Scientia Militaria, South African Journal of Military Studies, Vol 10, Nr 4, 1980. http://scientiamilitaria.journals.ac.za

ASPECTS OF ARMY ROAD TRANSPORT MANAGEMENT

Lt M. L. Japhet*

Introduction

A basic tenet of transport management must be the efficient operation of all constituent parts of the transport function. In recognition of the growing urgency of the energy problem as a primary goal and of the need to maintain a high level of combat readiness at the same time, this article will look, albeit briefly, at the various aspects of road transport that need to be dealt with in the search for cost-effectiveness. Five major elements of road transport management are: Purchasing policy; maintenance; driver training and control; movements planning and procedures; and Research and Development.

Vehicle Operating Policy

The framework for these 5 elements would be contained in what may be referred to as a Vehicle Operating Policy that should be committed to writing so as to avoid ambiguity and to provide a reference point for all transport related questions. A logical and important point of such a policy is the institution of an effective costing system — an approach that is sorely needed in all aspects of Defence management. The most important reason for this is that a proper knowledge of what costs should be and what they have actually been is essential in order to control the activities of the transport element.

Costing is essentially the allocation of expenses to units of production, there being two basic ways of defining the concept of costs. Firstly as the resources which have been consumed in the transportation process; or as what has to be consumed in order to produce a certain transport output. In the first case costing merely provides a record of what has been, but in the second case such an approach will allow for planning and budgeting and a built-in system of control of transport efficiency. Gerrie Prinsloo, lecturer in transport economics at the Rand Afrikaans University, distinguishes between historical costing and standard costing. The former provides detailed information on expenses which have been incurred, which has significance in the action which it prompts to eradicate waste, lower costs and thereby to increase efficiency. 'Standard costing is an attempt to provide a check on current cost by setting predetermined standards for each vehicle in terms of anticipated performance, running costs and the like, with which 'actual' performance and costs may be compared.' 'It calculates what costs and performance should be under normal average, not ideal — conditions, and actual results may be expressed as a ratio of this standard.'[1] In this way those in charge of transport may have abnormalities in performance of a particular vehicle brought to their attention as soon as they occur, so that steps may be taken to restore the vehicle in question to full operating efficiency as soon as practicable.

Costs may be further compartmentalised insofar as there are fixed costs (depreciation, licences and the like, not dependent upon vehicle utilisation); and variable costs (fuel, repairs, oil, and so on, dependent upon kilometres travelled and hours worked). For costing purposes the economic life of a vehicle is usually considered to be 5 years, whilst for accounting purposes it is normally amortised on a 20% straight line or $33^1/_3$% reducing balance basis. It is said that the advantage of adopting the reducing balance system is that one gets rid of a major portion of the depreciation cost while the vehicle is still new and repair costs are low, hence the annual combined costs are likely to be more even over a five-year period. Further this system is also preferred for a motive unit because it more accurately reflects the decreasing worth of the vehicle in terms of its market value.

If a vehicle is expected to have a residual value at the end of its working life this should be taken into account in depreciation calculations. Thus with the reducing balance method, the percentage rate of the depreciation is adjusted in such a way as to give a net book value of the vehicle which is approximately equal to its residual value at the appropiate time.

Clive Wooley, a director of Rio Tinto Tankers, has this to say on the question of replacement of vehicles. 'As far as the correct time to replace a vehicle is concerned, one theory recommends the point at which the graphs of depreciated value and annual repair costs intersect. I don't agree with this theory in all cases. Some of our own vehicles are over five years old and thus fully written down in the books — yet they are providing 90%-95% availability and their normal running repairs are costing only a few hundred rand per year. It therefore seems more economical to carry on using these vehicles. The business of replacement involves a number of factors, including the type of operation. If, for example, a vehicle has done three loads a week from the Reef to Durban for five years then it is time to retire it — continued reliance on it for such a long haul could be costly. But if one also has an urban, short distance operation, the vehicle could well go into that operation and perform reliably for a few more years. And, with current high cost of new equipment, operators are increasingly opting for major overhauls to extend the life of vehicles instead of replacing them.' It is quite obvious that with careful control and management of military vehicles, taking operational readiness fully into account, that such an approach is not only practical but highly desireable. Both the practice of switching vehicles that have previously been involved in long distance transport to short-haul routes, and that of carrying out major overhauls, after completing suitable costing, rather than going to the expense of replacing them, fall into this category. Bearing this in mind a purchasing policy must be formulated.

