

TYRE PRESSURE CONTROL

An investigation into how reducing tyre pressures could increase efficiency and effectiveness of timber haulage



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Terms Of Reference

- To investigate the costs and benefits of fitting Tyre Pressure Control (TPC) to a timber lorry.
- To generate and evaluate these costs and benefits.
- To draw conclusions from this investigation and put forward recommendations as to whether Tyre Pressure Control can be justified taking into account financial issues and human factors .

Summary

The following project is a 5 month investigation of using Tyre Pressure Control on timber Lorries. It shows what the potential improvements are to the efficiency and effectiveness of timber haulage.



Picture of a TPC system fitted.

The project concentrates on what Tyre Pressure Control systems claim are the benefits such as:-

- **Increased traction**
- **Increased tyre life**
- **Reduced lorry maintenance**
- **Increased hauling days**
- **Reduced road costs**
- **Driver benefits**
- **Better management**
- **Lower fuel costs**

THE PRESENT SITUATION

FUEL PRICE

The haulage industry in the United Kingdom has changed greatly since 1995 when the Government's Fuel Price "Escalator" started to come into effect. This policy meant an annual rise in fuel of 6% which has resulted in the United Kingdom having one of the highest fuel prices in Europe. The government acknowledges the fact that fuel is high but argues that the way forward is to make Lorries more efficient.

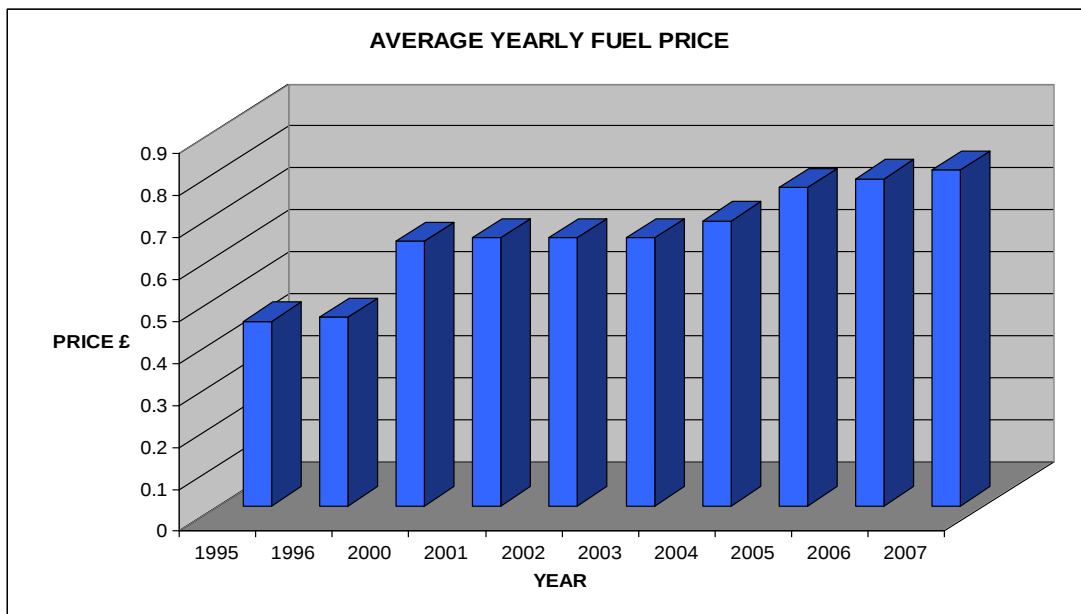


Figure1 (above) shows the rising cost of fuel (excluding VAT) since 1995.

ENVIRONMENTAL

The government has set out a clear policy for lowering emissions of carbon dioxide from vehicles which lorry manufacturers must reach. Haulage companies, in future, will be expected to measure their "CARBON FOOTPRINT" and show what steps are in place to lower these.

LEGISLATION

May 2005 saw a major change in legislation with the introduction of the European "Road Traffic Directive". This limited drivers to working an average of 48 hrs per week instead of 70 + hrs. This has had a huge impact on haulage costs due to increased wages.

LORRY SPECIFICATIONS

In July 2001 the Department for Transport allowed Lorries to run at a maximum of 44.00 tonnes instead of 38.00 tonnes. This was supposed to help reduce the numbers of vehicles and also make haulage more efficient.

Trailers also changed with the introduction of “Super Single Tyres” This meant lorry trailers could now have only 6 tyres not twelve.

ROADS

The local Councils in Scotland are now imposing weight restrictions on any roads which are being damaged by Lorries. These roads often lead to remote forest locations which would then become “Landlocked” (e.g. Kinbrace to Rosal A897)

Forest Roads were designed to withstand Lorries with a Gross weight of 38.00 tonnes with twin wheels not 44.00 tonnes with super singles. Roads are therefore being damaged which are expensive to repair. Cost savings by the landowner often result in cheaper sub standard roads. These roads are not capable of supporting the increased timber production and haulage over a shorter period of time.

With all the above factors, it is paramount to explore the use of any new technology which will help improve the efficiency and effectiveness of timber haulage.

A new system called [TYRE PRESSURE CONTROL \(TPC\)](#) has just come onto the market in the UK.

INVESTIGATION

TYRE PRESSURE CONTROL (T. P. C.)

This is a system which electronically controls tyre pressures from the cab of the lorry while the vehicle is moving.

There are only a few systems available worldwide which range from:-

TIREBOSS who are Canadian (www.tirepressurecontrol.com)

BIGFOOT who are from New Zealand (www.ctibigfoot.co.nz)

AIR C.T.I. from Australia (www.aircti.com)

There are only four TPC systems fitted to Lorries in the UK. The first system was fitted last year, followed by 2 systems fitted to our own Lorries in June 2007. The trial of the system is still in its early days, so there are no past performance indicators to compare the system with in the UK.

At the moment there are no extra financial incentives from customers or suppliers to encourage hauliers to purchase and fit a T.P.C. system

All these systems claim that there are many benefits, not just financial, to having them fitted. This investigation will provide some useful information on whether the TPC systems can help improve efficiency and effectiveness of these timber Lorries by:-

Increased Traction

A longer footprint is produced when the tyre pressure is decreased. The diagrams below clearly illustrate how this footprint is enlarged when the tyres are deflated producing significantly increased traction.

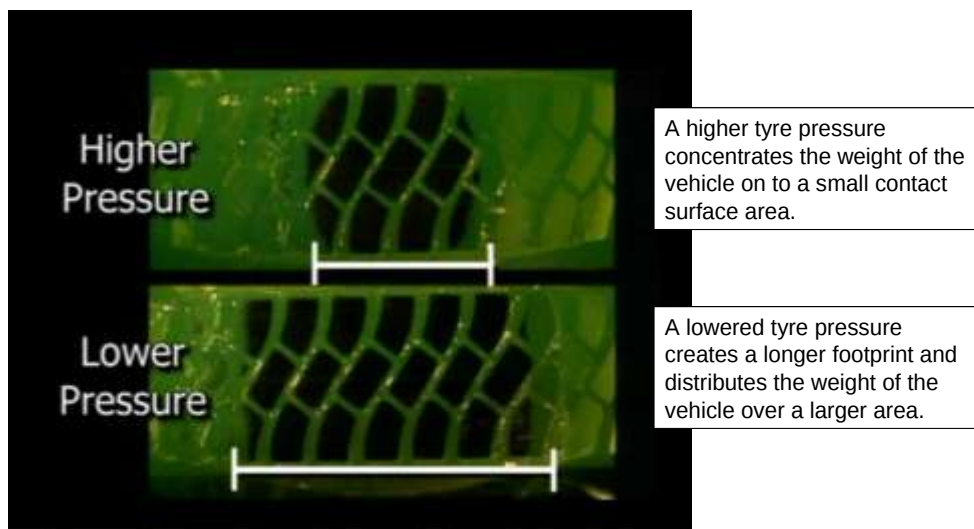


Figure 2

(above) shows difference in tread between a tyre fully inflated and deflated.

