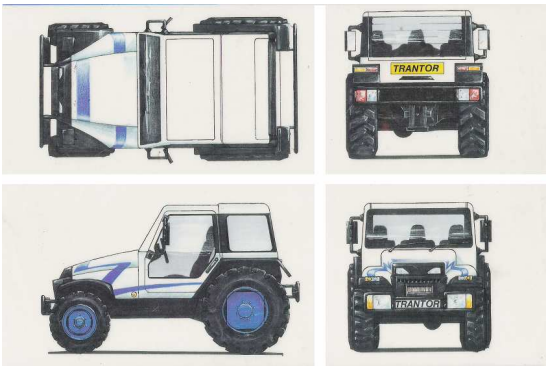
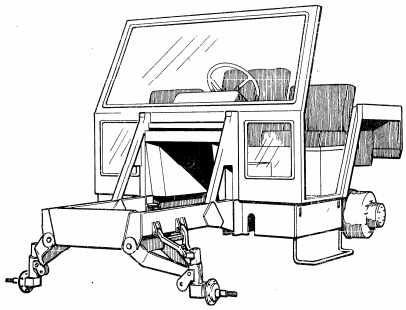
THE TRANTOR TRACTOR PROJECT IS NOT ONLY VERY MUCH ALIVE BUT A SIGNIFICANT PART OF FARMING'S FUTURE, *as Zero-Tillage becomes better understood.*

Prof. Malcolm Stansfield of Reading University, now Royal Agricultural College has been lecturing students for many years on the importance of TRANSPORTATION in a farming context. More recently Graham A.B. Edwards has argued that the transport and low-draught work tasks in farming use up more time than those of the heavy duty (ploughing & sub-soiling types of work). He reports that the transport share of transportation activities has increased beyond 70 percent when drilling, spreading, spraying etc is seen as transportation. Farms have increased In size, usually by amalgamation (with longer distances from barn to field) and farm contractors (who have further to travel) are playing a bigger role than ever. Research with Ag-implement makers analysed the time spent on each tractor work task on typical European farms. This confirmed that ploughing and heavy cultivation took up less work task time in a tractor's typical year – sometimes only about six weeks. Lighter jobs on the other hand – spraying, muck-spreading, mowing, bale-wrapping and haulage of all types – took up far more work time. Using a new farm tractor concept, like the lightweight transport-first Trantor tractor, would deliver a fuel saving of 10-40 percent, with the biggest savings on haulage. (Appendix 1 illustrates the work tasks and the potential savings from each when using Trantor tractors) instead of ploughing tractors.

More to the point, this new tractor concept has powerful Lockheed brakes all round, plus all-round suspension and 50-60 mph capability on good roads. The front suspension on the Series 1 Trantor was independent by Avonride torsional rubber springs, but the really clever (and fully patented) feature was in the rear axle design. The cab and chassis were suspended by conventional leaf springs but there was also a third-suspension system supporting the hitch, for trailers, and the three-point linkage. A hydraulic ram with a substantial leaf spring, which provided self-levelling and allowed high road speeds (with a loaded trailer on the hitch) was utilised on Series 1 models and an accumulator on Series 2 Mark 1 models. Harry Ferguson said "Borrow the weight from the plough and put it on the tractor". Well, Taylor, Trantor's early-lead designer said, "borrow the trailer-weight on to the hitch and add suspension on the hitch and linkage of the tractor!"

The question was how to put this promising prototype into production. More research and development followed, including a lot of field/road testing by 500 plus farmers in 15 countries. A Trantor tractor was even shown to Anthony Bamford of JCB Ltd., who drove his first hi-speed farm tractor on the 20 September 1984, (with his then M.D), at a secret location. The fully-suspended high-speed Fastrac appeared later. Graham Edwards clearly admires the big, heavy, ploughing-focused Fastrac but considers that Taylor's concept is much more a part of the future of farming worldwide, where there is a much bigger world market for a lightweight general-purpose, hi-speed tractor. The Fastrac is now a 10.6 tonne ploughing-first tractor with 65 kph ability on good roads. The Fastrac is pretty good at all of the work tasks in Appendix 1 but it's also very big, expensive, heavy and therefore uses lots more fuel on the transport and low-draught work tasks and creates more soil-compaction when compared to the revised hi-speed, general-purpose farm tractor that the Trantor tractor is:-





The New Series 2 Mark 2 Trantor tractor concept is much more "vehicle-like than farm tractor-like" and is therefore a combination of Land-Rover, Farm Tractor (and with trailer) a Truck.

