REFEREED PAPER

PBS VEHICLES IN THE SOUTH AFRICAN SUGAR INDUSTRY: OPPORTUNITIES AND LIMITATIONS

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Abstract

Since 2007, Smart Trucks have been operating on South African roads as part of a pilot project where a Performance Based Standards (PBS) approach to designing heavy freight vehicles is employed to design vehicles that are superior in a range of dynamic performance criteria. These performance criteria address items such as road safety, vehicle productivity, and economic and environmental sustainability. Voluntary self-regulation as defined by the Road Transport Management System (RTMS) consisting of independent auditing and accreditation, is a precursor to operating PBS vehicles to ensure that they are operated in a responsible fashion. The PBS project is an initiative to encourage innovative designs and is not limited to the design of longer, heavier vehicles. This paper evaluates potential limitations of the front-end configurations of various mills that may restrict their ability to receive specifically longer and/or heavier PBS vehicles and also provides an economic feasibility and potential for PBS vehicles within the industry. Mill receiving limitations were determined through discussions with cane procurement representatives at each of the mills where a reliance on past experiences and knowledge of the representatives were used to identify potential problem areas for PBS vehicles. From an economic perspective, PBS vehicles are typically suited for longer lead distances, and payload management is important to ensure maximum benefits from a PBS vehicle. An analysis was carried out to determine the viability of Smart Trucks in sugarcane transport and is based on a hypothetical higher payload vehicle subject to a number of assumptions as detailed in the paper. This study aims to provide guidance to interested hauliers on the suitability of PBS for their local mill receiving facilities and the economic feasibility thereof.

Keywords: feasibility, mill yards, PBS, RTMS, Smart Trucks, sugarcane, transport

Introduction

Since 2007, Smart Trucks have been operating on South African roads as part of a pilot project where a Performance Based Standards (PBS) approach to designing heavy freight vehicles is used to design vehicles that are superior in a range of dynamic performance criteria. This is in contrast to traditional prescriptive regulatory standards that specify configuration, load and dimensional constraints to which vehicles must comply. A Performance Based Standards (PBS) approach prescribes dynamic stability and performance criteria that address issues pertaining to safety and protection of road infrastructure. This new and innovative approach allows for vehicle designs that might traditionally fall outside the prescriptive requirements in terms of loading or dimensional constraints. Although more complex to regulate, the PBS approach has a number of benefits such as (a) improved vehicle safety; (b) improved productivity; (c) reduced infrastructure degradation, road wear and vehicle emissions; (d) a more optimal use of the existing road network; and (e) the encouragement of innovation in vehicle design. Since 2007, Smart Trucks operating under the PBS programme in South Africa have and are increasing at an exponential rate. Over 200 PBS vehicles are operating in South Africa across a wide spectrum of commodities and routes. These vehicles have covered over 70 million km and so far, have proved to be beneficial and cost effective. This paper explores the potential for adoption of PBS vehicles within the sugar industry. A general investigation of potential operating constraints at the mill receiving facilities and the results of an economic assessment to investigate the economic viability of PBS vehicles are presented.

Background

The objective of PBS is for the operation of heavy vehicle combinations that deliver superior productivity while conforming to road infrastructure, safety criteria and performance standards specifically pertaining to PBS (Nordengen *et al.*, 2008). The ability of PBS vehicles to safely carry heavier loads within these requirements allows for improved productivity and safety performance, which can be realised as direct cost saving benefits to commercial haulage operations and a reduction in the cost of logistics in South Africa of which transport is the largest cost component (Anon, 2013). The framework for the regulation of PBS vehicles is through a voluntary industry-led self-regulation scheme where best management practices (BMPs) are put in place and adhered to by transport operators. This framework is known as the Road Transport Management Scheme (RTMS). Further details can be found at www.rtms-sa.org.

RTMS – A precursor to PBS Smart Trucks

The adoption of self-regulation and associated best management practices for transport operators automatically addresses issues relating to the improvement of the transport logistics chain, productivity and loading compliance, and associated road infrastructure and safety improvements. Fully supported by government, the consignees, consignors and transport operators are able to participate with the objective of creating an equitable and responsible freight transport environment that benefits all road users, industries and the country as a whole. RTMS accreditation and certification of forms a critical precursor to PBS, through which a track record of competent and compliant transport operation and management is shown.