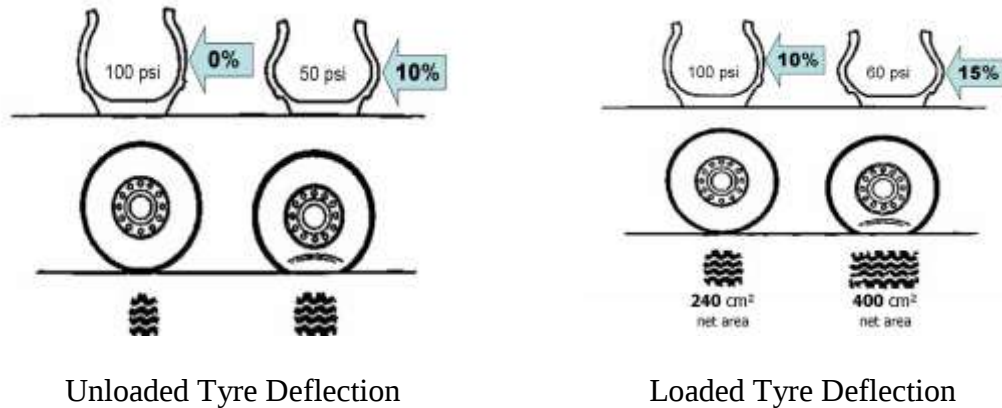


Figure 3 (above) clearly shows the greater footprint of a deflated tyre when unloaded /loaded to that of a normal inflated tyre.

TPC claim up to 34% better traction in sand and 17% in mud. This has been proven on some road surfaces in a report by FERIC (**ref: www.feric.ca**)

I have been keeping a “Log book” which has been and still is monitoring the progress of the TPC system since they were fitted. This includes some very positive feedback from everyone involved in the TPC trials (**see appendix I**)

Increased Tyre Life

Most Lorries run with tyre pressures which are set for tarred roads when loaded. It is recognized that tyres should have different pressures for when they are loaded and unloaded. They should also have different pressures for when they are on tarred or forest roads. The TPC system allows this change to be made when the lorry is moving. The system also keeps all individual tyres at the pressure required which should result in better and more even tyre wear. Lorries with no TPC systems should not have different individual tyre pressures. I have monitored tyre pressures on our Lorries to see if this is the case (**see appendix II**)

Michelin have also proven that under/over inflated tyres on public roads do shorten length of tyres and also reduce fuel consumption.(ref:www.michelin.co.uk)

I have also monitored the tyre treads on our Lorries as well (**appendix III**)

The system also claims that because the tyres are deflated while running on the forest roads which allows the tyres to flex better that there should be :-

- a) less damaged tyres
- b) less punctures

Another advantage is when there is a slow puncture. The TPC system is capable of keeping the tyre inflated until it is sorted which saves on downtime and callout charges. (**All of the above has been recorded in the “Log book”**)

Reduced Vehicle Maintenance

The softer tyres on the forest roads should reduce the vibration on the lorry which can then increase the life of components. (See **feedback from mechanic in “Log Book”**)

Increased Hauling Days

In Canada and Sweden the authorities allows Lorries that are fitted with a TPC system to haul from forests during the thawing season. This will be monitored, in the “Log Book” when and if the case arises. (Ref: www.skogforsk.se)

Road Costs & Maintenance

Depth of road surface material needed to support Lorries can be reduced. Lower tyre pressures reduce the amount of rutting which occurs with fully inflated tyres. Grading of roads can be reduced by 75%. It is fair to say that moderately rutted roads caused by vehicles with “fully inflated” tyres can be “healed” by the lower inflated tyres
(Ref www.feric.ca)

Haulage companies would argue that road costs is not their problem as the roads should be made to a suitable standard for their Lorries.

Driver Benefits

Lorries do vibrate and the worst time for this is when the Lorries are travelling on the forest roads empty. Using TPC should significantly reduce the vibration and make driving the lorry a lot smoother and more comfortable. This should also reduce the amount of sore backs which drivers suffer from.

(All of the above is covered by feedback from the drivers in the “Log Book”)

Management

The management of the Lorries with TPC systems is significantly improved just by knowing that the Lorry will not get stuck. This then means no de-bogging costs, no re-routing and satisfied customers. You have the confidence to deliver what you want when you want.

Fuel Economy

TPC is claiming a fuel saving of 3-4% can be achieved. I have monitored the fuel for this year on the Lorries before and after TPC was fitted (see **appendix IV**)

Life Span of TPC

A TPC system is supposed to last for 15 – 16 years. This equates to the life of 3 units and 2 trailers.

All of the above benefits and more can be seen on a flow chart (see appendix V)

EVALUATION

The investigation looked into having a TPC system fitted. If this system was not fitted then we would be “standing still” with the lorries we have at present which are:-

- **Tag - Axle** (see appendix VI)
- **Double Drive** (see appendix VII)

Briefly Double Drives are what they say....they have two axles which “drive” compared to the Tag - Axle which has one, therefore the double drive has better traction but at a cost.(see appendix VIII)

By fitting a TPC system onto these Lorries we can evaluate how efficient / effective this system is compared to the Lorries we operate at present.

Increased Traction this is by far the best advantage of the system with very positive feedback and results. Very hard to measure financially but definitely more efficient and effective as you have the confidence the lorry will get in / out of forests without being de-bogged or having to be re-routed (cost of being de-bogged is usually into £000,s) Great for just in time deliveries and keeping suppliers and customers satisfied. Double Drive with TPC being the most effective but Tag - Axle with TPC being the lorry with the most improved traction (comparable to Double Drive without TPC)

Increased Tyre Life difficult to prove at this stage with tyre wear itself although there are signs of tyres wearing more evenly across the tyre itself. Certainly a reduction in damaged tyres (saving at least £600.00 per annum) Very efficient and effective with slow punctures which allow us to repair in our own time. (Saving at least £300.00 per annum) There is also added safety for the driver / tyre fitter with the prevention of slow punctures which prevent unwanted stops in unwanted places. (What price on Safety ?)