Purchasing Policy

As with any 'problem', in this case the transport 'problem', the primary task is to make a systematic analysis in terms of objectives and costs or alternatively, where this is not feasible, to draft a plan that solves this problem and then to identify the requirements of this plan. In the latter case, this must be followed by feasibility checks. Can the 'required' performance characteristics, such as some designated speed, range and capacity be obtained in actuality?

If a variety of options exist, none of which comply with the requirements exactly, then further factors must be taken into consideration such as standardisation, flexibility of role and the like. Standardisation has tremendous inportance as far as cost efficiency goes in that larger orders of a specific vehicle type will enable the Army to obtain special purchase prices on them on the one hand, whilst on the other, maintenance and spare part acquisition is more easily facilitated. It is self-evident that the fewer the number of vehicle types and/or manufacturers, the easier it will be to train maintenance crews; whilst bulk purchasing and interchangeability of spare parts will see a reduction in maintenance costs per unit, both directly and indirectly. The important point to grasp is the need of approach in providing for the transport element in the Army that could be termed 'scientific professionalism.' It is clear then that in the spirit of such an approach it is vital that the vehicles employed are the best available for the job in every respect.

In order to compare the relative merits of a number of vehicles that most nearly meet the requirements for a designated function — say troop transport — it is necessary to assign a system of 'weights' to various criteria that have to be taken into consideration. Amongst these are troop capacity, speed, fuel consumption, type of fuel used, service intervals, spare part cost and availability, ground clearance and so on. To each of these and other criteria a figure or 'weight' can be assigned, being higher the more closely it approaches the ideal in each respect. In this way it may be possible to make a precise and scientific choice of a particular vehicle for a particular function by taking the one which has the highest 'score' according to the weights that have been assigned to its characteristics. This may all be done via computer analysis and such a system is currently in use with a truck manufacturing company in South Africa. According to a recent newspaper article[2] this system is programmed to take all fuel economy factors into account and to indicate the effect of various component combinations on the performance characteristics of a truck before it is built. Information is entered concerning engine, transmission, auxilliary transmission, rear axle ratio *GUW/GCW* tractor or truck, radial or bias ply tyres, tyre size, modulated fan and air deflector. It also takes other considerations such as accessory power losses, drive line efficiency (6 x 4 or 4 x 2), speed restrictions, gear split effects, fuel flow in driving cycles, full engine fuel map, wheel slip, mission times, acceleration times to speed and rolling inertias of wheels and engines.

Print-outs give the expected benefits of certain changes in vehicle components or by changes in such specifications as tyres, clutches, fans or air deflectors. This will appear on a graph showing wheel-horsepower vs truck speed. It also details the truck's features along with fuel consumption predictions for a city, surburban and highway cycle. Quite clearly such a system can be adapted to a military context by minor changes in the programme, that allows for combat and non-combat situations. Such a system also exists for cars and light delivery vehicles so that every type of vehicle that is used in the Army and in the Defence Force in general can be made subject to detailed examination via the computer prior to the decision to purchase.

Maintenance

Having so ensured the employment of the most efficient vehicles, it is essential that a programme of maintenance geared to the task of maximum efficiency and hence maximum output from these vehicles is carried out. Several questions have to be answered in detailing maintenance policy for particular vehicles such as when, where and by whom they should be serviced. In answer to the first question, the approach that must be adopted is that of preventive maintenance. In this way the two goals of optimal efficiency and readiness may be achieved. The part drivers can play in this respect will be dealt with in the section on Driver Training and Control. By detailed study it is possible to project the life of every important part on the vehicle so that particular attention is paid to these parts at the correct times. This can be achieved by the use of a computer which will also carry information and issue directives on the service dates for every vehicle in the army. (Such an approach is currently being highly successfully implemented in the largest privately-owned transport fleet in the Republic). Such dates will be known at the beginning of a vehicle's service life and therefore contingency planning may be made well in advance by both the maintenance depot and the unit from which the vehicle will be coming.

