by private operators in order to improve access and productivity'*.

While the Productivity Commission 2006 report suggests mass, distance and location heavy vehicle charging and cost recovery, it has still not developed sufficiently to be trialled, so is not considered in this paper.

1.2 Operator and road manager context

An important matter considered by this paper is whether road freight operators will invest in HPVs allowed by any increased access to a route or corridor. A key issue in their decision is whether the freight cargo costs are lowered by switching to higher order HPVs. If the transport costs are significantly lower for the cargo offering, road freight operators are likely to transition over time to larger HPVs, in order to remain competitive[1].

If road managers had access to high quality RFOM, they could incorporate the likely operator response and resulting charges revenue into the road infrastructure investment decision for increased HPV access. Any extra charges would have to be low enough so that road freight operators would still choose to use the newly accessible, higher order HPVs. The RFOM could provide insights on the charges level that would not deter road freight operators from using the higher order HPVs. In this way the RFOM could help determine the HPV infrastructure cost limit, which would still result in operator benefits for HPV transition.

This paper presents a RFOM developed for up to 101 HPV types for two routes, one coastal and one inland, and discusses its impacts to demonstrate its utility.

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[1] Operators switching to a higher order HPV which has access is dependent on many other factors including terminal designs at loading and unloading points, freight markets, etc (Dudgeon et al 2015)

Another matter is whether diverse HPV access on competing freight routes affects operator's freight route decision, which the RFOM addresses. The level of mass access allowed whether at general or higher mass limit for heavy vehicles, is included but not explored.

1.3 Primary research source

This paper draws substantially on aspects of the Austroads Research Report AP-R504-16 (Austroads 2016) *Improving High Productivity Vehicle Access through Potential Charging Regimes*. In particular it considers the attractiveness to road freight operators of higher order HPVs should they be given increased access to an Inland Freight Route between Townsville in North Queensland to Brisbane, compared with the Bruce Highway coastal route.

The authors express their thanks to the road freight operators, manufacturers and equipment suppliers for their data, and Austroads for approving use of its AP-R504-16 research. However, any statements in this paper remain the responsibility of the authors.

2. HPV and two corridors descriptions

2.1 HPV types

Table 10, *PBS Scheme – Network Classification Guidelines* (NHVR 2007) states:

- PBS2A vehicles may be 26 metres in length; PBS2Bs may be 30 metres long;
- PBS3A vehicles may be 36.5 metres in length; PBS3Bs may be 42 metres long; and
- PBS4A vehicles may be 53.5 metres in length; PBS4Bs may be 60 metres long.

Some knowledge is assumed in this paper of the various HPV types. For information, Austroads 2016 Table 2.1 depicts 28 HPV types, without considering their trailer types.

2.2 Bruce Highway

The Bruce Highway between Townsville and Brisbane is a coastal route 1,335 kilometres in length. The Bruce Highway services cities with the following 2011 populations:

- Townsville: 158 thousand
- Mackay: 74 thousand
- Rockhampton: 62 thousand
- Gladstone: 40 thousand (bypassed by the Bruce Highway)
- Bundaberg: 49 thousand (bypassed by the Bruce Highway)
- Hervey Bay/Maryborough 70 thousand (bypassed by the Bruce Highway)

As well, the Bruce Highway services towns with populations exceeding 10 thousand include Ayr/Home Hill, Bowen, Proserpine/Airlie Beach, Yeppoon and Gympie. A road manager challenge is HPVs interacting with other road users, especially urban drivers and tourists.

The Bruce Highway is a Higher Mass Limit (HML) route restricted to PBS2A B-Doubles.

2.2 An inland freight route

The Transport Infrastructure Council, comprising State and Territory Ministers, approved on 7 November 2014 a new national freight route between Charters Towers, which connects to Townsville via the Flinders Highway, and Roma, where the Warrego Highway connects to Brisbane. This inland freight route between Townsville and Brisbane is 1,491 kilometres long, 156 kilometres (11.7%) longer than the Bruce Highway coastal route. The Brisbane Toowoomba leg is 130 kilometres (8.72%) of the inland freight route.