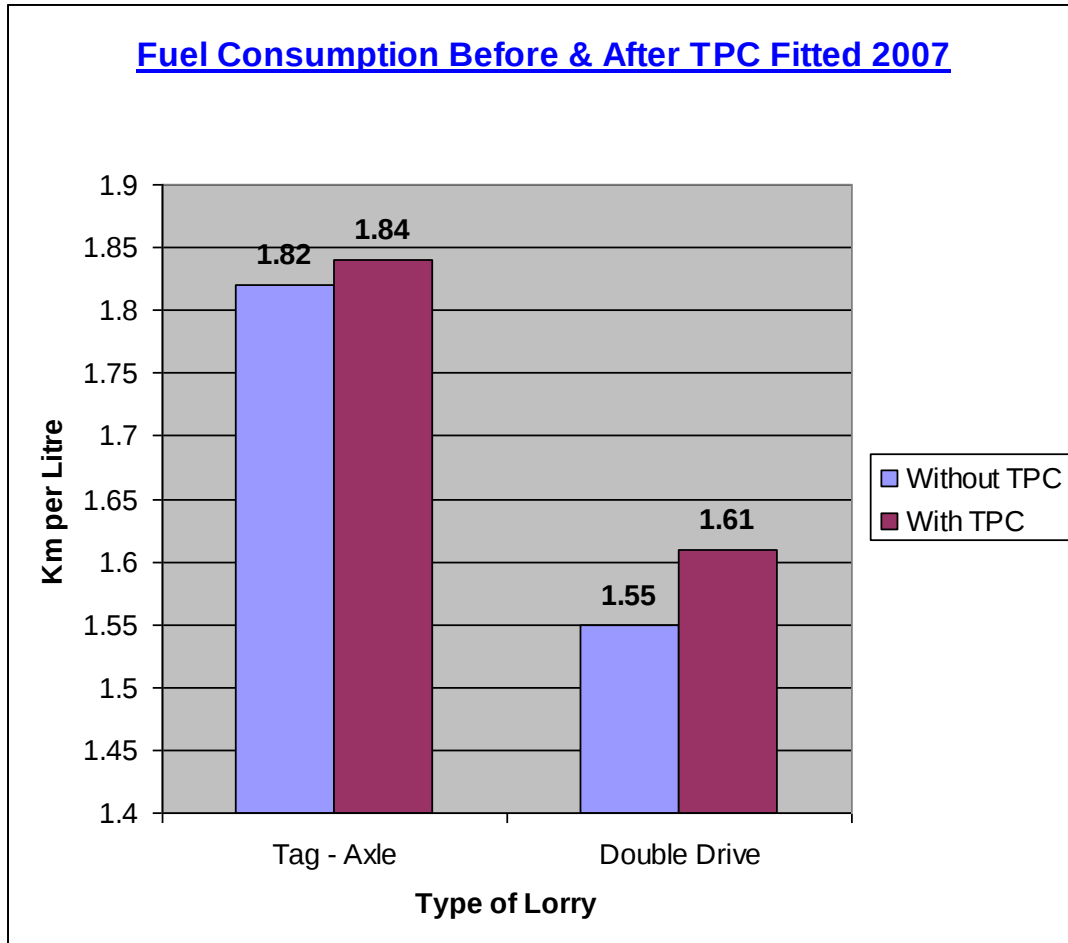
Maintenance TPC systems have proved fewer vibrations on Lorries which has coincided with fewer replacements of light bulbs and tightening of bolts. This is supported with feedback from drivers / mechanic. (One hour a month at £40 per hour is a saving of £480 per annum)

Drivers from feedback they are delighted with the new system. They use it all the time which speaks for itself. They have a smoother ride, which, in their own words allows them to go faster. This should therefore increase productivity. They are more confident which also means less stress and fatigue levels. . (Additional load per annum £175.00)

Roads Costs difficult subject as these are not direct costs to the haulier. (Is this my problem?) Arguably roads should be a suitable standard for the Lorries. There are local councils, just now, who will only allow Lorries with TPC to use certain roads.

Management more satisfied customers, suppliers and drivers with less hassle and reduced costs what more could you ask for? (In-valuable)

Fuel Consumption the fuel figures for 2007 to date are down on 2006 figures but have improved, if only slightly, since the TPC systems has been fitted.(see appendix)



As you can see from **figure 4 (above)** there is more of an increase in the Double Drive than the Tag-Axle. Double Drive is the lorry with two drive axles which suggests that the system does make it easier to drive and therefore more economical.

COST BENEFIT ANALYSIS

The Tag-Axle with TPC shows the most favorable financial gains in:-

- Annual Net Income
- Payback Period
- Return On Investment

For all “Cost Benefit Analysis” calculations (see appendix IX)

CONCLUSIONS

Tyre Pressure Control is certainly a promising innovative system which is designed for Lorries which have 'on' and 'off' road activities such as timber haulage.

In the short time the system has been on trial the feedback from everyone involved has been very encouraging. There are already signs that the efficiency and effectiveness of timber haulage is improving

On-going monitoring is needed to establish " **actual results**" This can then be used as comparisons to results in Canada and Sweden. In future these will then be able to be used as performance indicators.

Double Drives are certainly a very effective lorry but due to the price of fuel they are becoming very in-efficient.

For hauliers to invest in TPC there are major barriers to overcome;-

- **COST** today there is very little money to be made in timber haulage. At present there are no incentives for the haulier to invest in a TPC system from either the supplier or customer.
-
- **SCEPTICAL** hauliers are very sceptical about this system probably as it is a new system to the UK which has no performance indicators.
- **NOT MY PROBLEM** hauliers do not see the cost of maintaining and building roads as their problem.

Lorries using TPC will be more "Road User Friendly"

TPC is also extremely good for driver comfort and improving safety for drivers.

RECOMMENDATIONS

The TPC system is definitely the way forward for timber haulage. This is an innovative system which can benefit either a Double Drive or a Tag-Axle Lorry.

I would, however, recommend that in future, we only buy Tag-Axles with TPC fitted

The cost of buying a Tag-Axle is cheaper, weighs less and has better fuel consumption making it more **efficient** than the Double Drive.

By having the TPC system fitted to the Tag-Axle it then becomes just as **effective** as a Double Drive (without TPC) due the increased traction. This means you can haul what you want when you want.

The Tag-Axle with TPC fitted has the best financial gains with;-

- Payback Period of 4 yrs
- Net Income of £35,224
- Return On Investment of 79.7%

It is also important to have a fleet of Lorries with TPC systems fitted rather than just one or two. This means that when we need to supply a customer with a large quantity of timber quickly from one site we are not restricted by the number of Lorries that have TPC. To do this would involve:-

- fitting TPC systems to any Lorries within the current fleet which has 3 years left
- look to offer incentives to haulage contractors that work for us to fit TPC.

By having this fleet of Lorries with TPC systems it would be hard for competitors to overtake the service we could provide.

Explain to drivers that do not have TPC all the benefits of the system, especially the increased driver comfort and improved safety features.

Promote the system to local councils and landowners to show the advantages of the system to them

By fitting TPC systems this will decrease our “CARBON FOOTPRINT” which is going to be measured in future.

Continue to monitor and review the TPC system to find “Actual Results”

Appendix (I)

TPC LOG BOOK 2007

June 17th - two Lorries fitted with TPC

June 22nd – Trial road at Seafield. TPC Lorries hauling only (no ruts, no damage) Road
Looks impressive as if rolled, any holes have been flattened out.