The question of where a vehicle should be maintained must be decided upon by investigating as to the optimal size of a maintenance depot in terms of capacity and efficiency and then locating these according to all relevant criteria such as proximity to the bases served and lines of communication. At all stages detailed costing of the various alternatives must be made in order to achieve an optimum. Projections should also be made as to future needs and likely location of new bases so that the existing maintenance infrastructure may be adapted accordingly at the minimum cost, when the need arises.

Who exactly should be responsible for the maintenance of vehicles refers to the use of military or civilian personnel. There are strong arguments to be made for the maintenance of headquarters vehicles by private concerns who have the pressure of wishing to retain a large and lucrative contract on them, thus providing the incentive to perform the job to the best of their ability.

To imbue a sense of responsibility for a particular vehicle, a single driver should be in charge of it for as long as it is feasible. Further he should be directly responsible for carrying out regular preventive maintenance, for which manuals should be created. The United States Army has gone about this aspect in a particularly novel and imaginative way by issuing a monthly magazine/manual in comic form that covers different aspects of preventive maintenance. In this way unscheduled maintenance of vehicles may be kept to a minimum and thus both cost and operational readiness considerations may be taken care of at source.

Mention has been made previously of the central importance of a computer for the implementation of such an approach to maintenance, not to mention for other aspects of transport management still to be discussed.

Driver Training and Control

There is no question that driver training is of the utmost importance if vehicle life, petrol consumption and running costs in general are to be kept at an optimum level. Only thorough training of the best men available can ensure that many problems associated with transport are dealt with at source. Such an approach would call for higher standards for existing courses and a strong emphasis on maintenance. A sound grounding in the mechanical complexities of any vehicle a driver is likely to use, along with detailed instruction in the art of economy driving, in whatever conditions, is therefore necessary. The potential driver must be made aware of all the areas where fuel wastage can occur so that corrective action can be taken as soon as is feasible.

It follows of necessity that if economy driving practice is being followed that wear and tear upon vehicles concerned will be kept to a minimum. After fuel, tyres are the most significant contributor to running costs and the most important control of tyre costs is in fact through physical inspection rather than via fiscal exercises. In cognisance of this fact and backing up what has been said before, the driver must be made aware of this during training maintaining tyre pressures at an optimum, avoiding potholes and other tyre damaging obstacles where possible and rotating tyres according to wear. Where possible a full time tyre supervisor could be appointed, when 20 - 30 vehicles or more are permanently stationed. One need only think of the number of tyres on vehicles belonging to a defence force and to assign a value to them, to realise the potential savings involved in measures that improve tyre life by say an average of 10%. It is thus vital, when new vehicles are purchased, that the tyres fitted to them are those that have been selected after careful evaluation of the makes and types available, providing an optimum in the trade-off between tyre life and other requirements. It follows that spare and replacement tyres must be of the same type as far as is feasible.

In todays climate of austerity brought on by the shortage of reasonably priced oil, an important point to remember is that five barrels of crude oil are required to produce ten truck tyres, thus providing yet another incentive to strive for maximum tyre performance. Figures quoted in a recent article[3] state that: "between 60% and 80% of truck tyres are operated in an under-inflated condition, and over- or under-inflation is the cause of 80% of all premature tyre failures.

A tyre operating 10% under-inflated uses 9% more fuel than when correctly inflated, because of increased rolling resistance. The use of steel-cord and radial ply tyres can save up to 10% in fuel consumption, but the maintenance of these tyres is twice that of fabric tyres if the best service and maximum benefit is to be derived.'