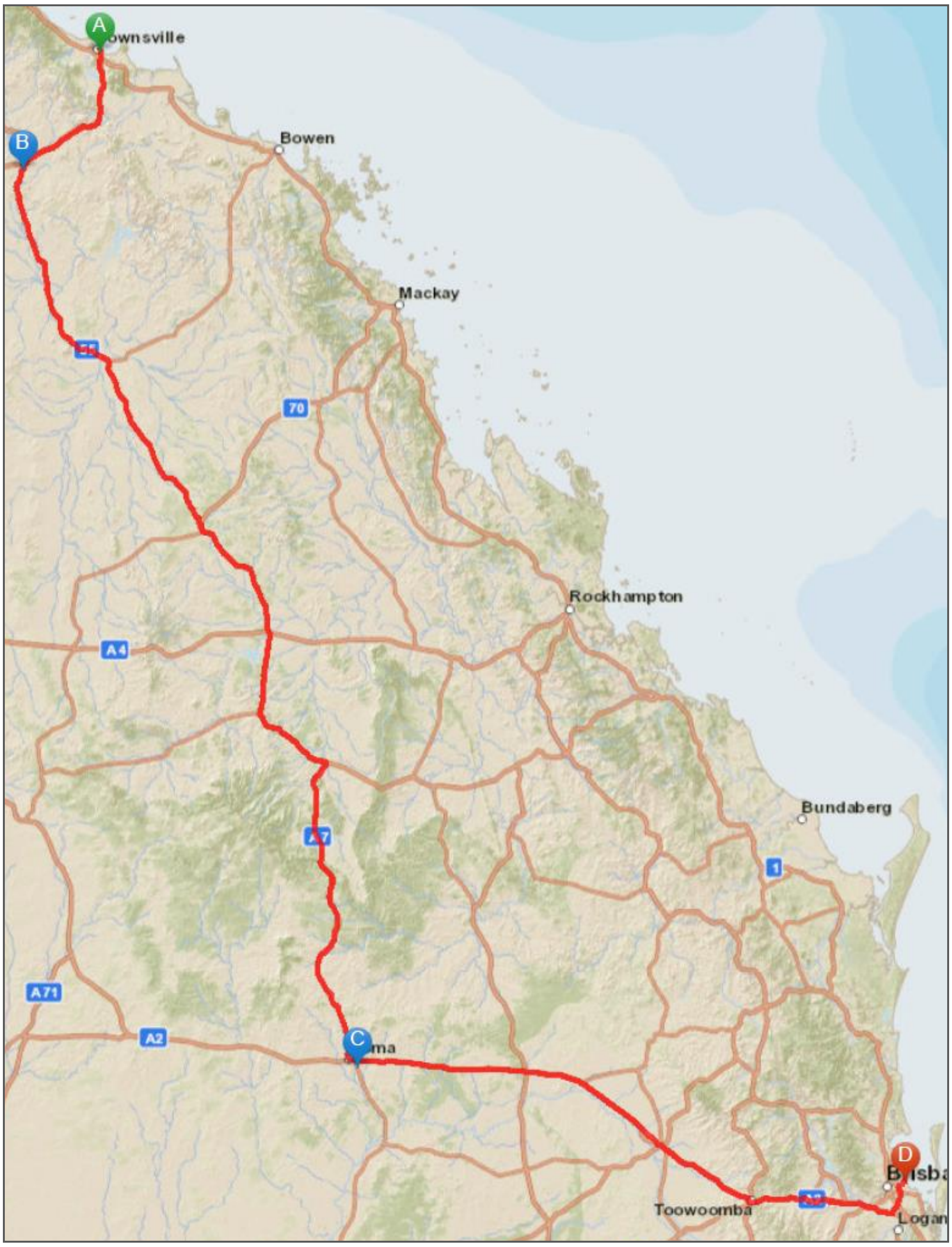
As it is longer, road freight operators would consider using this inland freight route only if it was accessible to more efficient, higher order HPVs than could use the Bruce Highway. This could include its upgrade from General Mass Limit (GML) to HML.

The inland freight route is PBS4A accessible (Triple Road Trains or Type 2 Road Trains (T2RTs)) as far as Clermont, just north of Emerald. South to Roma and Toowoomba, it is accessible to PBS3A (Double Road Trains or Type 1 Road Trains (T1RTs)). From Toowoomba to Brisbane, it is accessible to PBS2A B-doubles.

The inland freight route traverses only one city, and Toowoomba's 125 thousand people are about to be bypassed. Of the remaining towns, Emerald and Dalby have populations just over 10 thousand, and Roma and Charters Towers have populations exceeding 5 thousand.

The inland freight route is shown in Figure 1. The Bruce Highway can also be discerned passing through Bowen, Mackay and Rockhampton.

Figure 1: Townsville Brisbane inland freight route



Source: NHVR Journey Planner, Brisbane, Queensland, 2015

3. A road freight operational model

3.1 Why an RFOM?

An RFOM was desired to analyse which HPV combination might provide cheaper road freight costs on the two competing freight routes between North Queensland and Brisbane.

Road freight costs can be calculated from sources such as the FreightMetrics model. Higgins et al has shown how this model can be applied at a strategic level in Australia. However, a bespoke model was desired for this project for the following reasons:

- Control the model inputs to reflect specific circumstances applying on the two routes:
    - An example is the BAB Quad HPV, rather than a BBA or AAB types. This format integrates most effectively with shuttle transport between any of Emerald, Roma and Toowoomba to Brisbane. Also, the Quad axle groupings were designed so that trailer loads are still legal on the shuttle leg;
- Control some complex variables for comparability, such as single driver running;
- Reflect the types and costs of prime-movers and trailers used on the two routes; and
- Obtain currency in fleet operational costs, including operational travel times and operating cost data of long-standing operators.