June 29th – **both drivers say feel a smoother, more comfortable lorry
Definitely less vibrations which means they can go faster on forest
Roads**

July 2nd - demand from 2 sites for TPC Lorries
1) Kinbrace
2) Foulis – tags and double drives both needed to be pulled out,
but TPC Lorries managed in and out with no problems

July 3rd – Highland Council allowed TPC Lorries on Helmsdale to Kinbrace Road
But not Kinbrace to Rosal (Forest Location)

July 4th – Munro Foulis - Scania had problems due to depth of mud when
deflated.....rubbing on bottom side of lorry

July 6th - Munro Foulis – Job deteriorated but TPC Lorries still managed.

July 19th – **both drivers delighted with TPC. Use it all the time and have more
confidence going in and out of forests.**

Aug 1st – Double Drive could not reverse back for timber at Seafield Lay-by
TPC Lorry managed no problem

Aug 3rd – Different driver onto TPC lorry while driver away on holiday.
**New driver really impressed with how smooth and how comfortable
the TPC is**

Aug 8th – No work carried out by mechanic yet. Commented on less light bulbs
needing changed and less tightening of bolts.
- Munro Foulis - TPC Lorries into a field 10 yards off the forest road
To pick up logs
(Driver reckons normal Lorries would not be capable of doing that)

Aug 14th – TPC lorry had slow puncture...TPC system kept it up until repaired.

Appendix (I)

TPC LOG BOOK 2007 (contd)

Aug 23rd – first load out of Deishar...road still overgrown....**driver reckoned if not for TPC system then lorry would not have managed out.** This also helped clear grass off the road which then cleared the road for other Lorries to use.

Aug 23rd - Successfully in and out of a site near Cromdale that other hauliers were (contd) having problems with. I do reckon other Lorries would manage, however, the road is extremely rough and bumpy.

Aug 24th – had meeting with Ron Munro to discuss payback for TPC.

Aug. 27th – parcel of timber up for sale near Bonar Bridge, road restrictions in place, (will consider TPC lorries)

Sept 7th – Double drives struggling at Deishar but are managing...just...TPC lorry is coping rather well.

Sept 14th – Lorry, with no TPC, struggled to get out of Deishar. Had to take load off and have second attempt. (Raining most of the day)

Sept 19th – Double Drives still struggling with Deishar while TPC marches on

Sept 20th – meeting with Michelin to discuss TPC
Have also decided to take out a “Michelin tyre policy”

Sept 25th – haulage seminar at Inverness...TPC lorry on show but sceptical like everyone else to date.

Sept 26th – TPC lorry onto a new road at Deishar which no other lorry could attempt
Driver quoted that a Double drive would not manage

Sept 27th – Double drive lorry went into site at Tomintoul, loaded but could not get out again. Lorry had to unload then get pulled out by a tractor.
TPC lorry advised not to go in but did go in, loaded and came out with no problems.

Sept 28th – TPC lorry back to Tomintoul with a crowd to watch the lorry manage in and out.

Oct 9th – Meeting with Ron Munro

Appendix (I)

TPC LOG BOOK 2007 (contd)

- Oct 13th – Inchindown road causing problems. Drivers with the TPC Lorries reckon ordinary Tag – axles would not manage but Double drives would
- Oct 15th – New road constructed at Achnacloich. Previously told to keep off road for 10 days to let settle. Landowner allowed TPC lorries to use road to see if any damage....none of course.
- Oct 26th – two double drives needed £1000.00 worth of tyres each. This is due to the road condition at Deishar. TPC Lorry tyre wear is even with no damage.
- Nov 2nd – TPC Lorries continue to operate effectively from Deishar and Inchindown.
- Nov 8th – TPC lorry which has tag – axle has super super single tyres fitted to trailer Highland Council will now allow this vehicle on Kinbrace to Rosal road. (this was previously banned)
- Nov 9th – Seminar at Inverness on “Roadex” which involved TPC
- Nov10th – Met Brian Spreen MD of TIREBOSS who was across for Roadex seminar
- Nov 14th - Haulage seminar at Dunked (FTA) Emphasis was on Carbon measurement
- Nov 15th – Slow puncture over night on TPC lorry which left tyre off the rim. When switching on in morning the system not capable of repairing (unusual).

Appendix (II)

Examples of tyre PRESSURE monitoring (Double Drive)

SY05 ATN Foden DD TPC FITTED	Date KM	18/07/07 203718	24/08/07 212847 9129	28/09/07 22/08/05 8360	07/11/07 229271 8064	24/11/07 235040 5769
	AXLES					
	Front	L	110	100	110	100
		R	110	100	110	100
	Drive	L O	90	100	70	70
		L I	90	100	70	70
		R I	90	100	70	70
		R O	90	100	70	70
	Tag / DD	L O	90	100	70	70
		L I	90	100	70	70
		R I	90	100	70	70
		R O	90	100	70	70
	1st	L	110	100	90	70
		R	110	100	90	70
	2nd	L	110	100	90	70
		R	110	100	90	70
	3rd	L	110	100	90	70
		R	110	100	90	70

Above - All axle tyre pressures are equal with TPC

Below – Axle tyre pressures are unequal

SY05 DCZ Foden DD No TPC	Date KM	17/07/07 197699	24/08/07 206500 8801	28/09/07 216319 9819	05/11/07 223041 6722	-223041	0
	AXLES						
	Front	L	115	100	110	105	
		R	115	100	110	110	
	Drive	L O	90	85	90	80	
		L I	85	90	90	80	
		R I	90	90	90	80	
		R O	85	85	90	78	
	Tag / DD	L O	90	85	85	78	
		L I	95	85	88	82	
		R I	95	85	85	80	
		R O	90	85	85	80	
	1st	L	115	110	110	110	
		R	115	115	115	117	
	2nd	L	110	115	115	115	
		R	115	110	110	110	
	3rd	L	115	110	110	115	
		R	110	120	110	115	

Appendix (II)

Examples of tyre **PRESSURE** monitoring (Double Drive)

SV06 FAU Scania Tag TPC FITTED	Date KM	17/07/07 83856	24/08/07 92317	28/09/07 100555	07/11/07 112660	24/11/07 116665	- 116665
	AXLES		8461	8238	12105	4005	
	Front	L R	120 120	110 110	110 100	90 90	
	Drive	L O L I R I R O	95 95 95 95	90 90 90 90	90 95 95 95	95 95 95 95	
	Tag / DD	L O L I R I R O	95 x x 95	110 x x 110	90 x x 90	95 x x 95	x x
	1st	L R	95 95	90 90	100 100	95 95	95 95
	2nd	L R	95 95	90 90	100 100	95 95	95 95
	3rd	L R	95 95	90 90	100 100	95 95	95 95

Above - All axle tyre pressures are equal with TPC

Below – Axle tyre pressures are unequal

SV06 FAM Scania Tag No TPC	Date KM	18/07/07 98908	24/08/07 109745	28/09/07 118066	07/11/07 130286	23/11/07 135645	- 135645
	AXLES		10837	8321	12220	5359	
	Front	L R	115 115	95 95	110 108	100 100	
	Drive	L O L I R I R O	110 110 110 110	85 85 85 85	90 85 85 90	85 84 95 95	90 85 85 90
	Tag / DD	L O L I R I R O	110 x x 110	100 x x 100	110 x x 110	100 x x 98	100 x x 100
	1st	L R	120 120	120 115	110 110	100 100	110 110
	2nd	L R	120 115	115 120	115 117	105 98	115 110
	3rd	L R	110 120	120 115	110 111	105 100	110 115

