CAN AN ENVIRONMENTALLY EFFICIENT ROAD TRANSPORT OPERATION BE COST AFFECTIVE

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CAN AN ENVIRONMENTALLY EFFICIENT ROAD TRANSPORT OPERATION BE COST COMPETITIVE?

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1. Introduction

1.1 John Fixx's best-selling paperback, "The Complete Book of Running", promises firstly to introduce the reader to the extraordinary world of running and, secondly, to change the reader's life very much for the better.

1.2 Neville Shute's autobiography, "Slide Rule", quotes from a pre-first-world-war poem "Around the next corner of the next street, adventure waits for you".

1.3 I cannot promise to change your life or even provide an opportunity for adventure but I will attempt to describe a vision of a road transport system which would be far more environmentally acceptable and which would raise the status of the road transport industry to one I believe it so richly deserves.

1.4 Also to consider whether this vision that no doubt could be considered by some as soft-hearted idealism could compete with cold-blooded commercialism.

2. Definitions

2.1 We Engineers use the word "efficient" far more than other professions, frequently as a percentage of actual performance against a theoretical maximum. In the context of this paper, efficiency is defined as "producing the desired result" as efforts to determine absolute zero emissions, for example, would arguably be better spent on improving the existing standard.

2.2 Cost competitive, in the context of this paper, means that one's own fleet fixed and running costs are lower than any third party Operator.

2.3 So, if "efficient" is defined as producing the desired results - what are the results desired?

2.3.1 Must be more likeable.
2.3.2 Accepted as a friendly contributor to improving communities' life style.
2.3.3 Be less obtrusive.
2.3.4 Be more aesthetically pleasing.
2.3.5 Quieter.
2.3.6 Reduce all types of operational emission.
2.3.7 Be more route friendly.
2.3.8 Carry a greater payload at lower cost.
2.3.9 Increase component recyclability.
2.3.10 Pay back its true environmental costs.

3. Firstly - Lorry Must be Likeable - Friendly - Less Obtrusive

The Road Transport Operation must be unobtrusive to the point where it becomes a warmly accepted part of the community.

3.1 Why is it that the occasional horse-drawn vehicle holds up traffic, sprays multitudinous emissions in an uncontrolled and unpredictable fashion, - has no fail-safe braking system - stamps and clatters its way along the pavements, yet appears to be loved by everybody - and yet again the deafening, clattering, shrieking, splattering, ineffective steam locomotive that has eroded Victorian bridges with sulphurous blasts not only has armies of admirers but also is humanised in very young children's reading books - Thomas the Tank Engine to mention but one! - But seldom, if ever, the lorry.

3.2 Against this, the road vehicle is most countries' life blood - in the UK, 90% of goods go by road (77% in USA 1990).

3.3 The lorry has won the majority of really challenging battles both on the trunk road and delivery in City Centre. There is no form of transport that can match its flexibility and cost - nor is there a rival on the horizon. Surely it must be possible to make it less obstructive and more likeable, if not lovable, by lowering and shaping. Curvaceousing to aesthetically please is one aspect that will not be driven by legislators nor, my guess, the by hard-nosed vehicle operator - not by current Truck Manufacturers who prefer to supply the regular vehicle machine.

3.4 Aerodynamic efficiency could be a helpful influence but "wait" - as the world becomes more attuned to beautification is it possible that vehicle body designs would need aesthetical type approval.

3.5 No doubt a curvaceous body would cost more so unless the body beautiful attracted more business through imaginative advertising livery, the environmentally conscious operator would lose out.

4. Noise

4.1 Historically, truck diesel engines were extremely noisy - the Cummins V.I.N. and VALE high revving configurations being amongst the noisiest.

4.2 There was also the Foden Supercharged Two Stroke - always music to my ear but a high scorer on the noise meter.

4.3 An early Rolls Royce normally aspirated 220 b.h.p. engine fitted to a Scammell Handyman provided the driver with 102 d.b. (A) at ear level - this would be early 1970's.

4.4. I recall at that time listening to a Nurse who had been called in at short notice to speak about health and fitness for Lorry Drivers. She casually remarked that she could always detect a Lorry Driver through a damaged left gear change hand and failing hearing.

4.5 Reduction in noise levels has and will be driven by both National and Global Vehicle Type approval and Health and Safety Commission working standards.

4.6 Health and Safety at Work legislation not only very clearly states the maximum noise levels an employee should be subjected to - without the

provision of ear protectors - but also the maximum working day noise dose measured in L.E.Q. units.

4.7 Noise-induced deafness has now been recognised in addition to being a nuisance and irritant and this acknowledgement could become very significant in terms of employee compensation claims.

4.8 I predict that permissible dose levels will continue to be reduced to a point where it will be necessary to seal and double glass cab windows and screens, leading to the inevitable air conditioning. Again, no haulier is likely to spec these extra cost items if he is not forced to do so by law.