A cost model used by Neil Findlay, a road freight fleet operator for 30 years, was adapted and updated to become the RFOM. The RFOM describes the trip cost and unit tonne kilometre rates for 101 HPV combinations/ commodity trailer types for GML and HML cases.

3.2 RFOM scope

Four different commodity[2] trailer types were considered:

- Tippers, for bulk goods;
- Open trailers or flatbeds for general freight and containers holding various products;
- Curtain Sides carrying fast moving consumer goods (FMCGs) for household and lifestyle products; and
- Fridges (reefers) carrying temperature controlled food or goods more securely.

Six different heavy vehicle configurations were costed:

- Single trailer (Semi-trailer), typically a six axle articulated combination;
- B-double, typically a nine axle combination with two trailers;
- B-triple, typically a 12 axle combination with three trailers;
- A-double, typically an 11 axle combination with two trailers;
- AB-triple, typically a 14 axle combination with three trailers; and
- BAB Quad, typically a 17 axle combination with four trailers.

Livestock and bulk tankers were specifically excluded. There is no through livestock traffic on the Bruce Highway (Dudgeon et al 2015) with cattle going to the nearest abattoir or port. Similarly, fuel is delivered to east Queensland ports by sea rather than being trucked or railed along it. Options for both GML and HML were costed separately for each combination.

[2] As used in this sense, commodity is a type of cargo which could be a commodity, product or good

3.2 RFOM design elements and data sources

The RFOM utilises key elements of fleet costing including fixed and variable costs, all requested and received on a strictly confidential basis, with data only contributing to an average drawn from multiple sources. Key suppliers included:

- Multiple European and North American prime mover and trailer companies supplied balanced, average Capex, training, depreciation and maintenance costs and tare weights. The response from equipment suppliers was excellent in terms of the qualitative and quantitative data provided.
- Variable costs were sourced both from OEM suppliers, some of whom had highly documented fixed maintenance costs available, and also directly from operators who surrendered real-time data, some even profit margins.
- Specialist equipment or technologies were consulted to get accurate Capex and/or Opex (when available) for specific operating conditions. This included refrigerated trailer costs, and Intelligent Access Program (IAP) costs where applicable. The latter was just over $11.00 per trip. OBM (On-Board Mass Management) would only add a small cost similar to the IAP.

Every effort was made to ensure that costs obtained reflected what a good quality small to medium size fleet up to about 50 vehicles, would expect to operate and pay. Detailed costs were sourced from highly respected fleet operators, who all went ‘beyond-the-call-of-duty’ and provided sensitive information about operating costs, even margins in some cases.

Some cost areas were difficult to determine due to road operator diversity. Specifically, administration costs vary widely among small and medium fleet operators. A sum was used to reflect some operator data. Also, many miscellaneous costs that operators accrue are difficult to quantify, so a nominal per trip sum was included.

More details of the RFOM design and data are discussed in Austroads 2016, Chapter 6.

Depreciation Rates

Depreciation rates were the single most complex and controversial issue to resolve. The used equipment market in May 2015 was in a state of disarray due to multiple fleet repossessions and dispersals. This resulted in hundreds of used fleet assets flooding onto the market. The most common viewpoint is that this flat market for used equipment will remain subdued for some time.

Much research was conducted with fleet manufacturers, dealers, operators and auctioneers to arrive at reliable figures. ‘Middle-of-the-road,’ realistic depreciation rates were applied individually to the specific class and type of assets, not the then current ‘fire sale’ rates.

3.3 Approach and results

A number of matters underlie the RFOM approach, including:

- All operating scenarios were considered based on single driver operation. Significant productivity could be gained by adopting a multiple driver operation with annual prime mover kilometres travelled could rising from a nominal 180-200,000 to circa 400-450,000, assuming the freight task is sufficiently large for multiple driver operation.
- All costs and outputs were considered to be on an ex GST basis.
- No profit margins were included in the RFOM. This capability is built into the modelling and margins can be added at will, but for this study purpose profit margins were excluded.

- All trips were assumed to be 100% loaded times. In practice, market forces usually dictate northbound and southbound freight rates differences, and so prices may be unrelated to the short run cost of the service. Other challenges to the 100% assumption are discussed in Austroads 2016, Chapter 6.
- Provision was made in the RFOM to apply additional charges on a per Gross Net Tonne Kilometre basis, for evaluation of cost effects to industry. Other options are available on request to further explore charge application on a mass, mass/distance, infrastructure investment recovery or other basis.

With this approach, and depending on the freight task and whether multiple driver operation may be feasible, the RFOM outputs will generally under-estimate real world road freight operator costs and the freight tonne rates.

However, and most importantly, the RFOM allows an ‘apples and apples’ comparison.

