AN OVERLOAD CONTROL STRATEGY FOR THE PROVINCE OF KWAZULU-NATAL, SOUTH AFRICA

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ABSTRACT

The road network in South Africa is an essential facility for moving goods and services on a daily basis, and plays a crucial role in promoting the economic growth of the country. During the past few decades, the national and provincial road authorities have attempted to control heavy vehicle overloading and thereby protect an aging road network that is experiencing an accelerated rate of deterioration. Because of limited resources in the Provincial Road Traffic Inspectorates, both in terms of infrastructure and more particularly manpower, overload control efforts have had limited success. The diminishing level of funds for road maintenance has resulted in a renewed effort by many road authorities to control heavy vehicle overloading more effectively. This paper describes an overload control strategy that was developed for the KwaZulu-Natal Department of Transport with the aim of making a significant impact on the practice of overloading in the province. Three main corridors were identified and the strategy addresses a number of issues including weigh-in-motion monitoring, alternative (escape) routes, evaluation of existing infrastructure, required new infrastructure and equipment, manpower requirements and information management. A benefit-cost ratio was determined to evaluate the cost-effectiveness of the project. Benefits include reduced pavement damage as well as reduced accident costs involving heavy vehicles. The first phase of the strategy (the Durban – Johannesburg corridor) is currently being implemented.
1.0 INTRODUCTION

An efficient road transport system is a key element in the promotion of economic growth and acceptable living standards of the population. Overloaded heavy vehicles cause a disproportionately high level of damage to the road network - it is estimated that 60 per cent of the annual road wear or damage in South Africa is caused by the 20 to 25 per cent of heavy vehicles that are overloaded, although in certain unpoliced areas the extent of overloading may be more than 50 per cent. In 1985, 35 per cent of the national road network was classified as being in good condition. This figure fell to 25 per cent in 1991 and even further to 9 per cent in 1995 (Nordengen, September 1998).

The road network in South Africa is steadily deteriorating in the face of severe funding constraints, which has been further aggravated by a shift of freight from rail to road as well as unacceptably high levels of overloading in most parts of the country.

The overloading control efforts in KwaZulu-Natal are well known by the road authorities and freight transport industry, both in South Africa and the Southern Africa Development Community (SADC), which has 14 member countries. In 1998, 159 000 vehicles were weighed statically in South Africa, of which 51 800 were overloaded (32%) and 25 000 were charged for overloading because they exceeded the 5% allowable tolerance (Sallie and Nordengen, 1999). Of these, 8 045 (32%) were charged in KwaZulu-Natal, which represents one of the nine provinces or 12 per cent of the road network. Notwithstanding the reputation of the KwaZulu-Natal Department of Transport (KZN DoT), there are still numerous transport operators who deliberately overload their vehicles in order to increase their profits, thereby competing unfairly with other operators.

2.0 BACKGROUND TO OVERLOAD CONTROL IN KWAZULU-NATAL

Prior to 1980, overload control was carried out by means of single beam scales. These were relatively clumsy to use and vehicle weighing was a time-consuming process. They were also easily damaged and regular calibration was required to ensure consistent accuracy. Approximately 3 000 heavy vehicles were weighed per year in the province and it was estimated that 30 per cent of heavy vehicles were overloaded. During the past 15 years, considerable effort has been made to develop a network of modern weighbridges, or Traffic Control Centres (TCC's), in the province. Many of the older facilities have been upgraded to the extent that there are no longer single axle scales in use in the province. Furthermore, eight new facilities have been constructed at strategic locations on the major routes with the capacity to operate on a 24-hour basis at an estimated cost of US$ 1.3 million per site. The number of vehicles weighed statically per year has increased significantly since 1980. During 1990 approximately 15 000 vehicles were weighed in the province and this increased to approximately 50 000 in 1996, and 72 000 in 1999.

However, as a result of decreasing budgets, it has become increasingly more difficult to adequately police the many routes used by the road freight industry, given the limited manpower and the various responsibilities of the Road Traffic Inspectorate besides overload control. Dedicated projects such as Arrive Alive and Asiphephe ("Let us be safe"), which concentrate on speeding and drunken driving offences, have further
reduced the availability of traffic officers for overloading control. The result is that many weighbridges in the province are under-utilised, giving operators the opportunity to overload their vehicles and travel undetected, particularly at night.