4.9 Whilst Type Approval and User standards are supported by law, Environmental Efficiency does not penalise cost competitiveness.

4.10 Noise-promoting items such as air brake exhausts, cab door latches and fifth wheels and suspension and body systems not covered by legislation do penalise cost competitiveness if resolved by the use - especially air brake silencers and air suspension.

4.11 I see every reason for these two items at least requiring the support of legislation to achieve Environmentally Efficient Road Transport Operation. I am pleased to see European Governments encouraging road-friendly suspensions by increasing maximum permissible axle loads.

4.12 Today, the vehicle operator can do a great deal to reduce in-cab noise levels of both new and existing lorries, particularly at the lower quality end of the market - and at no great cost.

I have found that these include -

1. Ensure that all cab to chassis unused holes are well and tightly rubber grommetted and this goes for pedal and gear change draught extruded gaiters.

2. Keeping the above item on the periodic inspection schedule encourages in-cab noise levels to be kept at levels which will not aggravate and fatigue the driver and if not enhance the re-sale value of the vehicle at least make it more saleable.

3. Din Dame, marketed by P.E.R.A., is a simple magic material that can be easily applied to body/cab panels to reduce vibration and thus noise.

5. Exhaust Emissions

5.1 The day of the dirty diesel exhaust has rapidly become a thing of the past in Europe - well, in most EC countries at least.

5.2 A schedule for more demanding diesel exhaust standards over the next decade appears to have been accepted as challenging but achievable by the engine manufacturers.

5.3 During a recent trip to Cummins in Columbus, U.S.A., I was confidently advised that the required standards could be achieved without reverting to electronic diesel control systems.

5.4 I put this point to their rivals in Detroit (where electronically controlled engine is achieving good operator reception) - but their response was predictably "That's what they said about the alternative methods of charge cooling a few years back".

5.5 Be that as it may, Manufacturers such as Austria's Steyr have demonstrated that the diesel engine can be significantly cleaned up - and the new targets met by the manufacturer.

5.6 The operator has therefore little influence or reason to pay extra for an environmentally friendly engine.

5.7 On the ecological side, there are sufficient published reports for him to help make his mind up on which engine or vehicle is the most economical.

5.8 It would take a courageous operator to move to an alternative fuelled engine and nationwide supply of that fuel would no doubt be a crucial factor.

5.9 Having said that, in an earlier fuel crisis - either Federal Express or United Parcel Services went some way in developing a stratified multi-fuel engine once they realised that probably the continued existence of their distribution company depended upon the availability of an engine that would run on alternative fuel. However, once the fuel crisis was over the project was dropped.

5.10 For years there would have been no practical substitute for the diesel engine H.G.V. operation - in spire of its low engine speed and need for a heavyweight driveline to take its torque. Its death knoll could well be exhaust particulate.

5.11 In November 1991, Dr. M. Zockel presented an exciting paper on "Liquid" L.P.G. injection for Spark Ignition Engines at an I.M.I. and I.R.T.E. Sponsored Conference in Singapore.

The primary advantages of L.P.G. are lower operating costs and increased engine life as well as lower emission levels. The disadvantage of the current gasification system in use at present is the reduced performance which means a need for larger engines. These disadvantages can be overcome by Dr. Zockel's Liquid L.P.G. system which uses existing petroleum injectors - slightly modified and a modified Electronic Control Unit.

5.12 The current L.P.G. spark ignition system suffers from a 15% to 20% volumetric efficiency drop due to the induction of gaseous fuel into the manifold system.

Dr. Zockel's described system with wide open throttle and optimised ignition timing for the L.P.G.'s high octane rating matches the petrol fuelled engine torque curves and provides a 10% improvement at lower engine speed. I'm reliable informed that L.P.G. is half the price of petrol in some parts of Australia.

5.13 In the UK, Ken Garrett writing in our own 'Transport Engineer' about (l.n.g.) Liquid National Gas, points out that the UK is discovering more and more natural gas with a forecast supply life of up to 300 years and one of the challenges is how to use it efficiently. Up until now, l.n.g.

has not been used too enthusiastically as an alternative fuel for automotive work because of storage capacity difficulties. British Gas has threatened to resolve this by producing an absorbent carbon material which can store l.n.g. at a pressure of 35 bars, and is termed a (a.n.c.) absorbed natural gas.

5.14 Natural Gas runs in Cummins L10 10 litre 240 hp suitably modified engine has already met American Onerous Particulats Standards with thermal efficiencies at 37% not far short of that of diesel. As the fuel remains in a gaseous state down to very low temperatures, enrichment of the mixture for starting and running under cold conditions is unnecessary. In the cold state, therefore, not only is good economy obtainable but also the hydro carbon emissions are kept low by comparison with those from either petrol or diesel engines.