Table 1 shows the RFOM output expressed both as a single trip cost and a tonne kilometre rate, both net of GST and profit, for each HPV combination and commodity trailer type. It presents the existing or most plausible (in red) of the 101 RFOM scenarios.

Table 1: Road Freight Operational Model summary – Bruce Highway and inland freight route

Combination	Mass Limit (t)	Freight Rate	Bruce Highway				Inland Freight Route			
			Tipper	**Open**	**Curtain Sider**	**Fridge**	**Tipper**	**Open**	**Curtain Sider**	**Fridge**
Semi- Trailer	GML 42.5	$ p t	80.51	86.05	88.17	99.02	87.03	92.78	95.23	107.82
		$ trip	2,146	2,128	2,140	2,300	2,320	2,294	2,312	2,504
	HML 45.5	$ p t	**72.82**	**77.23**	**78.97**	**88.20**	**78.71**			
		$ trip	**2,160**	**2,141**	**2,154**	**2313**	2,334			
B-double	GML 62.5	$ p t	69.37	68.90	73.61	90.48	75.07	74.89	79.75	97.57
		$ trip	2,774	2,623	2,733	3,101	3,002	2,851	2,961	3,344
	HML 68.5	$ p t	**62.11**	**61.39**	**65.28**	**79.05**	**67.74**			
		$ trip	**2,856**	**2,706**	**2,815**	**3,184**	**3,092**			
A-double	GML 79.5	$ p t	55.34	58.52	60.29	70.66	60.04	63.58	65.44	76.35
		$ trip	3,030	2,977	3,013	3,383	3,287	3,235	3,270	3,655
	HML 85	$ p t	**51.94**	**54.58**	**56.10**	**65.24**	**56.38**	**59.32**	**60.92**	**70.53**
		$ trip	**3,129**	**3,077**	**3,112**	**3,482**	**3,396**	**3,344**	**3,380**	**3,765**
B-triple	GML 83	$ p t					67.43	68.15	71.20	94.32
		$ trip					3,631	3,503	3,557	4,131
	HML 90.5	$ p t					**59.86**	**60.18**	**62.63**	**81.34**
		$ trip					**3,673**	**3,545**	**3,598**	**4,173**
AB-triple	GML 99.5	$ p t					63.73	65.05	68.20	84.14
		$ trip					4,273	4,111	4,215	4,872
	HML 108	$ p t					**58.57**	**59.44**	**62.14**	**75.83**
		$ trip					**4,396**	**4,232**	**4,337**	**4,997**
BAB Quad	GML 119	$ p t					61.85	62.85	65.36	83.47
		$ trip					4,937	4,761	4,842	5,708
	HML 130	$ p t					**56.06**	**56.50**	**58.72**	**73.85**
		$ trip					**5,091**	**4,915**	**4,996**	**5.862**

Table 1 shows specific configuration costs are highly affected by their costs of capital, freight characteristics, the extent of HPV access, break down facilities, and shuttle truck costs.

This research defines freight efficiency as the price or rate paid per tonne of cargo for the two routes. It does so because charging schemes can only recover road investment to allow higher order HPVs access, by levying beneficiaries who take up the increased access. Where there are significant benefits, the beneficiaries can be levied more than under the PAYGO regime and will still find it commercially profitable to use the increased HPV access. If there are not significant benefits from using higher order HPVs, after including any charges to recover the access provision costs, road freight operators will not invest in these vehicles, and no revenue will accrue to the investing road manager.