By 2005, the familiar story of British manufacturing's well-established names moving production abroad or shutting up shop altogether was almost complete, as far as tractors are concerned. The recession was hitting tractor sales as well, especially something as different as the Trantor tractor. Building in small numbers meant it was a little more expensive than the conventional tractors and production ceased. Development continued and a revised low-cost supply-chain from overseas was created by 2010, when the need for improved designs for the new world of Zero-Tillage (Conservation Agriculture) could clearly be seen as the main farming system of the future.

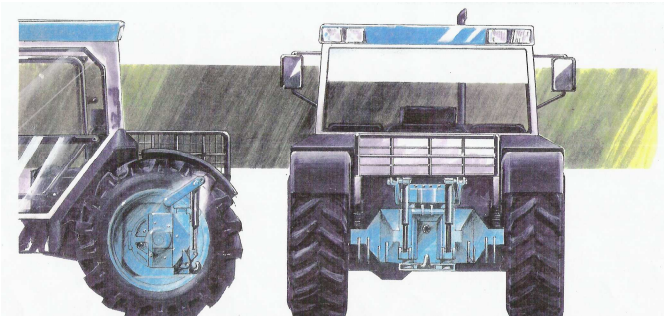
Trantor International Ltd., (TIL) now shares its offices with other small R&D innovation-led companies. What they've been doing since production ended in U.K. is developing a worldwide, market-focused tractor range. By conducting market research in the largest agricultural countries has enabled TIL to create the new product range (to be launched in 2013), directed to niche-markets in the biggest of the world's tractor markets in the 75 HP to 120 HP range, whilst working towards 185 H.P. quite soon.

Overseas Thinking and Tractor Development

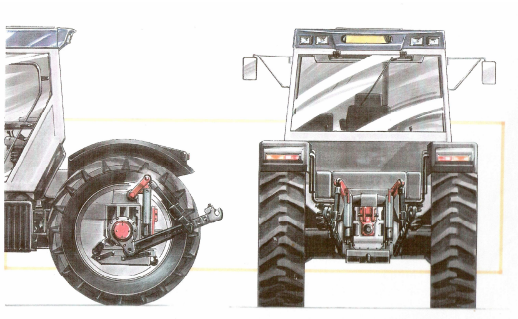
Early in the project, Stuart Taylor went to Africa at Lonrho's request and he built about 20 prototypes to assess the needs of developing countries. He found that Land-Rover vehicles were often used for carrying people in farming regions and he considered it essential that his first vehicle-like tractors would need to have at least 3 seats. Farm tractors do not usually have more than one seat and for village-based farming, this is not an advantage. Conventional tractors are also far too slow for village emergencies! The Trantor tractor has 3 seats, a platform for 4 passengers at the rear, a chassis plus suspension – it's completely different to a conventional tractor.

A problem is that farmers used to be less concerned with fuel costs (the big saving in using a Trantor tractor) than by labour costs. Only if oil continues to rise at a rapid rate will fuel economy be top priority when choosing a new tractor. There's another parallel with cars. Everyone moans about the price of petrol and diesel, but not everyone buys a small, economical car, and they won't do so until fuel is truly expensive. The conviction in the U.K. design team at TIL, is that the product-range has a worldwide market and this has helped the team, in the years of development-focused thinking. In recent years design and market research have been the principal considerations of the wholly British team.

TIL had to find a country with a substantial market for tractors and with a well-established automotive supply industry that could provide engines, transmissions and so on, at low cost. Mexico had all the right skills and many off-the-shelf components. India on the other hand, had a vast automotive industry and had all the suitable components with low-cost labour. TIL settled on the combination of TATA vehicles and ACMA (India) automotive components. Indian replacements for nearly all of the former U.K.-made components were found. TIL continues to work on developments of the Trantor concept. One of the recent prototypes is a 185 HP Javelin (Series 3) Trantor and is a big, high H.P. transport-first tractor. It will compete with the Fastrac, but be lighter and have a bigger load platform than Fastrac & the MB Trac but smaller than Mercedes-Benz Unimog.