5.15 So great things can be expected of (a.n.c.) absorbed natural gas and subject to cost and availability both of the gas and on-board storage and combustion process development - is where a cleaner fuel might provide the Road Transport Engineer with a cost competitive edge and environmentally efficient.

5.16 No paper on the effect of the automotive industry on the environment can be complete without mention of the car and Southern Californian's attempts to reduce atmospheric pollution and I enclose a very short paper at Appendix A on this subject.

5.17 This paper underlines the need for small automobile capable of travelling 60-70km and meeting AD 2007 South Californian Zero Emission Standard.

This points to the electric car which produces 4.1kg of pollution per 10,000 miles against 161kg per 10,000 miles for petrol engined car. The 4.1kg includes initial electric power station general pollution.

So, in South California, the ideal citizen would drive an electric car where the power is generated in another US State.

5.18 I could not resist comparing Dodge's latest American Dream Car, the Dodge Viper, due to be launched Spring 1992 with the Southern Californian Zero Emission Machine -

Item	Dodge Viper	Zero Emission Machine
Engine	V10cyl 400 b.h.p. 8 litres spark ignition	45 b.h.p. separately excited DC Motor plus auxiliary 500 c.c. Petrol Engine
Price	$55,000	$25,000
Max Speed	165 m.p.h.	$60 m.p.h.
Accel	0-60 4 sec	0-30 9 sec
MPG	15	
Range C	300 miles	150 miles

6. Carry a Greater Payload at Lower Costs

6.1 Dr. Rayner Mayer of Sciotech in Hampshire UK presented a paper to the Institution of Mechanical Engineers and the Institute of Road Transport Engineers in February 1990 at Birdcage Walk, Westminster, London, entitled "The Importance of Mass and Payload for Commercial Vehicles".

6.2 He listed Society requirements for the Heavy Goods Vehicle, namely the need to reduced exhaust emissions -

less noise
less road damage
reduction in freight costs
less congestion
less spray

The Operator, on the other hand, wanted -

improved duel consumption
more comfortable ride for driver and load
quieter vehicle
lower tyre wear
lower vehicle excise duty
higher payload

He concluded that, to resolve both requirements for a given Maximum Gross Vehicle Weight, the Tare Weight should be reduced or the Maximum Weight Limit increased.

6.3 He then listed components that could be re-designed using aluminium, glass fibre, - carbon fibre - indeed components that were already available in composite form.

6.4 He calculated that by increasing the payload of a 38 tonne tractor trailer, by reducing the tare weight by a tonne, would increase earnings by 25 Pounds per annum - on a single shift at 4,000 Pounds per annum on a double shift - compared with operating a 40 tonne combination.

6.5 It was interesting to note when H.G.V. limits were lifted from 32 tonne to 38 tonne in the UK, the HGV population dropped by 8%.

Engines have improved in efficiency to the extent whereby the 32 tonne consumed the same m.p.g. as the 38 tonner, and it would not be an exaggerated approximation to claim that emissions have at least reduced by the same percentage.

6.6 Modern lightweight proven composites can provide the opportunity to save another 4% of vehicles and therefore exhaust emissions and fuel, and provides an opportunity to be very broadly environmentally friendly and at the same time a cost-competitive edge.

7. <u>Aerodynamics</u>

7.1 Work carried out by Ricard - A.S.& A., in conjunction with Exel Logistics, in the UK, following comprehensive scale model wind tunnel trials proved that, in service, experience showed duel savings of around 20% comparing scientifically designed streamlined vehicles with the standard box bodied vehicle. Just to anticipate questions, the reduced aerodynamic drag enabled a lower numerical axle ratio to be fitted (4.808:1 instead of the standard 5.409:1) and a road speed limited was fitted and set at 63 m.p.h.

7.2 On the selected operation tested, an annual overall net cost saving of 600 Pounds was demonstrated.

7.3 However, the UK Brewery Transport Advisory Committee, in conjunction with I.R.T.E. has demonstrated the bolt-on drag foilers are not necessarily fuel-efficient and have really concluded for aerodynamics to provide a payback a fully integrated system is necessary.

7.4 It is also worth mentioning that, at 38 tonne operation, a drop in speed from 65 to 50 produced a saving of 31% in fuel costs.

8. Spray

8.1 The contribution to the lorry-dislike brigade is fired by wet weather spray and Type Approval Regulations require the heavier vehicles to be fitted with anti-spray wheel flaps in Europe.

8.2 These flaps, or water-absorption direction devices, are not too effective at speeds over 50 m.p.h. and there is sound reason for H.G.V. speeds to be reduced in wet weather.

8.3 There are a number of road surface materials that will absorb and help drain the Trunk Roads but these tend to be more expensive to provide and maintain.