This underlines two aspects, first that it is vital to choose the optimum equipment according to the potential use of a vehicle and secondly that driver training and control are vital if the overall goal of cost-efficiency is to be achieved. Hence a vehicle that has properly been fitted with steel-cord tyres whose driver pays constant attention to their correct inflation, can improve upon the fuel consumption of a vehicle with under-inflated cross-ply tyres by up to 19%, in theory; thus displaying the fuel saving potential of the approach mooted above.

As far as driver control goes this can be carried out in a number of ways. Again for it to be possible to carry out any coherent programme of driver control, it is essential that the number of drivers that use a particular vehicle should be kept to a minimum, whilst ideally only one person should be involved. A number of mechanical devices exist that facilitate detailed scrutiny of trips performed. The best known device is the tachograph which records in graphic form distances driven, standing times and speed. Accelerations and braking phases can also be deduced from the chart, whilst a second graph can record the duration and frequency of the operation of certain auxiliary equipment. Data so obtained can be optically scanned and evaluated with the help of a computer, and can be reproduced and compared in a variety of forms. Although an army situation precludes the use of financial incentives for drivers who perform the best, other incentives such as leave or rank promotion can be very effectively employed.

A more recent entrant on the driver control market is a locally manufactured device that, rather than measure speed against distance, records unnecessarily rapid acceleration, fast cornering and late, hard braking. This system has already been successfully employed by several large fleet operators in this country and has the advantage that it not only records the drivers driving habits but also issues a signal in the vehicle when an offence, such as rapid acceleration, is committed, in this way providing a constant reminder to the driver and passengers as to how he is conducting the vehicle. An example of the savings achieved by a company operating 7 Combis, was a reduction of R300 per month in maintenance bills and R150 per month in fuel bills.

Both devices mentioned do not involve high initial capital expenditure when related to the potential fuel, tyre, replacement part, and maintenance savings. Further, cognisance must be taken of the special requirements of the army with respect to combat conditions and other situations where the use of such devices is no longer of practical use. However when the number of vehicles actually constantly in operational use is considered the potential for introduction of such devices in the remainder, that are used on a regular basis, thus excluding those in vehicle reserve parks, still remains. Therefore it is advocated that a thorough-going study, of the number of vehicles that such devices could be used on with good effect, should be made in order to quantify the potential savings. Use of such devices may also help to combat the problem of a constant turnover in drivers that occurs of necessity where many of these men are national servicemen, in that whoever controls the vehicles in question may get an immediate idea as to the driving ability of a person on camp or who for some other reason would be in charge of a vehicle for a short period of time.

Having given some ideas on driver training and control, and mentioning finally that some large truck manufacturers give free instruction to drivers of their vehicles, it is necessary to cover movements planning and procedures.

Movements Planning and Procedures

In order to complement the work envisaged in previous sections it is essential that every major trip is planned beforehand so that the shortest route is taken — load factors are at an optimum and co-ordination of functions is achieved. 'Major trips' refers to the core traffic associated with the maintenance and supply of bases as well as forward positions; the transport whose requirements can be predicted well in advance. The scope of planning also goes well beyond these 'core' trips, but nevertheless is confined to those trips that lend themselves to planning in terms of criteria such as the priority and the nature of the trip.

The movement planning and monitoring functions and procedures that are involved here, can be adapted to the use of Automatic Data Processing. Having established a basic computer programme input data concerning transport capability of the mode operators, base loading and unloading capabilities and movement requirements must be fed in. However, since it is impossible to foresee precisely what transportation will be available; where, when and what supplies or personnel will be required to be moved, the relevant movements, personnel will need to make adjustments that are based upon both intuition and scientific weighing of the alternatives, as the situation requires and permits. These judgements must be rooted not only in professional knowledge gained from experience but also in an understanding of the interplay of closely related military considerations such as strategic and tactical situations, movement characteristics and current intelligence information.

With the necessary input data, then, the system may perform, amongst other tasks, the following:
a. Preparation of cargo disposition instructions.
b. Preparation of movements programmes.
c. Provision of an in-transit inventory.
d. Provision of a current inventory on status and locations of controlled vehicles or containers.