The Series 2 Mark 2 Trantor.



The Series 3 Javelin Prototype Trantor

What's certain is that the Trantor tractor is very much alive. In a world of global warming, finite oil supply and energy and food security, the Trantor tractor's overall efficiency is more relevant now that ever before. Graham's view is that "Ploughing Tractors will get heavier over the years but the real need is to take weight out so as to make them more fuel-efficient. More people are conservation-minded now, and the climate-change horizon will cause farmers to look ahead more, the more planning they do, is good for the Trantor concept".

Zero-Tillage is coming rapidly to large numbers of farmers in many countries and the recent development work on Trantor tractors for Zero-Tillage is a most significant new wholly British development.

This is an up-dated and abridged version of that published by Peter Henshaw in Tractor & Machinery Magazine in February, 2010.

FAST TRACTORS MUST BE A KEY PART OF THE FUTURE IN WORLDWIDE FARMING for Productivity Reasons Alone. Graham A.B. Edwards.

When discussing the future, the first question should relate to HOW FAST? The agricultural UNIMOG specification (post 1946), TRANTOR (1973) and the FASTRAC (1987), were all originally designed to operate at the legal maximum speed of 50 miles per hour (80KPH) and, therefore, required to have special tyres and a braking system of a Construction & Use (C&U) standard, which is roughly twice as efficient as the tractors mentioned (by Stephenson in T&M July 2011 page 30) which move "just a little quicker" than the convention, due to having only a very simple form of front suspension and no rear axle, hitch or linkage suspension at all!

It is vital to distinguish between "legally fast 80 KPH (50MPH) tractors" and the rest!

The most recent Fastrac press release (the Fastrac uses a rear axle suspension which is very similar indeed to that originated by the Trantor team) indicates a maximum speed of 60 KPH for the new 10.3 tonne plus model-range, which has a price in excess of £150,000 for the top of the range model.

Whilst the UNIMOG was never designed for, or capable of being efficiently operated with the un-balanced (UK-type) farm trailer (because Mercedes did NOT design their vehicle for un-balanced trailer-pulling) it was left to WSH Taylor, the originator of the Trantor tractor, to design (1973) the high-speed (80 KPH legal) tractor required to haul the 'Weeks'-type farm trailers, with air-over hydraulic braking systems (on the trailer and all tractor wheels), at 50 MPH. (80KPH)!

The Trantor team were well-aware that trailer specifications were made, and are sometimes even now made, to the lowest of low technical standards. It is a fact too, that most, if not all trailed farm implements, e.g. sprayers, spreaders, mowers follow in the wake of the low technical standards created for conventional tractors and their traditional trailers! Early Trantor experience showed that serious damage could occur to these low-specification farm implements, due to overheating of tyres, bearings, hubs and drums - when the Trantor pulled them at 50MPH (80KPH), when they were constructed to work behind 20 mph – rated tractors. The reason for this was the usage of very low-technical standards of "a cheap-jack" kind that farm implement-makers thought sufficient. Even today, there is a recognition that "slow but safe" is the tractor and ag-implement designers maxim. In 2013, tractor and trailed Ag-implement designs pay little interest to speed and therefore efficiency.

Inefficiency in farm work is not generally considered as speed-related, as it ought to have been in the 70's! Implement designs followed the widespread use of "snail-paced ploughing-first tractors", with the maximum speed of 20MPH (32 KPH), which were, and are, far too slow to achieve high-labour productivity! The Trantor tractor team were "too far ahead of their time" and had to wait over 14 years for the Fastrac to be accepted and thus cause some sensible technical improvements to trailers and trailed equipment, so as to work at speeds in excess of the 32 KPH (20 MPH) law in U.K. Even with JCB'S help, progress has been slow!

As farms get bigger and more widespread, the need to address the speed of the tractor, the trailers, the trailed spreaders, trailed sprayers, trailed mowers, discs, rollers, toppers, forage harvesters, tedders, in field, between fields, on rough farm tracks and on roads is the reason that Taylor (1973-1983) designed the suspension system (that JCB examined in some detail for the rear axle which was illustrated in both the Automotive Engineer (1979) and Power Farming Norman Lucas, April 1978 issue, which JCB now states is a unique system on their latest Fastracs.