Smart Truck participation

Parties interested in participating in the Smart Trucks programme must comply with requirements of the Smart Trucks Programme Rules. The following excerpt covers a few primary components of the rules document:

1. PBS vehicle requirements: Certain advanced vehicle design features and systems are prescribed and recommended.
2. PBS operator: Driver requirements for operating a PBS vehicle are stipulated.
3. PBS design: Concept approval (valid for five years subject to renewal of annual Exemption permits and full compliance with permit conditions throughout period) is required from the relevant Provincial Abnormal Load Permit Office(s) indicating:
    a. Concept design of the particular Smart Truck vehicle indicating key vehicle dimensions and masses.
    b. Proposed route maps from origin to destination (For Level 2, 3 or 4 PBS vehicles, the levels vary according to traffic density and road infrastructure).
    c. Preliminary bridge and road wear assessment (If the maximum combination mass exceeds the permissible mass).
    d. Proof of and validity for a minimum of six months of RTMS certification and compliance.

4. Principle approval from the National Department of Transport (in addition) may be required where the design of one or more of the vehicles making up the PBS combination does not comply with National Road Traffic Act Regulations.
5. Operational approval based on detailed design assessments of the PBS vehicle combination considering:
   a. PBS design and safety performance compliance.
   b. Road wear assessment compliance.
6. Final operational approval allowing to proceed with manufacturing and purchase of vehicle components in accordance with the approved design, NaTIS registration and vehicle licencing processes.
7. Commissioning and compliance checking of the approved PBS design and the issuing of Abnormal Loads permits valid for a period of 12 months, renewable annually subject to compliance with permit conditions.

Once commissioned, operational performance pertaining to PBS vehicles are recorded and collated across the demonstration project for statistical purposes to monitor productivity and safety data across the entire fleet of PBS vehicles. Monitoring of operational data and operating compliance includes live satellite tracking and links to PBS administrative staff and provincial Department of Transport personnel. Operator compliance, accident and incident reporting, data submission, monitoring, offences and non-compliance are covered in the rules documentation pertaining to the Smart Trucks Programme.

PBS in the sugar industry

The purpose of this paper is two-fold (i) to assess the acceptance, weighing and offloading facilities at each mill in the South African sugarcane industry for a ‘typical’ PBS type cane haulage vehicle, and (ii) to present an economic parametric assessment comparing such a vehicle against a range of lead distances for a range of loading parameters. A typical PBS vehicle in this case is defined as a heavier and longer vehicle compared against the standard fleet of high capacity vehicles currently complying with prescriptive regulations and rated at achieving permissible maximum combination masses of 56 tons.

Methodology: Assessing potential limitations for the use of PBS vehicles at mill receiving facilities

Potential limitations of the front-end configurations of various mills may restrict their ability to receive specifically longer and/or heavier PBS vehicles. Such limitations were determined through discussions with cane procurement representatives at each of the mills. A reliance on past experiences and knowledge of the representatives were used to identify potential problem areas for PBS vehicles. Dimensions and specifications pertaining to each of the weighbridges and spilling facilities were noted where possible. Subjective parameters such as grade or accessibility would ultimately be dependent on the specific PBS vehicle design. For such instances, the receiving facilities at the front ends of the mills were classified relative to large haulage vehicles from the standard fleets currently supplying cane to the mill. Where such vehicles were experiencing any issues, the circumstances and remedial actions were noted. This will assist the PBS designers to consider such issues in the design phase where applicable. For large commercial hauliers, turnaround time at the mill is a major limitation to achieving good vehicle utilization. Turnaround times vary considerably across daytime periods and also vary considerably from mill to mill.

During discussions with the respective mill area representatives, various issues worth considering were noted. These included:

- General approach, access, alignment and routing through weighbridges, mill yards and spiller tables.
- General dimensions of weighbridge width (guide railings) and length limitations.
- Infrastructure constraints in terms of calibrated and load limits of weighbridges and spillers.
- Administrative considerations regarding vehicle coding and LIMS.
- Potential issues with longer, heavier vehicles in general.