The application of such a system still requires the existence of localised transportation movements offices in order to provide the necessary information for the central office's computer and to co-ordinate movements locally.

The movements planning process that spawns the movements programme is the method by which the requirements for moving men and material are met. The three basic steps in this process are:
a. Developing the distribution pattern.
b. Developing and preparing the material and personnel movements forecast.
c. Preparing, publishing and distributing the movements programme.

The resultant movements programme will include both forecasts of shipping requirements and of transport capability. It may be sent out well in advance so as to allow localised preparation for the projected logistical activity. Steps in the formation of such a programme will include:
a. Determining requirements.
b. Analysing capabilities.
c. Selecting and allocating modes.
d. Co-ordinating and resolving priority conflicts.

A more detailed coverage of the actual process is not called for here, but the concept it is hoped, has been communicated. The merit of careful planning in terms of the efficient use of limited resources is beyond question.

Research and Development

A final aspect that must be considered is that of Research and Development. This can be aimed at the improvement of both systems and equipment that are currently in use, as well as anticipating future requirements.

The primary task in this regard is to study the whole transportation process in order to pinpoint areas that lend themselves to improvement. One such area is that of the use of alternative fuels that received much attention during the Second World War. Many innovations were introduced such as the conversion of vehicles to run on Liquid Petroleum Gas. Another development was the augmentation of petrol supplies by blending them with alcohol. At the time, on 27 May 1940, Natal

Scientia Militaria, South African Journal of Military Studies, Vol 10, Nr 4, 1980. http://scientiamilitaria.journals.ac.za

Cane Byproducts wrote to the Secretary of the Fuel Research Institute as follows: 'We should be pleased to hear if you have considered the utilisation of surplus alcohol in South Africa by the addition of a sufficient quantity of ether, to develop a suitable fuel to augment fuel resources in time of need.' The Fuel Research Institute report on tests along these lines summed up their results: 'The power increase was proportionate to the amount of alcohol, and. . . ., by using large enough jets, it was possible to regain all the power obtainable from petrol. At this point the alcohol consumption is only slightly in excess of the normal petrol consumption. The use of this mixture for commercial purposes is feasible.'[4] Today instead of ether, methyl alcohol has also been tested and it has been found that between 10% and 15% methyl alcohol can be used without any modification to existing engines. Alternatively essentially pure methyl alcohol can be used to fuel vehicles with appropiate modifications.[5]

The advantages, other than that of saving valuable oil, in using gas fuels are impressive to say the least: 'a reduction in atmospheric pollution in the order of 90%; increased economy of vehicle operations through reduced engine maintenance; reduced frequency of both engine oil changes and spark plug replacements; more efficient engine operation; elimination of vapour locks; and increased operational safety by virtue of the restricted ignition temperature range.'[6]

Natural gas may also be used to fuel vehicles and, although experience is not as great as with liquid petroleum gas, nevertheless operational experience has shown a marked reduction in maintenance requirements. Whilst conventional petrol engines can be converted to the use of such gas fuels at a low cost, Rolls Royce Motors have taken the logical step of producing two engines that are made specifically for gas operation which embrace a power band of from 140hp to 230hp, the top end being achieved by turbocharging. The engines themselves are derived from the petrol engine that currently drives the British Army's Ferret scout car, the Alvis Stalwart high mobility carrier and the Bundeswehr's H530 armoured patrol car.

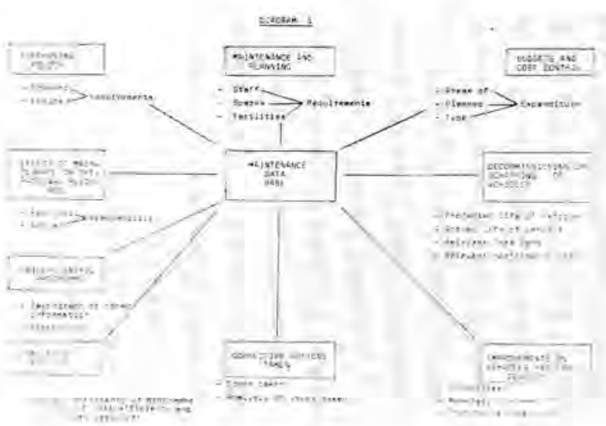
In the light of current worldwide fuel shortages and with ongoing shortages being envisaged in the forseeable future, a long hard look at the gas fuel alternative is strongly advocated.