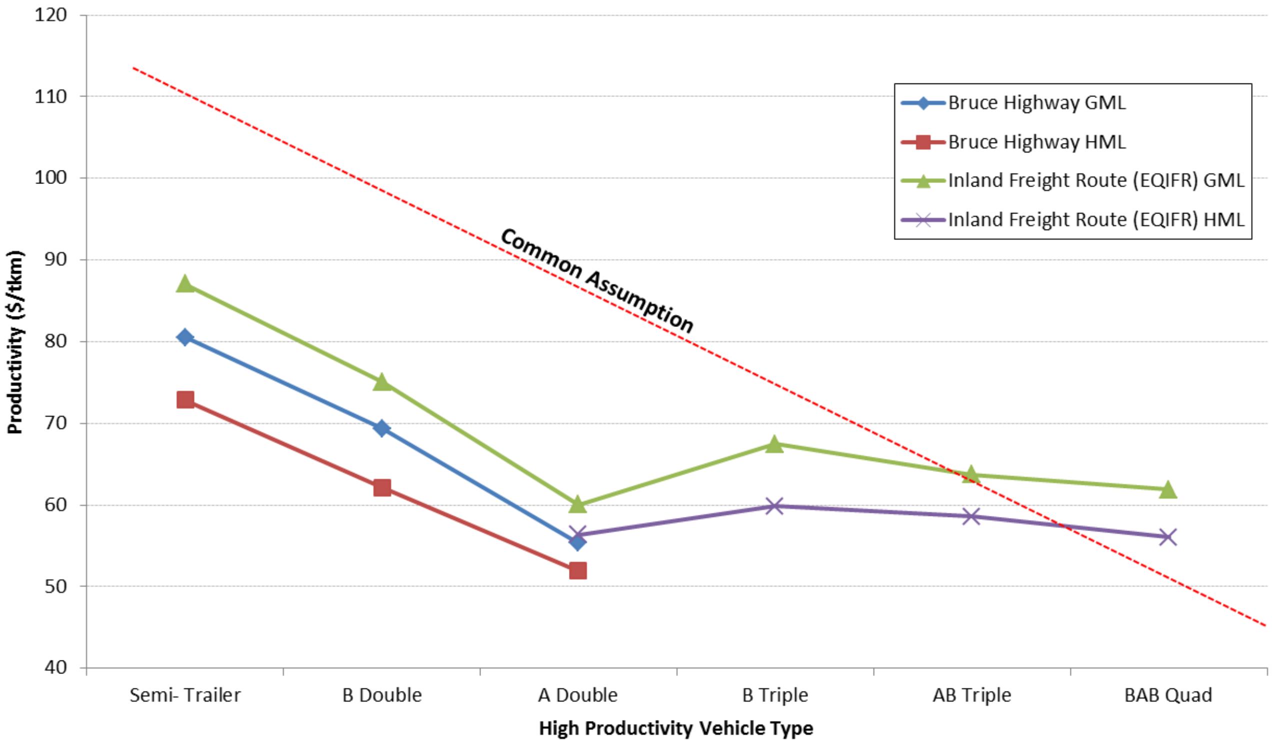
4. Testing the RFOM outputs

4.1. HPV efficiency and productivity

The RFOM output in Table 1 indicated that some HPVs are highly efficient, but the higher order one less so.

Figure 2 expresses the RFOM freight rate output of Table 1, as an inverse productivity performance measure. It shows HPV productivity, expressed as nominal dollars per tonne kilometre for the North Queensland Brisbane routes, increases as expected between Semi-trailers, B-doubles and A-doubles. It then roughly stabilises thereafter, partly due to AB-triples and BAB Quads not having access east of Toowoomba.

Figure 2: Assumed and real Tipper productivity efficiency for selected HPVs



Many in industry and government think that higher-order HPVs are more freight efficient than lower order HPVs because they have a higher payload. This expectation using Tippers is depicted as a Common Assumption line in Figure 2.

As the RFOM output does not accord with industry and government expectations for higher order HPVs, its formulation and design were rigorously checked. Three underlying factors that could instigate the RFOM outputs were also investigated. Although similar results for all commodity trailer types can be obtained, Tippers are used to compare:

- HPV combination payload efficiency;
- HPV inland freight route access effects; and
- HPV combination Capex efficiency.

4.2. HPV Tipper Combination Payload Efficiency

Table 2 states the Tipper tare mass and GML and HML payloads, used in the RFOM for selected heavy vehicle combinations.

Table 2: Derivation of Payload Efficiency for Tippers

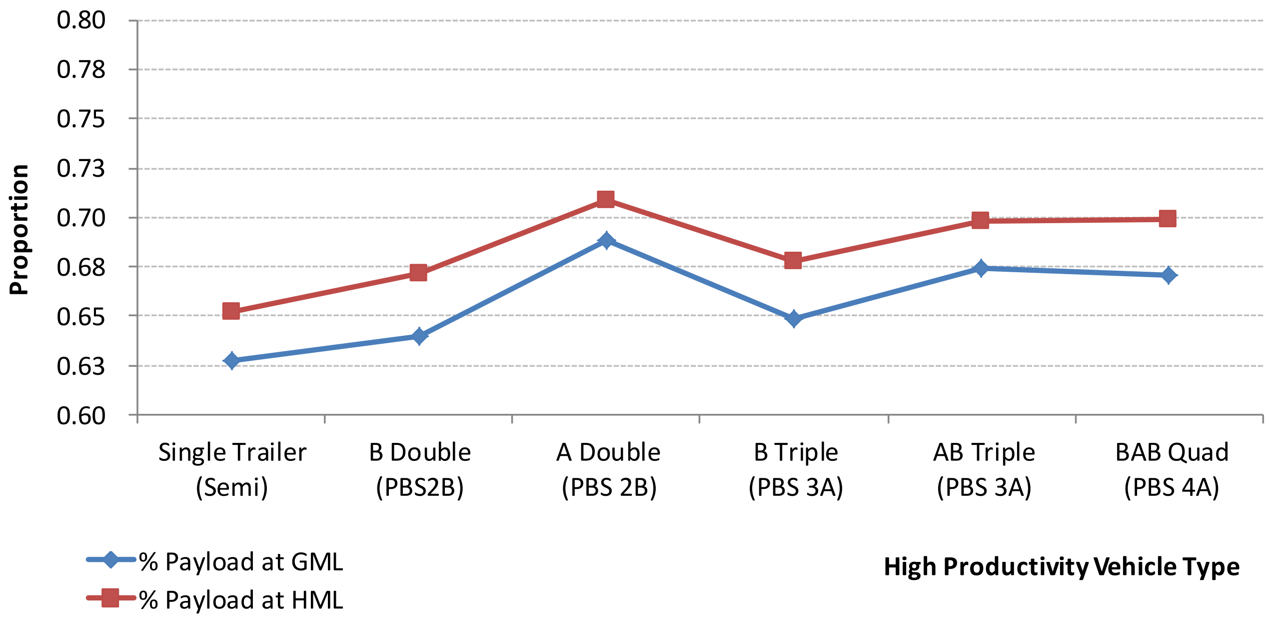
Tipper Combination	Tare Mass (t)	Payload (t)	GML Mass (t)	% Payload at GML	HML Mass (t)	Payload at HML (t)	% Payload at HML
Single Trailer (Semi)	15.84	26.66	42.5	0.627	45.5	29.66	0.652
B-double (PBS2A)	22.51	39.99	62.5	0.640	68.5	45.99	0.671
A-double (PBS2B)	24.76	54.74	79.5	0.689	85	60.24	0.709
B-triple (PBS3A)	29.15	53.85	83	0.649	90.5	61.35	0.678
AB-triple (PBS3A)	32.45	67.05	99.5	0.674	107.5	75.05	0.698
BAB Quad (PBS4A)	39.18	79.82	119	0.671	130	90.82	0.699