Results: Assessing potential limitations for the use of PBS vehicles at mill receiving facilities

A list of potential issues raised during discussions covering each mill yard are presented in Appendix A. Potential issues were colour coded according to ease in addressing a particular issue. These ranged from being perceived as not limiting to the major issue, where non-compliance was noted. Major issues, for example, would likely require major structural upgrades or alterations to be made in order to comply. Such a list provides a quick reference where potentially interested PBS operators can further investigate options with the millers and/or PBS designers/route clearance specialists, depending on the concerns raised. As a brief overview of the 14 mills: nine had potential weighbridge limitations; three weighbridges were rated at a 60 tons maximum load limit; nine weighbridges were calibrated to 60 tons as a maximum; 10 mill yards may have routing constraints; seven mills are likely to have specific access issues into the spiller areas with narrow set widths of the spiller rail guides. Mills with the least known issues appear to be Eston, Noodsberg and Umzimkulu.

Investigating potential opportunities for PBS vehicles in the industry

To establish the scenario to which a PBS vehicle is most suited, a costing exercise was conducted, comparing a hypothetical PBS design relative to a high capacity baseline vehicle of 32 tons. Costs and assumptions pertaining specifically to PBS vehicles were included in the costing exercise as listed in Table 1. The full complement of costing assumptions is contained in Appendix B.

Table 1. Summary of assumptions used in the costing of a longer, heavier PBS vehicle.

Description	Approximate value
Capital cost of a new baseline vehicle of 32 t payload	R2 060 000
Capital cost of PBS vehicle	R2 320 000
PBS design and road wear assessment fees - once off, provisional	R250 000
PBS Abnormal load permit fees (per PBS vehicle per annum)	R5000
RTMS adoption (per depot)	Not included, benefits accrue
Driver wellness initiatives, advanced driver training etc (per driver)	Not included, benefits accrue
Load cells and telemetry (per vehicle)	Not included, same as base
3rd party RTMS auditing by external auditors (per vehicle)	R12 000

An analysis to determine the cost-effectiveness of the PBS vehicle is presented in Table 2. In the table, PBS payloads are contrasted against varying one-way haulage distances. The data is expressed as a percentage of PBS cost against the equivalent baseline cost of a high capacity interlink haulage vehicle achieving 32 tons legal payload according to prescriptive regulations. Both the baseline and PBS units are assumed to be fully utilized.

Table 2. Data table comparing PBS vehicle costs for a range of one-way distances and payloads expressed as a percentage relative to the baseline vehicle costs.

		PBS vehicle payload (t)					
		36	38	40	42	44	46
One-way distance to the mill: (km)	15	104%	102%	100%	98%	96%	95%
	20	108%	106%	103%	101%	100%	98%
	25	99%	96%	93%	91%	89%	87%
	30	103%	100%	97%	94%	92%	90%
	35	108%	104%	101%	98%	96%	94%
	40	99%	95%	92%	90%	87%	85%
	45	100%	97%	94%	91%	88%	86%
	50	105%	102%	98%	96%	93%	90%
	55	110%	106%	103%	100%	97%	94%
	60	99%	96%	93%	90%	87%	85%
	100	99%	96%	93%	90%	88%	85%

The results from Table 2 indicate that the payload required to make PBS cost effective is typically in excess of 40 tons for an individual PBS unit. Payload management is of upmost importance to improve profitability with a PBS vehicle. Generally, the average haulage distances need to be in the order of 25 to 30 km lead or 40 to 45 km lead, although high average payload PBS units can operate profitably on shorter distances. The cases where the baseline vehicle costs are shown as more cost effective are where the baseline vehicle is able to achieve an additional trip per day and thus has greater utilization compared to the PBS unit which has unutilized spare capacity. In practice, such cases may be avoided through short haul contracts to keep vehicles fully utilized or to adjust operational rules to avoid unnecessary or prolonged non-operational periods. For a scenario where the PBS vehicle can achieve 40 tons of payload, it is estimated that the fuel saving per ton of product delivered is in the order of 14% and approximately 25% of the number trips that a baseline vehicle would require could be saved. Such potential benefits would need to be placed within the context of more regulated and higher operating constraints associated with PBS operations.