Appendix (III)

Examples of tyre **TREAD** monitoring (Double Drive)

SY05 ATN Foden DD TPC FITTED	Date KM	18/07/07 203718	24/08/07 212847	28/09/07 22/08/05	07/11/07 229271	24/11/07 235040	-
			9129	8360	8064	5769	235040
	AXLES						
	Front	L 10 R 10	10 10	8 8	7 7	6 6	
	Drive	L O 8 L I 12 R I 13 R O 9	12 11 11 12	10 10 10 10	9 9 9 9	9 9 9 9	
	Tag / DD	L O 6 L I 5 R I 7 R O 6	9 5 5 6	20 20 20 20	15 15 15 15	15 15 15 15	
	1st	L 12 R 13	12 12	10 11	9 10	8 8	
	2nd	L 11 R 13	13 13	17 12	17 12	16 17	
	3rd	L 8 R 7	6 17	15 14	13 13	12 11	

Above – Double Drive with TPC tyre treads

Below – Double Drive without TPC tyre treads (more monitoring is needed)

SY05 DCZ Foden DD No TPC	Date KM	17/07/07 197699	24/08/07 206500	28/09/07 216319	05/11/07 223041	-223041	0
			8801	9819	6722		
	AXLES						
	Front	L 10 R 10	9 9	8 8	7 7		
	Drive	L O 4 L I 7 R I 5 R O 7	4 7 6 9	20 20 20 20	16 13 14 13		
	Tag / DD	L O 11 L I 10 R I 11 R O 12	10 8 10 10	8 7 8 9	7 5 6 6		
	1st	L 11 R 11	10 11	9 8	8 7		
	2nd	L 12 R 13	13 14	15 13	10 13		
	3rd	L 8 R 5	15 16	15 14	12 13		

Appendix (III)

Examples of tyre **TREAD** monitoring (Double Drive)

SV06 FAU Scania Tag TPC FITTED	Date KM	17/07/07 83856	24/08/07 92317	28/09/07 100555	07/11/07 112660	24/11/07 116665	- 116665
	AXLES		8461	8238	12105	4005	
	Front	L 11 R 11	11 15	13 13	7 11	7 10	
	Drive	XDY					
	Tag / DD	LO 9	18	13	10	9	
		LI 8	18	13	10	9	
		RI 7	18	13	10	9	
		RO 9	18	13	10	9	
	Tag / DD	LO 12	13	12	10	9	
		LI x	x	x	x	x	x
		RI x	x	x	x	x	x
		RO 13	15	11	9	8	
	1st	L 7 R 14	5 12	3 11	15 15	14 14	
	2nd	L 15 R 14	14 13	13 13	15 15	14 14	
	3rd	L 9 R 13	6 10	4 8	14 14	14 14	

Above – Tag-Axle with TPC tyre treads

Below – Tag-Axle without TPC tyre treads

(more monitoring is needed)

SV06 FAM Scania Tag No TPC	Date KM	18/07/07 98908	24/08/07 109745	28/09/07 118066	07/11/07 130286	23/11/07 135645	- 135645
	AXLES		10837	8321	12220	5359	
	Front	L 12 R 12	11 11	10 10	9 9	9 8	
	Drive	spare RE-MIX					
	Tag / DD	LO 6	13	14	10	10	
		LI 6	4	14	10	10	
		RI 6	5	14	10	10	
		RO 6	4	14	10	10	
	Tag / DD	LO 11	9	8	7	7	
		LI x	x	x	x	x	x
		RI x	x	x	x	x	x
		RO 11	11	10	9	8	
	1st	L 11 R 7	10 6	8 6	7 13	7 13	
	2nd	L 8 R 17	8 17	7 16	7 16	7 15	
	3rd	L 15 R 15	13 13	10 11	8 8	7 8	

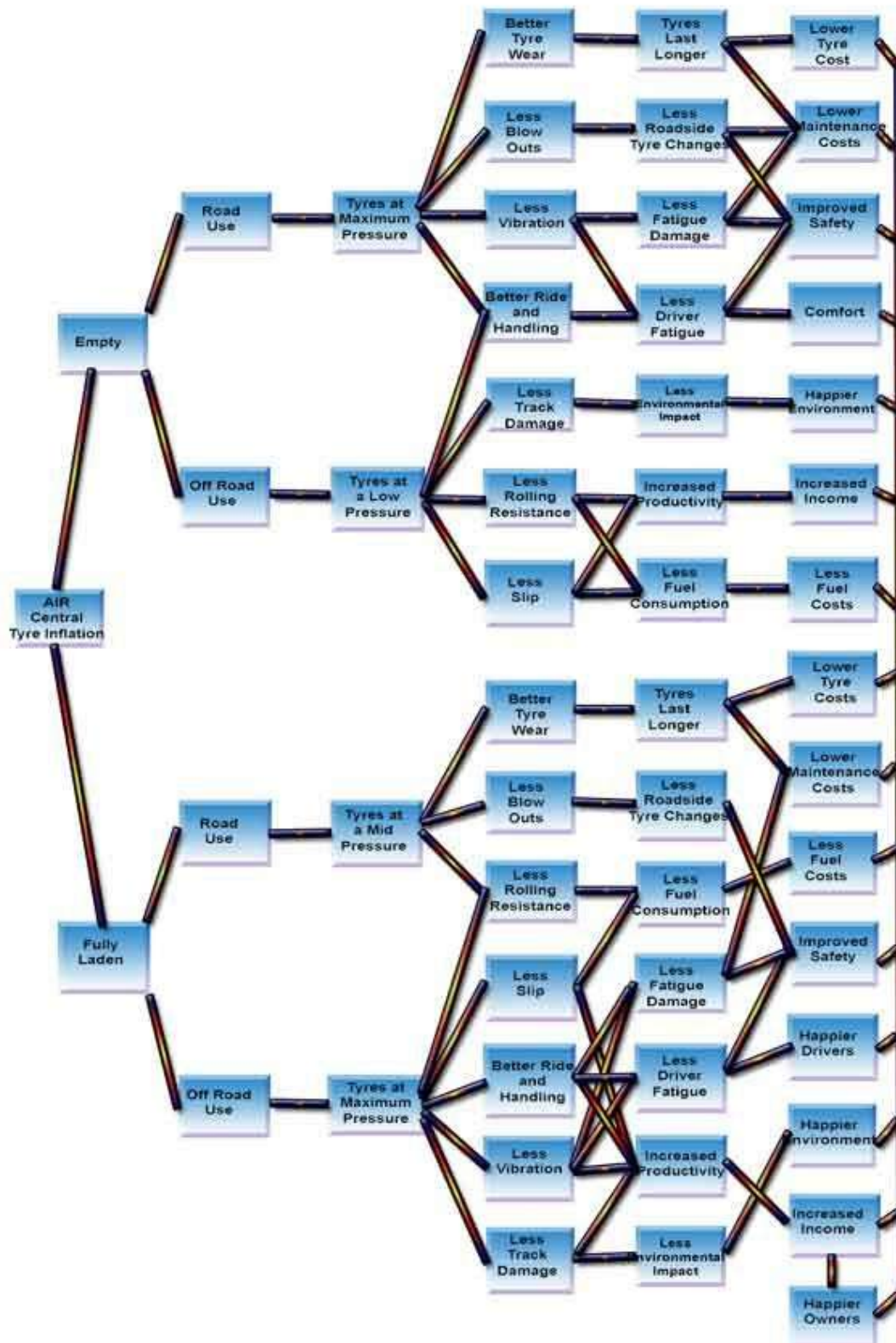
Appendix (IV)