The efforts in KwaZulu-Natal during the past ten years have yielded dividends. The average overload on single axles has reduced from 22 per cent in 1988 to 14 per cent in 1998, and for tandem and tridem axle units from about 12 per cent to 7 per cent during the same period (see Figure 1) (Nordengen, Sallie and Hellens, 1999). The increase in the average overload during 1994 and 1995 was largely due to the increase in the allowable tolerance from 5 to 15 per cent during those two years. The average overloads in 1996 and 1997 were approximately the same as in 1992 and 1993, despite the 10 per cent increase in the maximum permissible axle loads on 1 March 1996.

3.0 DEVELOPMENT OF AN OVERLOAD CONTROL STRATEGY

Because of the seriousness of the overloading problem and the severe limitations on manpower and funding, the KZN DoT decided to appoint the CSIR to assist in developing an overload control strategy or "master plan" for the province. The project had three main aims as follows:

- Make recommendations for the optimal use of existing manpower and equipment.
- Determine the requirements in terms of manpower, equipment (including new weighbridges) and costs in order to improve overload control in the Province to an acceptable level i.e. reduce the extent of overloading to less than 5 per cent.
- Serve as an aid to secure funding to finance the proposed strategy.

Due to its urgent nature and budget limitations, the project was confined to a one month desk study. All relevant data (traffic counts, WIM statistics, static weighing statistics, weighbridge operational costs and pavement design data) were made available by the KZN DoT and the South African National Roads Agency. A workshop was also held with the Station Commanders of the Road Traffic Inspectorate and representatives from the Head Office. A draft strategy was submitted in September 1998 and the final draft the following month (Nordengen, October 1998).

4.0 MONITORING HEAVY VEHICLE OVERLOADING

Permanent weigh-in-motion (WIM) sites are used both for collecting unbiased vehicle and axle mass data on a 24-hour basis, and in some cases for selecting overloaded vehicles to be weighed at a static weighbridge (screening). They are an invaluable source of information for determining the degree and extent of overloading on selected routes. There are currently four such WIM sites in KwaZulu-Natal. Table 1 shows statistics from three of these sites for 1997, together with statistics from the corresponding weighbridges.

The table shows that on average between 13 and 15 per cent of all heavy vehicles were overloaded on these routes during 1997 (including those that were within the 5 per cent tolerance limits), and that less than two per cent of the overloaded vehicles were prosecuted.
The identification of additional WIM sites was recognised as an important component of the project, both on major and alternative routes in order to adequately monitor the overloading trends in the province, and to evaluate the impact of overloading control strategies.

5.0 IDENTIFICATION OF MAIN CORRIDORS

Figure 2 shows the major routes in KwaZulu-Natal, the location of the weighbridge stations and the Annual Average Daily Truck Traffic (AADTT) on the major routes. Based on the heavy vehicle volumes, three major corridors can be identified as follows:

- Durban - Johannesburg (N3, N11, R103, R33, R74)
- South Coast (N2 south of Durban, R102, R61, R56)
- North Coast (N2 north of Durban, M4, R102)

Experience has shown that overloading control on a single route is largely ineffective unless alternative routes are monitored as well. Typically, when a weighing exercise commences, heavy truck drivers, with the aid of long distance radios and cell phones, select alternative routes within a matter of hours or less, in order to avoid the operational weighbridge.

5.1 The Durban - Johannesburg corridor

Based on the 1997 statistics from the WIM sites on this corridor the extent of overloading varies between 10 and 15 per cent. This represents an average of between 15 000 and 23 000 overloaded vehicles per month (including those which fall within the 5 per cent tolerance limits), of which a monthly average of 230 vehicles were prosecuted on the corridor during 1997.

The primary reason for these low prosecution rates is the limited availability of the Road Traffic Inspectorate personnel at these stations due to other commitments as discussed in Section 2 and the wide geographic areas of responsibility.