The suspensions related here are rear-axle related:-

(a) the suspension of the pick-up hitch (drawbar)
(b) the suspension for the (3 point-linkage) mounted, farm implements
(c) the suspension system of springs and shock absorbers to enable the chassis, cabin and both axles to have a vehicle-like system!

The objective of the Trantor tractor team was to create a 50 MPH (80KPH) farm tractor that:-

(i) would conduct farm tractor work much more efficiently, because of speed increases
(ii) would increase dramatically the efficiency of all low-draught farm work
(iii) would carry passengers safely and in comfort in the cabin and on the removable rear platform/tailgate.

The Trantor objective continues to be similar to that which existed in the 70s and 80s “to create a much more efficient general-purpose tractor” and so be the most important change in tractor design since Ferguson, Ford or David Brown. It was always a secondary objective to create a product-range that would be no more than 10% to 15% more expensive to the user (when the suspension, cabin and superior braking system was present) than a slow, conventional tractor of similar horse power.

With such a vision and with more advanced engineering, the all-British team were well aware of the direction being taken by farm tractor majors. Bigger, heavier, lower power-to-weight ratios and the ability to work in heavy cultivation particularly well, has been the ACTUAL fact of farm tractor design-improvements since the 70’s. It is, however, clear, to those with common-sense, that MOST of the other farm work tasks operate with conventional tractors at horrendously low levels of efficiency and at a very expensive fuel cost (because of weight). This level of productivity, fuel consumption and soil compaction is demonstrated in Appendix 1, which shows the benefits achievable when a transport-first and low-draught-second farm tractor is used instead of a conventional ploughing-first tractor.

The acceptability of British ideas by British tractor users was always sought by the all-British Trantor team who, in the 80’s, created a British assembly facility based on a largely-British supply-chain. In 2013, The Trantor company has created a suitable, high quality, low-cost but overseas supply-chain and as fuel costs rise and the efficiency (speed of work) becomes more important in farming, the Trantor clearly has a place in future.

N..B. This is an abridged version of an article first published in “Tractor & Machinery” magazine in February 2011.

The Contribution of Errors in the Procedures Concerning New Farm Tractor Concepts, by Graham A.B. Edwards.

As a young man of 16 years, I was fortunate to obtain an engineering apprenticeship at The Royal Aircraft Establishment, Farnborough (RAE), and in so doing (whilst dropping jeeps from aircraft and analysing why the Comet jet-aeroplane had crashed at Elba, and much else), learned the significance of trial and error. It was the value and analyses of mistakes and their correction that characterised the best engineering designers!

As it happens, about 20 years later, I found myself in the leadership role in the most exciting and revolutionary farm tractor design project ever conceived, and before Stuart Taylor built his

prototype, in the Derby Road, Manchester shed. Project design leadership, in the Trantor tractor project, means "that the buck stops with me" and therefore, since 1974, the responsibility for big and little mistakes, properly, lies with me.

Stephenson's contribution to the mistakes of the Trantor team (Tractor & Machinery letters July 2010) need to be assessed. His strong influences, from ploughing-tractor history, is one aspect but, primarily, he has not taken sufficient notice of what it is that farmers actually "do" in their whole calendar year. (Appendix 1 illustrates the calendar of tractor and ag-implement work tasks) in temperate, European agriculture. This chart shows what is actually conducted in the commonly-used ploughing-focused farming system. It also shows when it is done, for how long and what kind of tractor and implement combination is utilised. The basic analysis concerns "how much work is heavy draught and how much more is low draught and transportation work?

The volume of farm transportation (including spreading, spraying, drilling) and low-draught work (e.g. mowing, baling, bale-wrapping, topping), is frequently, not to say usually, in excess (man-hours on the farm) of ploughing, sub-soiling and heavy cultivation. (see Appendix 1). This led Taylor towards a transport-first tractor specification, with suspension contained in two patents.