Fuel consumption 2007(before and after TPC fitted)

	week	KM / Litre	Tag	Axle	KM / Litre	Double	Drive
1	06/01/07	1.9			1.6		
2	13/01/07	1.7			1.5		
3	20/01/07	2			1.6		
4	27/01/07	1.8			1.7		
5	03/02/07	1.9			1.7		
6	10/02/07	2	before		1.7	before	
7	17/02/07	1.7	TPC		1.4	TPC	
8	24/02/07	1.9			1.5		
9	03/03/07	1.6			1.7		
10	10/03/07	2	Total	43.6	1.7	Total	35.7
11	17/03/07	1.4	Weeks	24	1.4	Weeks	23
12	24/03/07	1.9			1.6		
13	31/03/07	2.1	average	1.82	1.4	average	1.55
14	07/04/07	1.8	KM / Litre		1.2	KM / Litre	
15	14/04/07	1.8			1.6		
16	21/04/07	1.8			1.5		
17	28/04/07	1.9			1.7		
18	05/05/07	2			1.5		
19	12/05/07	1.6			1.4		
20	19/05/07	2			1.5		
21	26/05/07	1.7			2		
22	02/06/07	1.7			1.7		
23	09/06/07	1.8			1.1		
24	16/06/07	1.6			1.3		
25	23/06/07	1.9			2.1		
26	30/06/07	1.9			1.9		
27	07/07/07	2.2			1.4		
28	14/07/07	1.9			1.6		
29	21/07/07	1.9	After		1.9	After	
30	28/07/07	1.7	TPC		1.4	TPC	
31	04/08/07	1.9			1.8		
32	11/08/07	1.8			1.6		
33	18/08/07	1.8	Total	38.6	1.6	Total	35.5
34	25/08/07	1.8	Weeks	21	2	Weeks	22
35	01/09/07	1.7			1.4		
36	08/09/07	1.9	average	1.84	1.7	average	1.61
37	15/09/07	1.7	KM / Litre		1.3	KM / Litre	
38	22/09/07	1.8			1.8		
39	29/09/07	1.4			1.3		
40	06/10/07	2			1.8		
41	13/10/07	2.1			1.4		
42	20/10/07	1.9			1.8		
43	27/10/07	1.6			1.6		
44	03/11/07	1.8			1.4		
45	10/11/07	1.9			1.4		
46	17/11/07						
47	24/11/07						
48	01/12/07						
49	08/12/07						
50	15/12/07						
51	22/12/07						
52	29/12/07						

Appendix (V)

FLOW CHART OF TPC ADVANTAGES

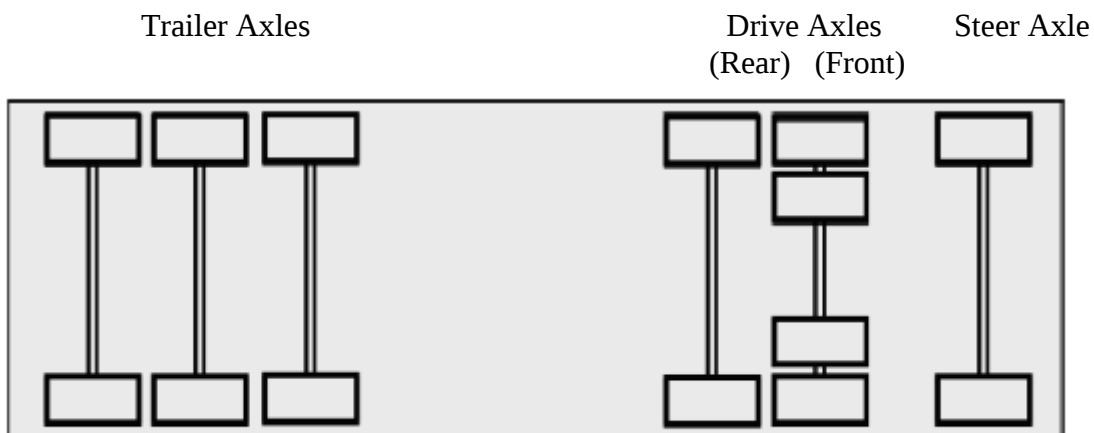


Appendix (VI)

TAG-AXLE

This is a lorry that has two single tyres on the steer axle, and then has a set of four tyres on the Front Drive axle but only two on the Rear drive Axle. The two tyres on the rear drive axle can be raised off the ground. This then increases the weight on the front drive axle which then also increases traction. There is a better or shorter turning circle which means there is also better mobility. There is, arguably, less cost for tyres as there are two less tyres needed. These tyres can also be raised while the vehicle is on the road empty therefore prolonging the life of the tyres.

Below is a diagram of a tag-axle lorry showing the axles with the relevant number of tyres



The tag-axle lorry weighs a good bit less than a double drive which provides a better payload, usually half a tonne. This does of course mount up significantly at the end of the year.

The lorry also has better fuel consumption than a double drive which again mounts up significantly at the end of the year.

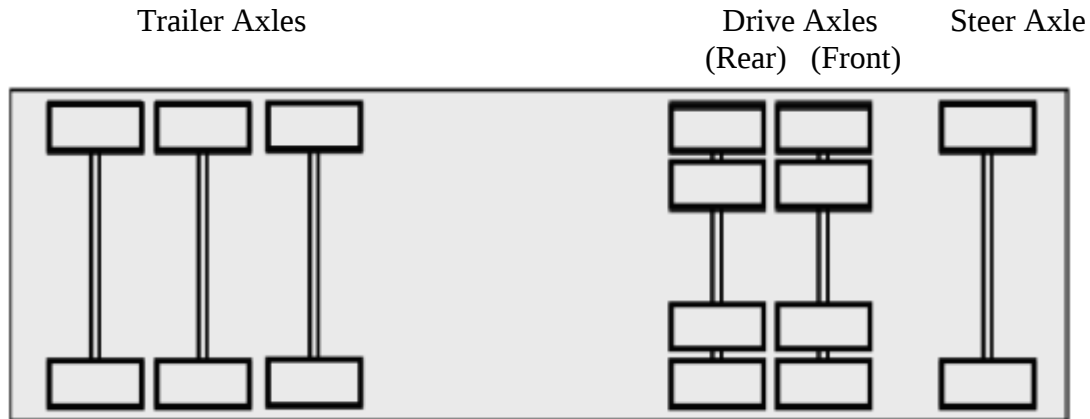
The tag-axle, even with the axle raised does not have as good traction as the Double Drive. The front drive axle does offer to spin more, even with the extra weight on it, which can then damage the tyres and roads. The tag axle is not supposed to be raised when loaded, especially on the forest roads. It is however an accepted practice to be used in emergencies only.