5.2 Recommendations for overload control

In order to significantly increase control on this corridor the following recommendations were made:

- Operate two strategic weighbridges on the corridor (Midway and Mkondeni) on a 24-hour basis.
- Increase weighing activities at the balance of the weighbridges on the corridor to a minimum of 8 hours per day.
- Carry out a minimum of 4 hours of screening per day on the alternative routes on the corridor.
- Install additional WIM sites on both the main and alternative routes.
In the medium to long term, plan and construct a new facility at a strategic location on the corridor (Shongweni).

5.3 Cost implications

The Station Commander of each Traffic Control Centre was required to provide information regarding the cost of operating the weighbridge (normal time, overtime, maintenance, calibration, vehicles, stationery etc.) as well as a budget for operating the weighbridge at the recommended levels according to the strategy. A summary of the current and proposed costs for overloading control on the Durban - Johannesburg corridor is given in Table 2. They do not include the infrastructure cost of the proposed new facility.

A summary of the fixed and increase in annual operational costs for each of the three corridors is given in Table 3.

6.0 FINES AND THE COURT SYSTEM

Inadequate fines and unsuccessful court cases continue to be a stumbling block in the way of effective enforcement of overloading. Fines imposed for overloading, both by traffic officers for admission of guilt and by magistrates in a court of law remain, in most cases, unrealistically low compared with the damage done by the vehicle to the road and the additional profit made by the haulier in transporting a heavier load. The maximum fine that can be imposed by a traffic officer for admission of guilt for overloading is currently US$ 250, and in a court of law the maximum penalty is US$ 20 000. However, in practice, the majority of fines range between US$ 30 and US$ 150, and seldom exceed US$ 1 000. These fines obviously do not have a significant effect on discouraging overloading. One of the major problems is that many magistrates do not appreciate the seriousness of the problem, and often view overloading offences as trivial in relation to other crimes.

The outcome of a recent court case in Pietermaritzburg typifies the situation. A heavy vehicle was weighed at the Mkondeni weighbridge in September 1997 and found to be overloaded by 23 tons. The case was continually remanded until September 1998. Eventually the defence pleaded guilty on behalf of the accused and the prosecution called for a fine of US$ 4 000. The defence requested a maximum fine of US$ 2 500 on the grounds of financial problems within the transport company. After a short recess the magistrate passed sentence, imposing a fine of US$ 350. Ironically the province had to refund the transport company an amount of US$ 150 as the driver has originally been released on a bail of US$ 500!

It is hoped that the introduction of the Administrative Adjudication of Road Traffic Offences (AARTO) by the newly formed Road Traffic Management Corporation (RTMC) will go a long way to solving the above and similar problems, by introducing administrative fees for overloading offences which are commensurate with the severity of the offence and by greatly reducing the number of offences that are taken to court.
7.0 ECONOMIC IMPACTS

7.1 Road damage

The cost of damage to a road network by overloaded vehicles is difficult to determine accurately as it is a function of the axle load distribution of the overloaded vehicle population, the number of kilometres travelled per vehicle and the pavement design of each section of road travelled on. It has been estimated that the annual road damage to the road network in South Africa is some US$ 100 million per year. If one assumes that the damage is uniformly distributed on the road network, KwaZulu-Natal would attract an estimated US$ 12 million (12 percent) of road damage due to overloaded vehicles per year. This figure should be decreased as a result of the high level of overloading enforcement in the province in relation to other provinces, but should also be significantly increased because of the relatively high traffic volumes in the province. The net effect is most likely an increase in the damage cost, and based on the original assumption, it can be conservatively assumed that the road damage cost in KwaZulu-Natal due to overloaded vehicles is in the order of US$ 13 million per year.

A simplified model was developed to estimate the annual cost of damage caused by the overloaded portion of overloaded vehicles travelling on the N2 and N3 national routes in KwaZulu-Natal. Input parameters for the road included geometrics (number of lanes, lane widths, shoulder widths), pavement design (upper and lower limits of design E80’s per uniform section) and pavement rehabilitation costs (asphalt and concrete). Input parameters for the traffic on each section of road included AADTT, percentage of heavy vehicles overloaded, distribution of heavy vehicles per vehicle type and average overloaded E80’s per vehicle type. The model was used to determine an estimated minimum and maximum annual cost of damage due to overloading i.e. excluding the damaging effect of the tare weight and the legal payload. This resulted in an average cost of damage on the N2 and N3 national routes due to overloading of US$ 6.3 million per annum, which is in line with the previous estimate of US$ 13 million per annum for the whole province.