Research and Development into systems may include more extensive use of containers and palleting of material. Further, loading and offloading, storage and stock control procedures all lend themselves to investigation and improvement in the search for greater cost-efficiency within the bounds of maintaining approppiate operational readiness.

In the broader context such questions as whether a transport requirement may not be done more efficiently by rail, air or pipeline must be answered. Research and Development is the key to the successful continuation of the transport function and consequently must be given the appropiate status.

Conclusion

This article commenced with the approach of the need to strive towards optimum efficiency of all aspects in the fulfilment of the transport requirement in the army. Clearly there is much scope for improvement, particularly in the area of research and development in the light of projections as to oil supply which could critically effect the nations defensive capability.



Footnote

* Lt M. Japhet, BSc (Hons) (Bristol University) was employed at the Documentation Service as a National Serviceman.

** This article is a reprint of pionter No 11/79 which is also distributed by the Documentation Service.

REFERENCES

1. E. Russell-Walling: Feeding Your Fleet *(Management*, March 1979, p 39).
2. *Trucks and Trucking, Sunday Times Business Section*, 27 May 1979, Computer Analysis for Harvester Vehicles.
3. *Trucks and Trucking, Sunday Times Business Section*, 27 May 1979, Large Diesel Truck Uses 8 Litres An Hour Idling.
4. M. F. Bekker: *S.A. War Economy Petrol Control*, Union War Histories, 1958, p 74.
5. A Pasternak: Methyl Alcohol — A Potential Fuel for Transportation (D. M. Condine (ed): *Energy Technology Handbook*, pp 4-44 — 4-49).
6. A. Whiting: Indigenous Fuel for Australian Military Vehicles *(Pacific Defence Reporter*, Vol 5 No 9, March 1978, pp 74-78).

Bibliography

1. Bekker, M.E.: *S.A. War Economy Petrol Control* Union War Histories, 1958.
2. Considine, P.E. (ed): *Energy Technology Handbook*, McGraw-Hill Inc., 1977.
3. Hancock, W. K. and M. M. Crowing: *British War Economy*, History of the Second World War, London, 1949.
4. Hancock, W. K. (ed): *Statistical Digest of the War*, History of the Second World War, London, 1951.
5. Hitch, C. J. and R. N. McKean: *The Economics of Defence in the Nuclear Age*, Harvard University Press, 1960.
6. Payton-Smith, D. J.: *Oil — A Study of War-Time Policy and Administration*, History of the Second World War, London 1971.
7. Savage, C. I.: *Inland Transport*, History of the Second World War, London, 1957.
8. Yoshpe. H. B. and F. R. Brown: *Transportation : The Nation's Lifeline*. Washington D. C., 1961.

Periodicals

1. Bachman, R. R.: Army Meets the Fuel Crisis *(National Defense*, May/June 1976).
2. Munhall, W. V.: Strategic and Economic Aspects of Railroads *(Military Engineer*, January/February 1975).
3. Potter, E. D.: The Conversion of the British Army to a Bulk System of Operational Ground and Aviation Fuel Resupply *(The Royal of Transport Review*, Vol 2 No 4, September 1977).
4. Russell-Walling, E.: Feeding Your Fleet *(Management*, March 1979).
5. Stipo, V. D.: Defense and the Energy Problem *(The Military Engineer*, May/June 1974).
6. Supplement to the *Financial Mail*, Vol 71 No 13, 30 March 1979.
7. Witt, N. D. E.: Of Trailers and Bulk Refuelling. *(The Royal Corps of Transport Review*, Vol 2 No 15, March 1978).