When JCB farms bought two transport-first Trantor tractors and Stuart Taylor provided them with copies of his patents, JCB began to build about 13 prototypes, which differed considerably, from Taylor's transport and low-draught concept. The dichotomy showed that JCB's market research indicated that U.K. farmers would not buy a tractor if it could not plough about as well as the convention. JCB's work using Unimogs, M.B. Tracs and Trantor tractor's emphasised that the word "Tractor" meant "must plough and plough well."

JCB Ltd's, development staff accepted Taylor's higher speed views and, in consequence, the suspension on Fastracs gained massively from Taylor's patents. JCB, however, created "the hi-speed, ploughing tractor" and it was, and is, as different as chalk and cheese from Taylor's transport-first, low draught-second Trantor tractor concept.

The importance of Taylor's work and sales in Zambia, Yemen, Nigeria, Malaysia, South Africa and USA demonstrated the wide difference between the value and significance of a ploughing-first tractor under dry land conditions (65 per cent of world's acreage) compared to its value in temperate agriculture. The plough is well-designed to remove the moisture from the soil but, of course, is the antithesis of that needed in arid-lands. Taylor's concept, when viewed alongside direct drilling and 'zero-tillage', is clearly a very significant part of the changing world of the future, where Conservation Agriculture, Zero-Tillage, Direct Seeding and crop-rotation are growing in popularity and are essential ingredients of Green policies in worldwide farming. Over the last 30 years ploughing and heavy cultivation - indeed excavation - of the land have seriously damaged the soil-structure, so that too-much oxygen and too little humus have been the result (50 per cent loss in one generation, according to Prof. M. Dobre in Romania). The 6th Hugh Bunting Memorial Lecture, at Reading University, in 2011, well-explains the need to cease ploughing in temperate agriculture whilst highlighting the importance of retaining moisture in the soil in arid-lands.

The Trantor tractor project has always seen farm transport (defined as including spreading, drilling, spraying etc), as being a much larger consumer of work time than heavy cultivation. In the three decades of worldwide analyses, using the world's only general-purpose, transport tractor concept, the harvesting of 7000 million tonnes of crops has been seen to be capable of being made much more efficient and rapid. Ploughing tractor and trailer combinations are still the, old-fashioned, ridiculous but main system of transporting this crop volume from " field to fork". The 32 million daily users of ploughing tractors (FAO), have begun to know that labour costs and fuel efficiency are vital aspects of the future in farming. In the event of using a transport tractor for the transportation of all the crops from field to store, it would be possible to save £6,000 million to £10,000 million on diesel-fuel alone.

Readers of this magazine are amongst the world's most knowledgeable tractor users and, in consequence, the significance of the Trantor tractor will not be lost on them. In my opinion, we

should be complimenting the vision of British designers. Stuart Taylor's invention and Steve Castellani's development will surely, one day, rank alongside those other British inventions that are so revered worldwide.

This is an abridged version of an article published in Tractor & Machinery Magazine in October, 2010 (pages 28 & 29).

Two of a Kind.

Trantor tractors are a relatively rare sight in Northern Ireland; but not for John McCann from County Down. Two names are synonymous with the early development of the Trantor tractor. Stuart Taylor was a young engineering research student at Manchester University in 1971 and Graham Edwards, a professor at the university, was his supervisor. Stuart's research project identified that "transport" is a key component of the workload of a typical agricultural tractor and that a high-speed, transport-first tractor would fill a niche market void. Student and supervisor left academia and formed a company to design and develop a high-speed, transport-first and low-draught-second Trantor tractor.

The first prototype Trantor was ready for testing in 1973 and commercial production started in 1978. The Series One version was fitted with an 80hp Perkins diesel engine, 10-forward and 2-reverse synchromesh gearbox, suspension and air-operated hydraulic brakes on all wheels, diff lock, rear axle, rear p.t.o and three-point hydraulic linkage and drawbar, which were suspended. It had a top speed of 60mph. The main purchasers of the early Trantor tractors were government departments and local authorities but some farmers were wary of a tractor which DID NOT have the ability to plough to any real depth. At the top of the design criteria, Taylor and Edwards focused on low-draught fieldwork and farm transportation. (Appendix 1 illustrates the work tasks and the benefits commonly achieved in a ploughing culture).