9. Maximum Gross Weights

9.1 There is no question in my mind, having studied this subject for 20 years, that the greatest opportunity to reduce pollution is to increase vehicle permissible weights.

9.2 All the scientific and academic evidence indicates that high vehicle weights will reduce pollution, reduce the number of vehicles on the road and, therefore, congestion, would conserve our global finite fuel resource - and given more axles, produce less, not more road pavement wear.

Given sufficient payload opportunity, these vehicles could operate efficiently at lower speeds and on designated routes.

9.3 Francis Turner, a former USA Highways Administrator, has, for many years, recommended in order to move goods more efficiently and at a lower damage to the roadway, increasing maximum weight but reducing axle weight by increasing the number of axles.

10. Conclusion

10.1 The Road Transport Operation throughout the World has played a major contribution in providing the living standards that are now enjoyed.

10.2 Every indication is that it will continue to provide the lifeline required by modern civilisation and there are no alternative methods of supply currently emerging.

10.3 Global legislation is the major driving factor in improving the environmental efficiency of the Road Transport Industry.

10.4 Fully integrated aerodynamic vehicle body system can provide a cost competitive edge in certain operations as can tare weight reductions.

Both provide environmental efficiency improvement opportunities - yet not fully exploited.

10.5 A lower, lighter aerodynamic efficient, exceptionally quiet, multi road friendly, suspended axled vehicle powered by dual fuel stratified engine, with double glazed, sealed, fully air-conditioned cab, is likely to make more public friends and improve the status of the Road Transport Industry within the next decade.

10.6 The words of the late James Fletcher, Director of American National Aeronautical and Space Administration, N.S.D.A., pretty well summed up the overall conclusion to the question "Can an environmentally efficient Road Transport Operation be cost competitive?" when he stated -

"You are torn between soft-hearted idealism and cold-blooded commercialism - but you can't help being a little concerned when you see Planet Earth from Space.

It's the most beautiful Planet - it is blue and there is nothing else like it in the Solar System.

It's the only one we've got and we'd better take good care of it."

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A P P E N D I X 'A'

ELECTRIC VEHICLE : SITUATION REPORT 1989

1. Introduction

General Motors were on record as forecasting that by 1995 over 30% of American cars would be electric powered.

Whilst this forecast proved overwhelmingly optimistic, there are now indications that the electric car is being considered seriously, spurred on by suggested Southern Californian legislation that by the year 2007 all new 'fleet' vehicles must achieve zero exhaust emissions.

This short paper records the state of the art concerning clean air transport.

2. Information

The Los Angeles basin is the home of 8 million cars with an annual new registration of 900,000.

A scientific study demonstrates that 77% of Los Angeles pollution is car related.

Petrol cars are responsible for 161 kg per 10,000 miles, against electric cars 4.1 kg per 10,000 miles, and this includes initial electric power generation.

90% of car journeys in LA are less than 64 kms.

An Anglo-Swedish company, Clean Air Transport is building a hybrid powered car aimed at this Californian market.

The primary build of some 1,000 cars will be completed in Worthing (UK) by 1992 by which time a new 25,000 cars per year plant will be established in California.

The vehicle is designated LA 301, designed to meet ultra low emission exhaust vehicle standards which is 25% of current permissible.

By the year 2010, Southern California will be calling for 70% of fleet vehicles to reach zero emission.

The onus will be on fleet operators with 10 vehicles or more.

It will also be a requirement for each company to demonstrate reductions in emission as a condition of expansion.

The LA 301 will have a 34kw separately excited DC motor driving the front wheels and an auxiliary powered unit driven rear wheels through a 500cc water cooled piston engine running on reformulated petrol and exhausting through a catalytic converter.

Initially batteries will be lead/acid sealed and evidently this could be replaced by sodium/sulphur batteries.

The range is 60 miles on battery alone, up to 150 miles using battery and auxiliary power unit.

Top speed will be 60 mph, 0-30 miles/hour in less than 9 seconds, on-board charging over the full 8 hours, usually 4 hour top-up charge.

The car will have a GRF body on a galvanised steel chassis. Total weight 3240 lbs.

Selling price will be 14,000 Pounds.

The life cycle costs will be on a par with a conventional vehicle on an 8 year cycle (electric costs are taken at 5 cents per kw hour as opposed to the petrol at 1.15 US$/gal). In the UK par will be realised at 4.8 years in view of our high petrol cost.

3. Conclusions

3.1 Exhaust emission legislation is driving electric vehicles forward in California.

3.2 An Anglo-Swedish Company, Clean Air Transport, is producing a hybrid vehicle looking to sell 25,000 in the year 1992.

3.3 The vehicle will have an acceptable road performance, however it will be limited to 150 miles before requiring recharging.