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SHORT COMMUNICATION

THE FEASIBILITY OF AUTOMATIC ON-BOARD WEIGHING SYSTEMS IN THE SOUTH AFRICAN SUGARCANE TRANSPORT INDUSTRY

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Abstract

The varying bulk density of sugarcane causes harvest transport to being either overloaded (resulting in road and vehicle damage) or underloaded (resulting in economic losses). Automatic on-board weighing (AOW) systems measure payloads in real time and present a managerial tool that can reduce the frequency and magnitude of over and underloaded consignments.

The benefits and drawbacks associated with the implementation of AOW are presented. Evaluations of current AOW systems for both zone loaded and infield loaded cane are presented and cover accuracy, consistency and factors influencing gross vehicle mass.

An economic evaluation of AOW showing attainable return on investment (ROI) for various scenarios, lead distances and increases in average payloads is presented. Practical guidelines to be considered for the successful implementation of AOW are given.

Keywords: sugarcane, transport, economics, automatic weighing, automatic on-board weighing

Introduction

In the South African sugar industry, machinery costs (including transport) represent 30-40% of growers' total production costs (Giles *et al.*, 2007), and transport costs are estimated to be 11% of total production costs. In reality, however, transport costs can be as high as 25% when elements such as machinery maintenance, fuel, lubricants and farm staff are incorporated.

The South African sugar industry produces approximately 21 million tons of sugarcane annually, of which 75% is transported to the mills by articulated trucks, the balance being transported by rail and tractor-trailer rigs (Meyer, 2005). The average lead distance to reach a mill is 25 km, which translates to a total of 31 million km travelled per annum. The varying bulk density of sugarcane frequently causes haulage transport to be overloaded (resulting in road and vehicle damage) or underloaded (resulting in economic losses). Automatic on-board weighing (AOW) measures payloads accurately in real time and presents a managerial tool to reduce the frequency and magnitude of both over and underloaded consignments.

The AOW system has permanently installed load cells, fixed at specific points on the suspension of the truck, which indicate the load in real time. The AOW accurately relays load on each axle or tandem of a multi-axle vehicle and also registers the total load. The Road Traffic Management System (RTMS) for South Africa imposes strict regulations, and operating within these limits is essential for the survival of transporters. The AOW system is one method of managing adherence to the RTMS.

This short communication reports on the guidelines and cautions based on a systems, statistical and economic analysis of AOW implementation in sugarcane transport trucks.

Evaluation of commercial automatic on-board weighing systems

Benefits associated with the implementation of AOW

Vehicle benefits:

- Improved vehicle utilisation and reduction in per unit costs
- Reduction (and some prevention) of vehicle breakdowns

Fleet managerial benefits:

- Improved vehicle safety
- Increased driver safety
- Elimination of legal infringements
- Reduced time between deliveries
- Reduced weight disputes

Road benefits:

- Increased road safety
- Prevention of road damage

Drawbacks associated with the implementation of AOW

- Capital investment
- Increase in fleet managerial duties

Evaluation of AOW with zone loaded cane

Two separate transport operations loading loose cane on transloading zones were evaluated. For accuracy, the AOW weights were compared to mill weighbridge weights and the mean error between the mill weighbridge and the AOW system was 0.4 tons.

For consistency, on-board weight readings were recorded at the zone after loading, and again before the millyard weighbridge to determine weight variation during the trip. Seventy per cent of the data showed consistent measurements. Some outliers were investigated, with a possible reason being attributed to the truck drivers not releasing the handbrake when recording the millyard weight.

Assessment of variation in gross vehicle mass (GVM) showed that different vehicle drivers with different driving styles did not cause large variations in GVM; however, the average was slightly below the target GVM of 57 tons. Sugarcane variety N31 contributed significantly to low average GVM for one specific zone; other varieties did not significantly affect the average GVM. N31 is a fibrous, lodging variety that breaks easily and this could be a reason for the difference. Effect of delivery time on average payload differed by less than one ton. Investigation into the physical condition of individual transloading zones showed that this factor had a relatively small effect on the GVM.

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Comparison of vehicles with and without AOW, that hauled cane from the same zones, were compared to determine a difference in utilisation. On first appearances the average GVMs of the vehicles were similar. However, closer evaluation showed variations in distribution. Vehicles without AOW had an even distribution of GVM around the maximum load point, whereas vehicles that had been fitted with AOW showed a sharp decrease in the number of vehicles that were in the overload range and a large number of GVMs within the target GVM. The large number of overloaded vehicles without AOW compensated for the large number of underloads, enabling these vehicles to maintain an average similar to the AOW vehicles. Thus vehicle utilisation is much improved with the use of AOW.

Results showed that 32 and 41% of loads exceeded the legal maximum load limit for vehicles with and without AOW, respectively; a 9% higher overloading rate. AOW thus has the positive effects of reducing both the frequency and the extent of overloading. Nevertheless, much larger reduction is required if the maximum 4% RTMS overload standard is to be met.