Figure 3 illustrates the payload freight efficiency of HPV Tipper combinations assessed by the RFOM, using the Table 2 GML and HML access data. It shows the A-double has the highest payload efficiency of all RFOM Tipper HPV combinations. Table 3 illustrates that payload efficiency increases for B-doubles compared with Semi-trailers, and increases significantly for A-doubles compared with B-doubles. Higher order HPVs considered by this project cannot match the A-double for payload efficiency.

The reasons for the payload efficiency results appear to relate to each combinations:

- wheel groupings, which determines the allowable combination mass; and
- the higher strength and increased tare mass required by the higher order HPVs.

Figure 3: Tipper payload freight efficiency as a proportion of the gross vehicle mass



4.3. HPV inland freight route access effects

The RFOM assumes that all heavy vehicle combinations up to a B-triple can access the inland freight route. But for AB-triple and BAB Quad combinations, shuttles must be used between Toowoomba and Brisbane. In this situation productivity suffers and costs increase.

The Toowoomba Brisbane leg of the 1491 kilometre inland freight route is 130 kilometres (8.72%). Each AB-triple or BAB Quad requires two heavy vehicle shuttle trips for this leg. The efficiency loss is demonstrated by the AB-triple and BAB Quad shuttle cost proportions are 15.1% and 15.2% respectively at HML access.

Even though unlikely, if the AB-triple and BAB Quad Tipper combinations had HML and HPV access on the whole inland freight route to Brisbane, their freight tonne rates in Table 1 would reduce to $54.46 and $53.45 respectively. This is lower than the comparable A-double freight tonne rate of $56.38, but still higher than its $51.94 rate on the Bruce Highway.

With whole of trip access, and a stable two-way freight task and trip end facilities, AB-triples and BAB Quads can compete with A-doubles. This explains the high proportion of T2RTs on the Flinders Highway and Gregory Developmental Road, reported in Dudgeon et al 2015.

But their freight efficiency advantage over an A-double is small. AB-triples and BAB Quads with full access on the inland freight route still cannot compete with an A-Double using the Bruce Highway, which is only 156 kilometres (10.5%) shorter.

4.4. HPV Tipper Capex efficiency

Capex contributes significantly to freight rates. Table 3 depicts the Capex and HML payloads for selected Tipper combinations, to derive a Capex per Tonne efficiency measure. Once again, the A-double is the most efficient combination for this measure, with the AB-triple and BAB Quad being the second and third most efficient vehicles.

A B-double Capex is $122,500 more than a Semi-trailer, but buys an extra 16 tonne payload. An A-double costs only $7,667 more than a B-double, but it carries 14 tonne more payload.

Because Capex contributes a higher proportion of the trip costs than does drivers, Capex efficiency expressed per payload tonne helps explain the the RFOM output.

Table 3: Tipper Capex efficiency

Tipper Combination	Capex ($)	Payload at HML (t)	Capex per Payload Tonne
Single Trailer (Semi)	377,000	29.66	12,711
B-double (PBS2A)	499,500	45.99	10,861
A-double (PBS2B)	507,167	60.24	8,419
B-triple (PBS3A)	622,000	61.35	10,139
AB-triple (PBS3A)	658,083	75.05	8,769
BAB Quad (PBS4A)	801,733	90.82	8,828

4.5. RFOM validity

The output of the three sections above provides confidence that the RFOM is a robust costing model for the two long distance freight routes. Two other matters are relevant:

- The continuing presence of apparently reduced efficiency vehicles does not necessarily imply a failure of this research. A well maintained older semi-trailer which has been fully depreciated and which can be fully loaded for a particular market has a particular niche; and

- Austroads Research Report AP-R483-15 PBS 3 and 4 Standards Review researched, using 79 combination types, which PBS standards could be improved so the small numbers of PBS 3 and 4 vehicles submitted for assessment were more likely to pass, potentially leading to an increase in these types. While their meeting PBS standards may be an issue, does the small number also indirectly indicate that road freight operators do not find these vehicle types sufficiently efficient?