The impact of the recommendations for improved overloading control on the three corridors will significantly reduce overloading in the province, and should reduce the annual damage by at least 60 per cent. This would imply a saving in terms of road damage of approximately US$ 8 million per year.

7.2 Accidents involving heavy vehicles

In a report by the CSIR on causes and cost implications of accidents involving heavy vehicles on the N3 (Pretorius and Freemen, 1997), it was found that during the study period of 3 years and 8 months, 1 539 accidents, or 25 per cent of all accidents, involved heavy vehicles. This represents an average of 35 accidents per month involving heavy vehicles. The accidents were responsible for an average of 53 hours of full closure and 73 hours of partial closure of the road per month.
The direct and indirect costs as a result of these accidents were estimated at US$ 50 million for the study period, or US$ 13.3 million per year. A significant increase in the control of overloading on the Durban - Johannesburg corridor will have a positive effect on the heavy vehicle accident statistics in the following ways:

* A higher percentage of heavy vehicles will be legally loaded which will in turn improve vehicle controllability and will therefore reduce the probability of accidents involving heavy vehicles.
* The application of the Road Traffic Quality System (RTQS) at Midway and Shongweni will result in an improvement in the roadworthiness of heavy vehicles on the N3 in terms of braking efficiency, visibility, etc.
* The operation of Midway on a 24 hour basis as well as Shongweni in the long term, will improve response time for all accidents and will result in a reduction of indirect costs such as lane closures.

If one conservatively assumes that the impact of introducing improved overload control on the N3 will be a 25 per cent decrease in accidents involving heavy vehicles, this would imply a cost saving in the order of US$ 3 million per annum. Additional savings would be realised on the North and South Coast corridors by operating the Umدلoti and Park Rynie TCC’s on a 24 hour basis as proposed, increasing the total saving to at least US$ 5 million per annum.

8.0 NEW INFRASTRUCTURE

The following new sites for Traffic Control Centres were proposed (short and medium term):

- Mtubatuba (short)
- Shongweni (medium)
- Bayhead Road, Durban (short)
- Ginginhlovu (medium)
- Ixopo (medium)
- Eston (medium)
- Noodsburg (medium)

The first two are proposed Grade A TCC’s and will primarily protect the main corridors as described in Section 4. The latter four will protect provincial roads that carry more localised, seasonal traffic such as sugar cane and timber.

8.1 Mtubatuba

This facility will operate on a 24-hour basis and monitor the currently unprotected section of the North Coast corridor from Richard’s Bay to the KwaZulu-Natal - Mpumalanga border and, in the future, the proposed Lebombo corridor from Richard’s Bay to Swaziland and Mozambique. Transport operators are currently abusing this
section of the N2 because there is no risk of detection. It is also the ideal abnormal loads route from Richard’s Bay to Mpumalanga and Gauteng.

8.2 Shongweni

This facility will operate on a 24-hour basis and will primarily monitor the northbound traffic on the N3 from the Durban Metro area to Pietermaritzburg, the KwaZulu-Natal interior and other provinces to the north. The N3 between Durban and Pietermaritzburg currently carries an average of 5 000 heavy vehicles per day.

9.0 CONCLUSIONS

Three major corridors, carrying the bulk of heavy truck traffic in KwaZulu-Natal, were identified. These include the national routes N2 and N3 as well as economically viable alternative routes. During 1997, an average of between 13 and 15 per cent of heavy vehicles on these routes were overloaded.

Measures for the effective control of overloading on these corridors, primarily in terms of increased manpower resources at selected Traffic Control Centres, were recommended. The measures include the 24-hour operation of the TCC’s at Midway and Mkondeni (Durban-Johannesburg corridor), Umobloti (North Coast corridor) and Park Rynie (South Coast corridor).