Conclusions

An investigation into the potential for PBS in the sugar industry in South Africa has been conducted. Specific opportunities for contractors and individual hauliers with high delivery tonnages within the local mill areas was not explored as part of this study. A costing analysis expressed in the form of a data table of relative costs of PBS to baseline vehicle is presented to explore such varied scenarios. Individual hauliers or contractors interested in exploring PBS opportunities are encouraged to contact the authors to discuss alternative scenarios and costing parameters. Based on the results presented, it seems that PBS vehicles, when optimally managed, have the potential to reduce transport costs substantially when compared to the baseline vehicle. Higher vehicle payloads translate into a reduction in the number of trips required. Substantial fuel savings were also anticipated.

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APPENDIX A:
SPECIFICATIONS AND LIMITING FACTORS BY MILLYARD:

KEY: LIMITING FACTORS BY MILLYARD:	Not limiting	Maybe limiting / easy to change	Likely to limit – attention required	Yes – cannot comply (For PBS>22m). Major issue	Pending information/withheld

ITEM:	Sezela	Umzimkulu	Noodsberg	Eston	Gledhow	Maidstone	Felixton	Amatikhulu	Darnall	Pongola	USM	UCL	Malelane	Komati
Weighbridge: Length (m)	23.5	27.9	24	24	27.7	22	21.9	22	22	26*	22	22	22	24 (gross) & 22 (tare)
Weighbridge: Deck type	Single	Single	Single	Single	Single	Single	Single	Single	Single	*Split	Single	Single	Single	Single
Weighbridge: Maximum mass (t)	70	≥70	80	70	60	80	80	60	80	70	80	60	80	80
Weighbridge: Calibrated mass (t)	70	70	60	70	60	60	80	60	60	70	60	60	60	60
Route limits: Access/Grade/Tr														
Route limitations: To WB	N	N	Y-a	N	N	N	Y-bridge ht.	N	N	N	N	N	N	N
Route limitations: Millyard	Y-a (#2)	N	N	N	N	Y-a	Y	N	Y	Y-a (#2)	N	Y-a	Y –a #2	N
Route limitations: To Spiller	Y- g,tr steep incline	N	N	N	N	N	N	N	Y- g,tr steep incline	Y- g,tr gentle incline	N	Y – gentle incline	Slight incline	N
Route limitations: Millyard (exit from spillers)	N	Y- g,tr? Incline to WB+exit (maybe)	N	N	Y-a #2 exit	N	N	N	Y-a turning (maybe)	Y-a turning	Y- g,tr gentle incline	N	N	N
Spiller: Width between guide rails (m); comment	2.67	2.60 concreted	2.9	2.68	2.74; 2.7 concreted	2.8	2.65	2.8	2.9	2.65 concreted	2.87	2.65	2.54 concreted	Same design as at Malelane
Spiller: Hook bar dist.[1st–end] (m)	9.65	9.45	9.05	10.07	9.56;9.4 (#2)	7.4	9.3			9.45	9.45	8.84	1.02	
Spiller: Table wall length (m)	14.4	14.4	13.6	17.3	14	14.4				14.65	14.89	12.72	13.8	
Spiller: Table wall height (m)	3.22	3.16	2.85	3.34	3.17; 3.14(#2)	3.2				3.4	2.09	3.05	1.25	
Spiller: Lifting capacity (t)	36	36 20 (#2)	33	32	30	28.5	40	25	30	30	28	40		
Spiller: Maximum lift height (m)	10.53	10.5	10.26 (#2)	11.1	11.5;11.6	10.8	11	10.97	10.8	12.65	11	15.95	pivot: ±40°	

Abbreviations: Accessibility (a); Gradient (g); Traction (tr); 2nd spiller (#2)

APPENDIX B
Costing Assumptions

Item	Unit	Baseline	PBS
Vehicle utilization	days/year	220	220
Working hours	hours/day	20	20
Fuel Price	Rand/litre	R11.63	R11.63
Interest rate	%	8.5%	8.5%
Payload	tons	32	variable
Haulage distance	km	variable	variable
Average Speed	km/h	45	45
Loading rate	t/h	30	30
Unloading time (including delays)	minutes	60	62
Capital cost (including trailers)	Rand	R2 060 000	R2 320 000
Operator and Licence	Rand	R340 400	R357 400
Tyres	Rand	R150 800	R180 000
Fuel use	litres/100 km	70	75