Evaluation of infield loading

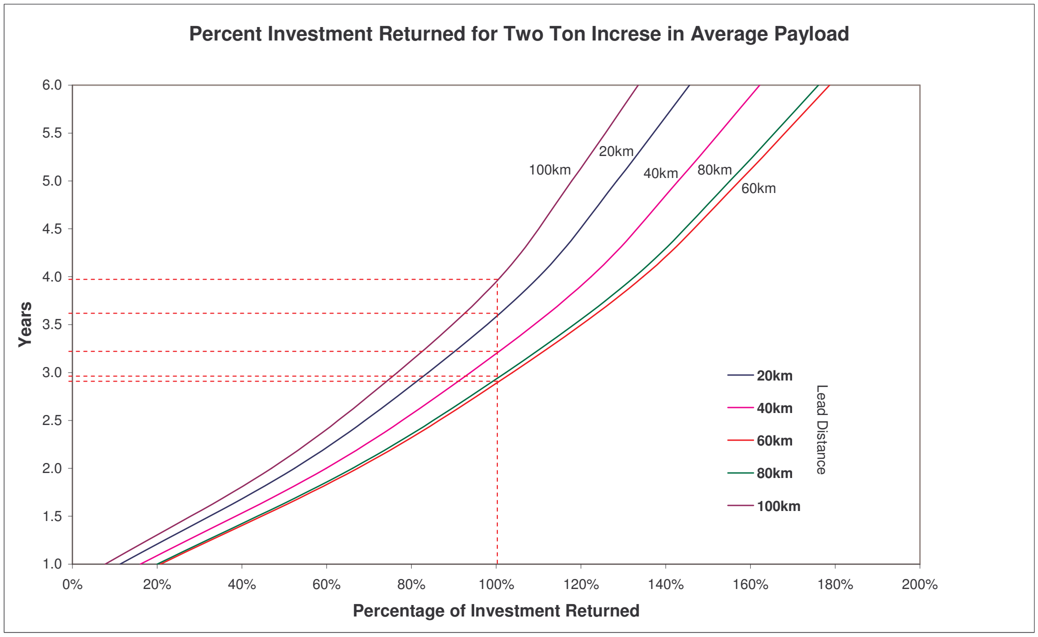
Use of the AOW system was compared between a grower-cum-transporter loading loose sugarcane infield and a commercial operation. The private operation showed a slightly higher average GVM, but the variation in GVM was significantly reduced. Overloading occurred 4% of the time.

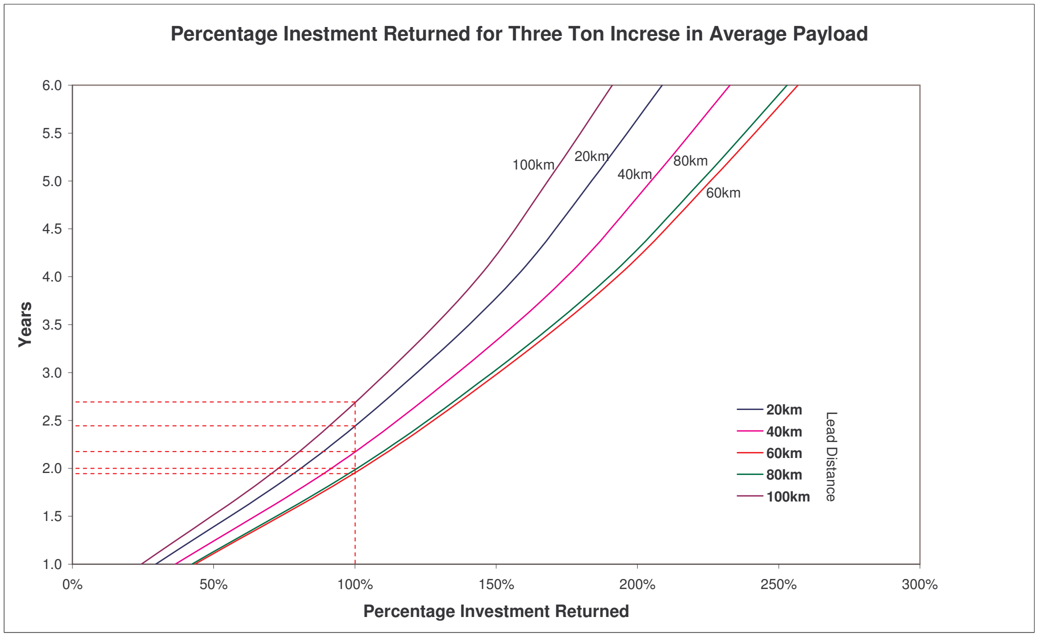
Data from the commercial operation loading infield showed a 6.3% rate overloading with AOW versus 10.7% overloading without AOW. When used infield, AOW is less accurate than zone loading due to topography, and consistency is more difficult to achieve.

Economic evaluation

The economic evaluation uses grower-cum-transporters and rigid drawbar truck-trailer configurations. It employs the capital budget method, fixed and variable transport costs, and considers different lead distances. Cost savings due to the implementation of AOW were determined for increases in average payloads of two, three and four tons.