Some manufacturing efficiency changes caused the project team to develop a second version to capture the attention of farmers at large – and the Series 2 Mark 1 Trantor tractor was launched. The new version had a choice of engines and gearboxes, adjustable beam front axle, load space at the rear of the cab and slightly reduced top speed, in addition to the features of the initial model. It was more suitable for light fieldwork, but should never be viewed as a conventional ploughing-first tractor. Ironically, given that the Series 2 Mark 1 version was launched to attract farming customers, John McCann's Series 2 Mark 1 has never functioned as a farming tractor. It was one of a pair sold to Roads Service in Northern Ireland (the government body responsible for roads in the province) in 1984. Given the unusual nature of the deal, the supplier, Hy Reach Plant of Belfast, decided to feature both tractors on its stand at the Balmoral Show of that year, after which they were dispatched to two Roads Service depots, one in Lisburn and the other in Seaforde, Co. Down. According to a Roads Service source, the main uses for the two tractors were general transport duties and, during the spring and summer, verge mowing. In general, the tractors were well liked by the operators. Most of the tractors used by Roads Service at that time were International Harvester conventional tractors but Trantor tractors were much more suitable for many of the tasks being undertaken. They used less fuel and travelled much more quickly than conventional tractors, as Appendix 1 helps to explain.

The three-seat cabin meant that the driver and his passengers could be carried in relative comfort to their place of work. Both tractors were fitted with hydraulics and suitable brackets to allow them to operate snow ploughs when necessary. Mechanically, the tractors were straightforward to maintain. Given that they were, in the main, constructed from well-proven components, mechanical reliability and maintenance were no cause for concern. This suitability of the Trantor tractor for Roads Service operations begs the question: why did they not become more commonplace in Northern Ireland, fulfilling this and similar roles? One possible answer is that, while the tractors performed well, the same could not be said for many of the implements and trailers used along with them. It's fair to say that the equipment of that era wasn't designed to travel at speeds in excess of 50 mph while attached to the rear of a tractor. It was perhaps this issue which led to Roads Service deciding to sell both tractors at auction after a few years of ownership.

John's tractor was purchased at auction by Henry McVeigh, an agricultural merchant based in Castlewellan. Henry's business used the tractor to deliver goods and materials to the farming community around Castlewellan, a duty which the tractor performed effectively for a number of years. Eventually, however, the Trantor tractor became surplus to requirements and Henry decided to sell it. At the time John McCann was looking for a more unusual tractor to restore and, after becoming aware that the Trantor tractor was for sale, he approached Henry. In discussion about the sale, Henry disclosed that as well as the Series 2 Trantor tractor, he also had a Series 1 version, which he had used until a gearbox problem led to its premature retirement. Henry made John an unusual offer – if John was prepared to pay the asking price for the Series 2 Mark 1 machine, Henry would throw in the Series 1 as a 'luck penny'. For the uninitiated, a 'luck penny', or a small proportion of the purchase price, is traditionally given in Ireland by the vendor back to the purchaser once the deal has been agreed so that the purchaser has good luck with his new acquisition. John had set out to purchase the Series 2 but, knowing a good deal when he saw it, he took on the Series 1 as well.

The gearbox problem alluded to was, in fact, concerned with the transfer box. The obvious solution was to source a replacement, but John found it difficult to track one down. Undaunted, he decided that the only remaining option, if the tractor wasn't to be scrapped, was to fabricate a new one. After taking careful measurements, the requisite sections were cut from mild steel with a laser cutter and welded together to form a new casing. An engineering works in Lisburn completed the necessary machining and the gearbox was re-assembled from the serviceable original parts, with new components included as necessary. All simple engineering tasks! Apart from the transfer box, the Series 1 was in good condition and, other than routine servicing and overhauls, the tractor needed little further mechanical work. The cosmetic restoration was undertaken by Paddy Kearney and the Series 1 is now resplendent in its original blue and cream colour scheme.