Appendix (VII)

DOUBLE DRIVE

This is a lorry that has two single tyres on the steer axle then has a set of 4 tyres on the front Drive axle and the same on the Rear Drive axle. This then gives the driver the option to lock the front and rear drive axles together which prevents wheels from spinning and so gives better traction (steering is difficult though) This particular set up has arguably the best traction of all the Lorries on the forest roads. There is also greater stability due to the greater number of tyres on the rear Drive Axle (Tag-Axle has only two tyres)

Below is a diagram of a double drive lorry showing the axles with the relevant number of tyres



Foden were well known for making double drives which have been used in quarries, forestry and on most construction sites. These double drives were relatively cheap to purchase compared with the better known manufacturers such as Scania and Volvo

Last year saw the closure of the Foden production line which has taken the option of purchasing a cheap double drive off the market. All other manufacturers of Double Drives charge an **extra £5000** over the price of a lorry that has a Tag-Axle.

Double drives unfortunately do weigh heavier than a tag axle... at least half a tonne. Over a year this adds up to a substantial amount of lost income.

Fuel consumption is also greater, and I mean a lot greater with figures in the region of 1.65km per litre for a double drive compared with tag axles which are 1.87 km per litre.

Appendix (VIII)

Comparison of Double Drive to Tag - Axle

To Purchase

Extra cost of purchasing a double drive

£5000.00

Fuel Consumption (2006 figures)

<u>Lorry</u>	<u>Km/Litre</u>	<u>MEAN Km/Litre (average)</u>
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Foden 1	1.63	
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Foden 2	1.67	
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Foden 3	1.64	
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Foden 4	1.72	
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DOUBLE DRIVE is 1.66

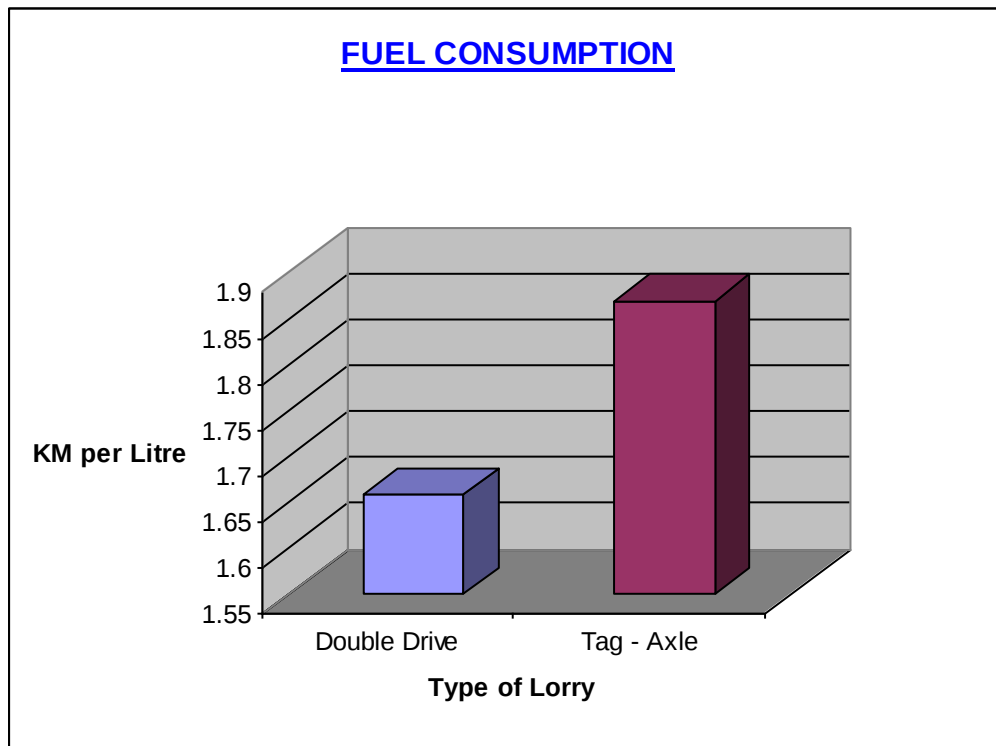
Scania 1	1.91	
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Scania 2	1.83	
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Scania 3	1.88	
----------	------	--

TAG-AXLE is 1.87

(See Graph below)



Appendix (VIII)

Comparison of Double Drive to Tag – Axle (continued)

Fuel Consumption(2006)

Taking these figures over a year doing 100 000km and price per litre being £0.80 then the difference in total cost of fuel would be

Double drive 100 000 / 1.66 = 60241 litres @ £0.80 = £48193

Tag Axle “ / 1.87 = 53476 “ “ “ = £42781

Extra cost of fuel per annum for Double Drive is

£5412.00

Every increase in Fuel of 1p equates to

Tag – Axle 53476 litres * £0.01 = £535 per annum

Double Drive 60241 litres * £0.01 = £602 per annum

Weight Loss

There are roughly 230 working days a year with an average of 3.5 loads per day which gives a total of 686 loads a year. Each load by a Double Drive is 0.5 tonnes less which amounts to 343 tonnes less for the year with an average price of £5.93.

Total lost income for a double drive due to weight loss per annum is **£2034.00**

Depreciation

Tag – Axle with trailer: cost £115,000 re-sale value being £25,000 after 5 yrs

Total depreciation is £90,000 over 5 yrs which equates to £18,000 per annum

Double drive with trailer: cost £120,000 re-sale value being £27.500 after 5 yrs

Total depreciation is £92,250 over 5 yrs which equates to £18,450 per annum

Maintenance

No difference in costs

Appendix (IX)

COST BENEFIT ANALYSIS

PAYBACK FOR A TPC SYSTEM

PURCHASE COSTS

Cost of TPC	£ 8000.00
Fitted Cost	£ 4000.00
Downtime cost (lorry / man)	<u>£ 1000.00</u>
	<u>£13000.00</u>

ANNUAL SAVINGS

Less damaged tyres (2 tyres at £300/tyre)	£ 600.00	
Less Maintenance (1 hr a month @ £40/hr)	£ 480.00	
Less tyre wear (1 tyre @ £300)	£ 300.00	
Less Punctures (2 callouts per year)	£ 150.00	
(saved downtime)	£ 150.00	
1 % of fuel savings	£ 500.00	
Prevention from being de-bogged (Callout vehicle and downtime)	£1000.00	
Extra load in the year (Due to increased speed on forest roads)	<u>£ 175.00</u>	<u>£3355 .00</u>

ANNUAL EXPENSES

2 hours maintenance @£40/hr	£ 80.00	
Parts	<u>£ 20.00</u>	<u>£100.00</u>

NET SAVINGS

Annual savings less Annual expenses	<u>£3255.00</u>
-------------------------------------	------------------------

Cost on Investment		less	Savings	
Year 1	£13000	-	£ 3255	= (£9745)
Year 2	£ 9746	-	£ “	= (£6490)
Year 3	£ 6490	-	£ “	= (£3235)
Year 4	£ 3235	-	£ “	= <u>£20</u>

Payback occurs in Year 4

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

NET INCOME

TAG - AXLE

Tag-Axle costs £115,000

Income for Year £140,000

Annual Expenses

Cost of Fuel is 53476 x 80p	=	£42781	
Wages		27550	
Tyres		7,500	
Maintenance		15,000	
O.H. (Premises, Insurance, Road Tax etc		<u>15,200</u>	<u>£108,031</u> <u>(Annual Cost)</u>

ANNUAL NET INCOME £31,969

TAG – AXLE (with TPC)