The pay-off period differed from two to four years, depending on the scenario and lead distance. Figure 1 graphically summarises per cent investment returned for different increases in average payloads.


Percent Investment Returned for Two Ton Increse in Average Payload
Years
Percentage of Investment Returned
100km
20km
40km
80km
60km
20km
40km
60km
80km
100km
Lead Distance


Percentage Inestment Returned for Three Ton Increse in Average Payload
Years
Percentage Investment Returned
100km
20km
40km
80km
60km
20km
40km
60km
80km
100km
Lead Distance

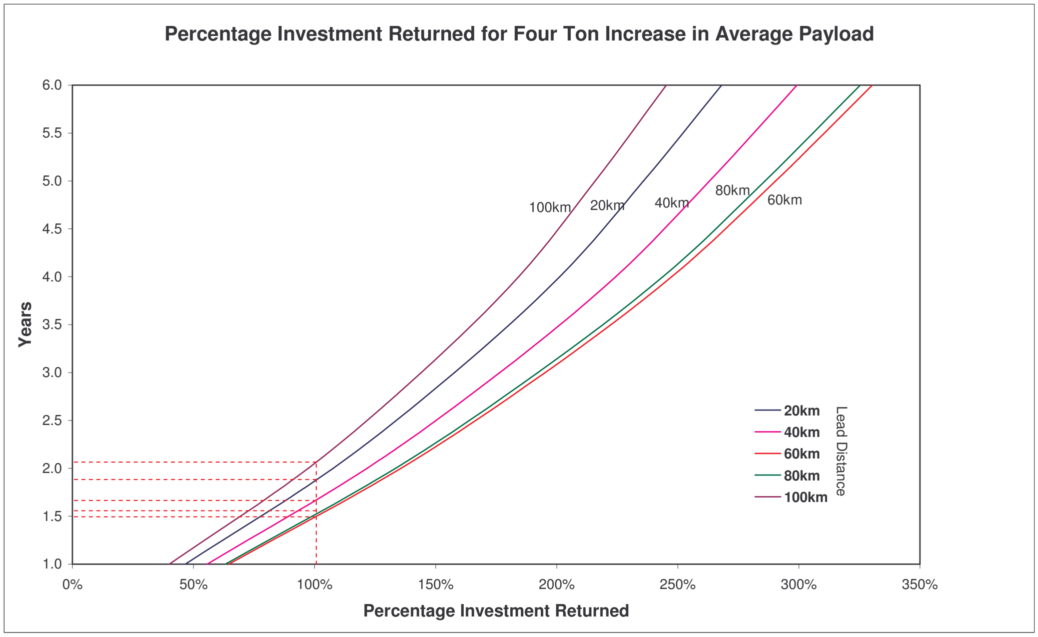


Figure 1. Percentage investment returns for two, three and four ton increases in average payloads and lead distances.

Guidelines for the implementation of automatic on-board weighing

Loading environments

Interlink and rigid drawbar trucks are loaded by (i) loose cane on zones, (ii) bundled cane on zones and (iii) loose cane infield (Meyer, 2005). Load cell AOW functions optimally when the truck is on a level surface (Cole, 2006) with even distribution of the load over the various load cells. Loose cane stockpiled on transloading zones and thereafter loaded onto a stationary truck using a grab loader provides an optimum loading environment for AOW.

Chain bundled cane presents problems with AOW due to bundle size variations of three to eight tons, with an average of six tons for burnt cane. Adding one single bundle changes underloading to overloading, defeating the purpose of AOW.

Cole (2006) showed that bundled cane can loaded using a grab loader to 'top up' a truck with loose cane after the bundles have been loaded. This additional grab loader impacts on the breakeven economics of the system, showing the shortest pay-off period as 4.2 years for a 60-80 km lead distance.

Using AOW without a grab loader, improved vehicle utilisation can be achieved through grading and separating the stack sizes stockpiled. Larger stacks are loaded first, with smaller stacks added to get to the desired load.

Infield loading is not conducive to AOW. The uneven topography of sugarcane fields substantially reduces the accuracy. As the truck moves along the rows of windrowed cane, communication between the truck driver and the loader driver becomes increasingly difficult from a gesturing, shouting and time consuming perspective. Close co-operation between the two drivers is imperative.

Managing the system

Management of AOW depends on the truck driver's experience, acceptance and continuous monitoring of the system. Proper training of drivers on how the system works and how it should be operated is very important, as is training of loader drivers to ensure that they co-operate and communicate. Managing the system closely will lead to adherence of the maximum 4% overload allowed by the RTMS.

Continuous monitoring of the system

To continuously manage the on-board weighing systems, tripsheets (printed from the on-board weighing system) must be printed for every load delivered. This supports management of the system and force the driver to use the system all the time. Regular comparison of the AOW and mill weighbridge weights will indicate any fault in the system or the need for routine maintenance.

Routine maintenance

Cleaning and lubricating the system is required periodically, and recalibration of the load cells by the equipment supplier once per annum is imperative to achieve acceptable, consistent reliability and accuracy.

Acknowledgments

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