The associated increased costs for implementing the recommended measures amount to US$ 1.6 million per annum for operations and a once-off infrastructure cost of approximately US$ 200 000. The increased annual operational costs for the Durban-Johannesburg, North Coast and South Coast corridors are US$ 0.77 million, US$ 0.41 million and US$ 0.44 million respectively. These costs exclude the construction costs of the proposed Grade A TCC’s at Mtubatuba (N2 north of Richard’s Bay) and Shongweni (N3).

The proposed measures should effectively eliminate overloading on these corridors, reducing the extent of overloading from the current 13 to 15 per cent to less than 5 per cent, including those vehicles that fall within the allowable tolerance.

The benefits in terms of reduced road damage and reduced accidents involving heavy vehicles are estimated at US$ 8 million and US$ 5 million respectively, a total of US$ 13 million per annum.

Besides the proposed Grade A TCC’s at Mtubatuba and Shongweni (for controlling overloading on the N2 and N3 national routes), four other Grade B or Grade C TCC’s were recommended for the medium term, for protecting provincial roads.
10.0 REFERENCES


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![Diagram](Image)

**Figure 1:** Average overloads in KwaZulu-Natal: 1988 to 1998

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**Note:**
Before March 1996: Single legal axle = 8 200 kg, Tandem legal axle unit = 16 400 kg, Tridem legal axle unit = 21 000 kg
After March 1996: Single legal axle = 9 000 kg, Tandem legal axle unit = 18 000 kg, Tridem legal axle unit = 24 000 kg
Table 1: Weigh-in-motion and weighbridge statistics of heavy vehicles for 1997 at Mkondeni (N3), Park Rynie (N2S) and Groutville (N2N)

<table>
<thead>
<tr>
<th>Locality</th>
<th>Weigh-in-motion</th>
<th>Weighbridge</th>
<th>Percentage of total overloaded vehicles charged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number weighed</td>
<td>Number overloaded</td>
<td>Number weighed</td>
</tr>
<tr>
<td>Mkondeni (N3)</td>
<td>1 829 906</td>
<td>237 883</td>
<td>5 178</td>
</tr>
<tr>
<td>Park Rynie (N2S)</td>
<td>511 022</td>
<td>76 649</td>
<td>11 345</td>
</tr>
<tr>
<td>Groutville (N2N)</td>
<td>498 031</td>
<td>64 739</td>
<td>5 774</td>
</tr>
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</table>

Table 2: Summary of fixed and annual costs (in US$) for overload control on the Durban - Johannesburg corridor

<table>
<thead>
<tr>
<th>TRAFFIC CONTROL CENTRE</th>
<th>OPERATIONS (annual cost)</th>
<th>INFRASTRUCTURE (fixed cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current</td>
<td>Proposed</td>
</tr>
<tr>
<td>Midway</td>
<td>55 000</td>
<td>360 000</td>
</tr>
<tr>
<td>Mkondeni</td>
<td>35 000</td>
<td>350 000</td>
</tr>
<tr>
<td>Ladysmith</td>
<td>50 000</td>
<td>110 000</td>
</tr>
<tr>
<td>One Tree Hill</td>
<td>15 000</td>
<td>50 000</td>
</tr>
<tr>
<td>Newcastle</td>
<td>15 000</td>
<td>50 000</td>
</tr>
<tr>
<td>Greytown</td>
<td>30 000</td>
<td>50 000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200 000</td>
<td>970 000</td>
</tr>
</tbody>
</table>

Table 3: Summary of fixed and annual costs (in US$) for overload control on the Durban-Johannesburg, South Coast and North Coast corridors

<table>
<thead>
<tr>
<th>CORRIDOR</th>
<th>OPERATIONS (annual cost)</th>
<th>INFRASTRUCTURE (fixed cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current</td>
<td>Proposed</td>
</tr>
<tr>
<td>Dbn.- Jhb.</td>
<td>200 000</td>
<td>970 000</td>
</tr>
<tr>
<td>South Coast</td>
<td>100 000</td>
<td>540 000</td>
</tr>
<tr>
<td>North Coast</td>
<td>150 000</td>
<td>560 000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>450 000</td>
<td>2 070 000</td>
</tr>
</tbody>
</table>
Figure 2: KwaZulu-Natal Overload Control Strategy Map