The next section outlines how it can be used to contribute insights to policy analysis of selected issues that jurisdictions need to consider and manage.

5. RFOM policy implications

The following discussion relies on the RFOM outputs. This means the insights may not apply to different commodity flows and corridors from the two specified for RFOM development.

Nevertheless, and subject to any further research results, this paper's RFOM research may have important implications for Australian and jurisdictional freight policy. This includes HPV combination productivity, jurisdictional cost recovery of guideline infrastructure investment for HPV access and HPV effects on long distance freight competition between road and rail.

5.1. HPV economies of scale

There has been little public knowledge of HPV costs.[3] Many may have assumed a strong decreasing relationship between HPV size and costs, as Figure 2 depicts. There are two significant 'face value' reasons to assume corresponding efficiencies, being:

- increases in the Gross Combination Mass (GCM) of higher order HPVs are so significant, as stated in the GML and HML columns of Table 2; and
- because all HPVs require only one driver, irrespective of combination size.

With regard to the first, the RFOM shows that the significantly higher HPV GVMs do not automatically translate to higher payload proportions of their GVM. Table 2 demonstrates that higher order HPVs have higher net tare masses. These are necessary to enable the HPVs to withstand the forces in carrying such high GVMs. Also, the higher tare masses translate to more expensive HPV combinations, shown in Table 3.

Secondly, driver costs are not a significant proportion of HPV costs. For an inland freight route Tipper at HML, driver costs are only 20.1% of the semi-trailer cost, 19.2% of a B-double, 17.5% of an A-double and 16.2% of a B-triple.

The RFOM provides this for the two routes of this research.

Higher order HPVs

The RFOM indicates that higher order HPVs have increasingly large operating costs. Their cost advantage over a PBS2B is sufficiently small that their use cannot be justified if road managers seek to recover any infrastructure investment to meet access guidelines. This is without taking into account such issues as operator concerns with other road user interactions, and road manager asset and road user antipathy concerns.

The RFOM indicates a rapidly diminishing economy of scale for HPVs larger than PBS2Bs. This has significant repercussions on other policy objectives, as outlined below.

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[3] The Freightmetrics calculator may be a quantum change in this domain

A-doubles

A-doubles are different and much more positive. One RFOM surprise was the efficiency and productivity of the A-double PBS2B operation compared with B-double operation.

The RFOM estimates an A-double Tipper HML freight tonne rate of $56.38 for the inland freight route. This is much lower than a semi-trailer's $78.71 and a B-double's $67.74. It is only slightly more than a Tipper AB-triple's $54.46, and a BAB Quad's $53.45.

We have not observed any light vehicle driver behaviour in proximity to an A-double that indicates drivers are aware it is different to a B-double, even though it is 13% longer and may have a 27% higher mass at GML. There appears not to be a road user backlash with A-doubles sharing lanes on divided carriageways, which would concern road managers.

5.2. Higher order HPV infrastructure investment recovery

The HPV access guideline (NHVR 2007) indicates infrastructure design standards including potential wide-ranging road design and structural investments to achieve higher order HPV access. This expenditure can be significant as indicated in Chapter 4, Austroads 2016. Jurisdictions have sought beneficiary contributions and Austroads 2015 provides advice for jurisdictional and private sector interaction. Austroads 2015 was endorsed by the Transport Infrastructure Council on 6 November 2015.

This paper suggests there seems limited scope for any recovery of infrastructure investment through increased road access charges from benefitting road freight operators using HPVs larger than PBS2Bs. This is due to the small extra efficiencies for road operators using HPV combinations large than A-Doubles. Even these savings from higher order HPV use may be consumed if new terminal investments are required for the larger vehicle (Austroads 2016).

There appears to be a disconnect between road manager infrastructure (guideline) costs for increased HPV access, and the RFOM road freight operator benefits of using HPVs larger than PBS2Bs. This would clearly depend on the road asset standard on the corridor, as the following examples indicate:

- If large numbers of road freight operators stand to benefit on an already high standard Adelaide Melbourne Sydney and Brisbane corridor (Austroads 2014) from increasing HPV use, large net benefits over decades should still accrue.
- For most other lower standard routes with much lower freight volumes, it is unlikely that road operator benefits from higher order HPVs will exceed infrastructure investment to allow their access. Austroads 2016 showed that this was the case for its inland freight route.