Tag-Axle costs	£115,000
TPC Fitted	<u>£ 12,000</u>
TOTAL	£127,000

Income for Year £140,000

Add TPC Annual savings £ 3,355
 £143,355

Annual Expenses

Cost of Fuel is 53476 x 80p	=	£42781	
Wages		27550	
Tyres		7,500	
Maintenance		15,000	
Additional TPC annual Expenses		100	
O.H. (Premises, Insurance, Road Tax etc		<u>15,200</u>	<u>£108,131</u> <u>(Annual Cost)</u>

ANNUAL NET INCOME £35,224

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

NET INCOME

DOUBLE DRIVE

Double Drive costs £120,000

Income for Year £140,000

Annual Expenses

Cost of Fuel is 59880 x 80p	=	£48193	
Wages		27,550	
Tyres		7,500	
Maintenance		15,000	
O.H. (Premises, Insurance, Road Tax etc		<u>15,200</u>	<u>£113,443</u> (AnnualCost)

ANNUAL NET INCOME £26,557

DOUBLE DRIVE (with TPC)

Double Drive costs £120,000

TPC Fitted £ 12,000

TOTAL £132,000

Income for Year £140,000

Add TPC Annual savings £ 3,355

£143,355

Annual Expenses

Cost of Fuel is 59880 x 80p	=	£48193	
Wages		27,550	
Tyres		7,500	
Maintenance		15,000	
TPC Annual expenses		100	
O.H. (Premises, Insurance, Road Tax etc		<u>15,200</u>	<u>£113,543</u> (Annual Cost)

ANNUAL NET INCOME £29,812

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

PAYBACK PERIOD

(TAG - AXLE)

<u>Year</u>	<u>Annual Income</u>	<u>Less Annual OH</u>	<u>Net Income</u>	<u>Cost (£115,000) Less Net Income</u>
1	140,000	108,031	31,969	115,000 – 31,969 = (83,031)
2	“	“	“	83,031 – 31,969 = (51,062)
3	“	“	“	51,062 – 31,969 = (19,093)
4	“	“	“	19,093 – 31,969 = £12,876 *

Payback for Tax – axle occurs in year 4

TAG – AXLE (with TPC)

<u>Year</u>	<u>Annual Income</u>	<u>Less Annual OH</u>	<u>Net Income</u>	<u>Cost (£127,000) Less Net Income</u>
1	143,355	108,131	35,224	127,000 – 35,224 = (91,776)
2	“	“	“	91,776 – 35,224 = (56,552)
3	“	“	“	56,552 – 35,224 = (21,328)
4	“	“	“	21,328 – 35,224 = £13,896 *

Payback for Tax – axle occurs in year 4

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

PAYBACK PERIOD (continued)

DOUBLE DRIVE

<u>Year</u>	<u>Annual Income</u>	<u>Less Annual OH</u>	<u>Net Income</u>	<u>Cost (£120.000) less Net Income</u>
1	140,000	113,443	26,557	120,000 – 26,557 = (93,443)
2				93,443 – 26,557 = (66,886)
3				66,886 – 26,557 = (40,329)
4				40,329 – 26,557 = (13,772)
5				13,772 – 26,557 = 12,785

Payback for Double Drive occurs in year 5

DOUBLE DRIVE (with TPC)

<u>Year</u>	<u>Annual Income</u>	<u>Less Annual OH</u>	<u>Net Income</u>	<u>Cost (£132.000) Less Net Income</u>
1	143,355	113,543	29,812	132,000 – 29,812 = (102,188)
2				102,188 – 29,812 = (72,376)
3				72,376 – 29,812 = (42,564)
4				42,564 – 29,812 = (12,752)
5				12,752 – 29,812 = 17,060

Payback for Double Drive occurs in year 5

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

RETURN ON INVESTMENT

(Without depreciation)

Tag – Axle

$$\begin{array}{l} \text{R.O.I} \\ \text{(Without} \\ \text{Depreciation)} \end{array} = \frac{\text{Net Income}}{\text{Annual Cost}} \times 100 = \frac{31,969}{108,031} \times 100 = \underline{\underline{29.6\%}}$$

Tag – Axle (with TPC)

$$\begin{array}{l} \text{R.O.I} \\ \text{(Without} \\ \text{Depreciation)} \end{array} = \frac{\text{Net Income}}{\text{Annual Cost}} \times 100 = \frac{35,224}{108,131} \times 100 = \underline{\underline{32.6\%}}$$

Double Drive

$$\begin{array}{l} \text{R.O.I} \\ \text{(Without} \\ \text{Depreciation)} \end{array} = \frac{\text{Net Income}}{\text{Annual Cost}} \times 100 = \frac{26,557}{113,443} \times 100 = \underline{\underline{23.4\%}}$$

Double Drive (with TPC)

$$\begin{array}{l} \text{R.O.I} \\ \text{(Without} \\ \text{Depreciation)} \end{array} = \frac{\text{Net Income}}{\text{Annual Cost}} \times 100 = \frac{29,812}{113,543} \times 100 = \underline{\underline{26.3\%}}$$

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

RETURN ON INVESTMENT

(Including depreciation)

TAG - AXLE

Average annual net Profit before Depreciation £31,969

Depreciation over 5 years = $\frac{\text{Cost less re-sale value}}{5 \text{ years}} = \frac{115,000 - 25,000}{5}$

Annual depreciation = £18,000

Average annual net profit = £13,969

$\frac{\text{Average annual net profit (less depreciation)} \times 100}{\text{Average investment}} = \frac{13,969 \times 100}{18,000} = \underline{77.6\%}$

TAG AXLE (with TPC)

Average annual net Profit before Depreciation £35,224

Depreciation over 5 years = $\frac{\text{Cost less re-sale value}}{5 \text{ years}} = \frac{127,000 - 29,000}{5}$

Annual depreciation = £19,600

Average annual net profit = £15,624

$\frac{\text{Average annual net profit (less depreciation)} \times 100}{\text{Average investment}} = \frac{15,624 \times 100}{19,600} = \underline{79.7\%}$

NB TPC life span 15yrs so have valued it at £4000 after 5 yrs

Appendix (IX)

COST BENEFIT ANALYSIS (continued)

RETURN ON INVESTMENT

(Including depreciation)

DOUBLE DRIVE

Average annual net Profit before Depreciation £26,557

Depreciation over 5 years = $\frac{\text{Cost less re-sale value}}{5 \text{ years}} = \frac{120,000 - 27,500}{5}$

Annual depreciation = £18,500

Average annual net profit = £8,057

$\frac{\text{Average annual net profit (less depreciation)} \times 100}{\text{Average investment}} = \frac{8,057 \times 100}{18,500} = \underline{\underline{43.6\%}}$

DOUBLE DRIVE (with TPC)

Average annual net Profit before Depreciation £29,812

Depreciation over 5 years = $\frac{\text{Cost less re-sale value}}{5 \text{ years}} = \frac{132,000 - 31,500}{5}$

Annual depreciation = £20,100

Average annual net profit = £9,712

$\frac{\text{Average annual net profit (less depreciation)} \times 100}{\text{Average investment}} = \frac{9,712 \times 100}{20,100} = \underline{\underline{48.3\%}}$

NB TPC life span 15yrs so have valued it at £4000 after 5 yrs