The Series 2, meanwhile, was in a very good state mechanically and needed no work other than routine overhaul of items such as the brakes. The rear mudguards on the Series 2 Mark 1 were the only components that were past salvaging and so, once again, John put his engineering skills to use and a new pair was fabricated. The paintwork was once again tackled by Paddy Kearney but this time the tractor was sprayed yellow and red. Why? "Yellow and red were the colours marked on the tax book so I wanted to keep the tractor as original as possible" said John. There's no doubt that Roads Service would have specified these colours when ordering the tractor because the normal colour scheme is, and was, white, blue & black.

Given that John is the proud owner of both Series 1 and Series 2 Mark 1 Trantor tractors, he's in a good position to compare and contrast the two versions. He thinks there's little to separate them. The Series 1 is faster on the road but it lacks the power steering found on the later tractor. The Series 2 Mark 1 is easier to sit in on the road because of the different front suspension set-up. Brakes are excellent on both tractors. The Series 2 Mark 1 tractor has more power as well. It's surprising, given that the Series 2 Mark 1 is a development of the Series 1 version, that according to John, there are few parts common to both machines (the Eaton 5 speed gearbox, the Land Rover front wheels and some braking items). This gives an indication of the long term design and development reasoning of Graham Edwards and the design director (Steve Castellani) who have now developed (2013) new versions of the Series 2 Trantor tractor (Series 2 Mark 2) in a product range between 75 and 120 H.P. & 2 and 4WDrive, with a revised, low-cost supply-chain and also a Series 3 Javelin prototype at 185 H.P. illustrated earlier.

<u>Conclusion</u>

Since the Trantor tractor design has been directed towards worldwide farming the way in which the Trantor tractor benefits those who utilise a ploughing system can be seen from Appendix 1. For those forward-thinking farmers, looking to reduce the amount and cost of farm inputs it is pdf Brochure A (available from TIL) that outlines how Trantor tractors relate to the Zero-Tillage system.

N.B. This is an abridged article from the "Tractor & Machinery" magazine of October, 2010, by Gary Connolly entitled "Two of a Kind".

Appendix. 1. - A Typical Farm Calendar – Tractor Work Task Analysis in a European Context. TRANTOR INTERNATIONAL LTD.

TRANTOR tractors are very useful in a ploughing culture on farms but ALSO are focused towards the DIFFERENT work tasks of Zero-Tillage (No-Till)
The diagram below shows the benefits in a ploughing culture.
Brochure A (available on request) indicates why the TRANTOR tractor is the World's First Zero-tillage Farm Tractor.

What kind of work are Trantor Tractors able to do more efficiently than conventional tractors where the benefits result from higher speed and lower weight (productivity due to speed, reduced fuel consumption due to weight reduction and transmission design) and where LGP tyres are essential for reduced soil compaction.

Farm calendar year.	1	2	3	4	5	6	7	8	9	10	11	12	BENEFITS		
													Speed	Fuel	Soil
General Haulage													***	40%	
Silage Haulage													***	40%	
Bale Haulage													***	40%	
Rape Haulage													***	40%	
Grain Haulage													***	40%	
Beet Haulage													***	40%	#
Potato Haulage													***	40%	#
Hedge Cutting													**	40%	
Spraying - LGP													***	20%	#
Spraying													**	20%	
Fertiliser Spreading													**	25%	#
Muck Spreading													*	25%	#
Slurry Spreading													***	40%	#
Cultivating													**	20%	#
Drilling													*	20%	#
Scratch Tillage													**	20%	#
Dressing													**	20%	#
Grass Mowing													***	20%	
Grass Seeding													**	20%	#
Hay Mowing													**	20%	
Hay Bobbing													***	25%	
Baling round/square													*	10%	
Discing													*	10%	#
Topping													*	20%	
Power Harrowing													*	10%	#
Harrowing													*	25%	#
Rolling													**	25%	#
Bale Wrapper													*	35%	
Grass Raking/Silage													***	25%	
Carrot Haulage													***	40%	#
VegetableHaulage													***	40%	#
Heavy Cultivation	2wk							2wk			2wk				
Potato bed forming			1 month												

*** a lot quicker and more productive than conventional tractors/faster
** quicker than conventional tractors/faster
* same as conventional tractors

the relevance of soil-compaction, particularly in Zero-Tillage and the need to fit LGP tyres on to the tractor, as well as on to the trailers, in order to protect the soil where that is essential, e.g in wet conditions.