The most likely outcome for most routes in the absence of further HPV design innovations, is a hiatus in long distance road freight efficiency due to increasing higher order HPV access. (This seems to mirror somewhat the circumstances of the rail network where investment on a few routes only may be justified.)

Another reason for limited uptake of HPVs is stated on page 23 of Austroads 2014:

> "HPVs will not emerge from all segments of the Australian truck fleet but from a subset of 37,000 vehicles which is just seven per cent of the 533,000 population of freight-carrying trucks in Australia."

That report contended that long distance freight HPVs would emerge only from the B-double fleet, which seems reasonable.

This RFOM research implies that currently the PBS2B A-double is among the most efficient HPVs. As well, being only 3.5 metres longer than B-doubles with improved turning, it could use many if not most B-double routes. Any new infrastructure would relate to selected structure (bridges and culverts) strengthening for its greater GCM.

If so, the A-double's productivity provides potential for increased road manager charges for infrastructure cost recovery. This assumes mass compliance for all heavy vehicles.[4]

There are about 100 A-doubles using the route between Brisbane, its port and Toowoomba. The road supply and traffic descriptions of these urban motorways and roads where A-doubles operate are not dissimilar to many others in and near the other State and Territory capitals of Australia. This similarity makes Queensland's operation of 30 metre A-doubles, currently under permit, of particular interest to road freight operators and road managers.

5.3. A-double efficiency impacts on rail

The RFOM indicated significant efficiency and productivity of the PBS2B A-double compared with B-doubles of the same configuration. Austroads 2016 found:

> "In a competitive market, freight rates for Tippers would be reduced by 16.4%, rates for Open/flatbeds would decline by 11.1%, for Curtain Sides by 14% and for Fridges by 17.5%."

The New South Wales and Queensland peak freight strategies (among others) seek both to increase road freight efficiency to best utilise existing road assets and also increased freight utilisation of the long distance rail network. These two distinct goals need to be managed in road and rail corridors.

The New South Wales Freight and Ports Strategy of November 2013 has Network efficiency as the first of three Strategic Action Programs. Its Action 1E is "Improve productivity of the rail freight network." Task 3 under Action 1D Improve productivity of the road freight network is "Improve access for High Productivity Vehicles on State and local roads."

Queensland's Moving Freight Strategy of December 2013 Priority one is to expand the use of rail freight. Its Priority two is to increase road freight network access with one of four key actions being "Promote strategic road freight routes for higher productivity vehicle access".

How might the Moving Freight Strategy apply? At the lowest point on the Bruce Highway there are about 150 B-doubles daily. However, Dudgeon et al 2015 found that the long distance road freight between North Queensland (Townsville) and Brisbane comprised 55 heavy vehicles daily, with half of these being B-doubles. These B-doubles have potential to transition to A-doubles depending on the type, volume and mass of the cargo being carried.

Taking the single rigid, semi-trailer and car-carriers into account, the long distance road freight movement between Townsville and Brisbane is less than a third of the freight being carried at the lowest trafficked point on the Bruce Highway. On Bruce Highway links where freight flows may be four times higher, the long distance freight is a much lower proportion.

The authors are unaware of the freight cargo carried on the North Coast Line which lies in the same corridor as the Bruce Highway.

To the extent that there is contestability between road and rail long distance freight in this corridor, granting full Bruce Highway access to the PBS2B A-double would put pressure on rail to reduce its freight rates by between 11.1 and 17.5%.

With jurisdictional goals to maintain or increase rail freight and increase HPV access, it may be judicious to research the contestability of rail freight cargo before increasing HPV access.

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[4] Unpublished data indicates that Semi-trailers and B-doubles may have higher non-compliance rates for mass restrictions; A-doubles which are mandated for IAP and OBM are virtually fully compliant

6. Summary

Jurisdictions balance many objectives when assessing increased HPV access. These include a HPV increase with modal aspects of jurisdictional freight strategy, the interaction of larger HPVs with other road users, and national charging regime and funding environments.

This paper has suggested that knowledge of 'real world' road freight operational costs provide added value to the development of HPV access policy. Selected freight policy areas where this may apply have been outlined in Chapter 5.

The RFOM also suggests that, subject to the caveats in Chapter 5, PBS2B A-doubles seem to be the most efficient form of HPVs with the least impacts on other road users and road infrastructure assets. Understanding this information will assist policy makers in assessing the level of road infrastructure investment for increased HPV access, which may be able to be recovered through potential charging regimes. Knowing heavy vehicle compliance and IAP and OBM costs could assist the latter's conditioning.

This paper also indicates that the RFOM results could be used to infer outcomes for other inland and coastal freight routes in Australia. For A-doubles, this could include their use on urban motorways connecting ports and regional areas.

It is not practical for policy specialists to fund development of an RFOM in all circumstances. Whether costing models such as the FreightMetrics Calculator can provide robust estimates able to apply to HPV access considerations has not been researched.

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