

**Right: PPC (predictive powertrain control) links cruise control to topography via GPS, for optimum shifting strategies**

**A**utomatic gearboxes are nearly as old as trucks themselves, with the first claim to automation made by a gearbox from the USA in 1904. Two forward speeds and ratio change by flyweights were not supported by the metallurgy of the time, so failure without warning was routine. But after the semi-autos of the 1980s and beyond, it's surprising to think that only in the last decade have we arrived at an AMT (automated manual transmission) for trucks that is a serious proposition.

The availability of affordable electronics – to let engines, clutches and gearboxes talk to each other without disagreeing – has been the key. The last hurdles to be demolished were cost of manufacture and operation, and driveability. With core operating economy lying upstream of the transmission, where the pain of expensive Euro emissions legislation has been felt, drivetrain developers have had to shout loudly to retain their funding.

Yet be it a bus, heavy truck or a van, getting an engine to deliver economy is only the start. Test and development teams know that the figures gained

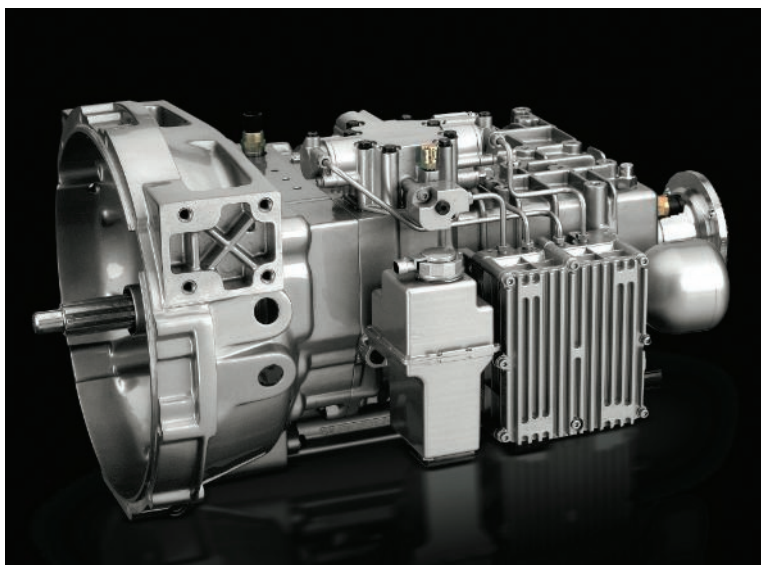


An unblinking spotlight has been shining on engines for so long that commercial vehicle transmissions have been put in the shade. They have a big impact on operating costs, but will innovation be stifled by evolution? Ian Norwell selects drive

# LOST in

**ZF Eurotronic automated transmission: 12 or 16 speed, electronically controlled**

from a power unit bolted to an engineering floor, nestled inside a soundproof booth and looking like a patient on life support, are only an initial guide to real fuel costs in service. There's a vale of tears between the two and, as the additional elements gather, the variables only thicken the fog of war.



Installation in a chassis and adding a transmission are only the start of developers' troubles. Driveability, the vehicle's aerodynamic performance, axles and maintenance standards all conspire to have the fingers of blame pointing in all directions, if the final numbers fail to deliver.

## The next big thing?

So how far away is the future? With most engineering evolutionary, developments that promise a revolution are both tantalising and frustrating. Torotrak's highly specialised IVT (infinitely variable transmission), based on its toroidal variator (*Transport Engineer* Nov 2012), seems as far away, or as close to, fruition as ever, depending on your degree of optimism. There are some big name backers that have run out of patience with the as yet undelivered promise of the variator, and they've reversed out of Torotrak. But Toyota, General Motors and Ford may yet stand to regret not sticking with the firm for the long haul, with the darkest hour often being the one before the dawn.

Despite that, Torotrak is not without serious backers. The biggest name is Allison Transmissions, which made serious commitments with licence and engineering services payments last year, and has now upped its stake to around 13% of the company.



ever-wider variety of applications. The long-resistant construction sector now has its own version, and the benefits it gives – of driveline protection and increased safety – have resulted in more of Volvo's current construction chassis taking it than not.

The break in torque between shifts, with its attendant loss of momentum and consequent efficiency penalty, is the next big challenge. Along with holding an engine in its efficient rev band, this is the goal claimed by Torotrak's variator. If this issue can be solved – maybe with engines that are economic over wider rev ranges – further developed AMTs may just beat the IVTs and CVTs (constant velocity transmissions) to the prize.

But how fast does a shift need to be? AMTs are already faster than a manual and some manufacturers have added faster shifting technology to the high ratios. At DAF's new XF tractor launch in November 2012, the manufacturer demonstrated its fast-shift, applied to the changes between 10th, 11th and 12th gears on the ZF AS-Tronic AMT. On the long Spanish grades north of Malaga, it certainly was fast and it begged the

# TRANSMISSION

Torotrak also has other technologies under development that could interest bus and truck fleets. Apart from its work on variable drive superchargers (V-Charge), it has dug into sparse funds for a 20% stake in Flybrid, which is developing a mechanical kinetic energy recovery system (M-KERS). This is claimed to outperform electric batteries when teamed with Torotrak's technology. A trial with bus operator Arriva early in 2014 should improve the profile and, if reserves (and backers) allow, Torotrak is expected to take a controlling stake of Flybrid within a year.

As investors now seem to be emerging from their recessionary caves, Torotrak's future looks brighter. But will such a revolutionary stepless transmission be out-manoeuvred by something as mundane as refinements of established designs?

## Speed of change

Back on planet earth, the powerful march of the AMT continues apace, and it's gathering up complementary technology along the way. AMTs have progressively relegated traditional manual boxes firstly to the options list, then cost options, and now erasure from many manufacturers' spec sheets.

Volvo's I-Shift has been around since 2002 and, like other AMTs, it's been modified to cope with an

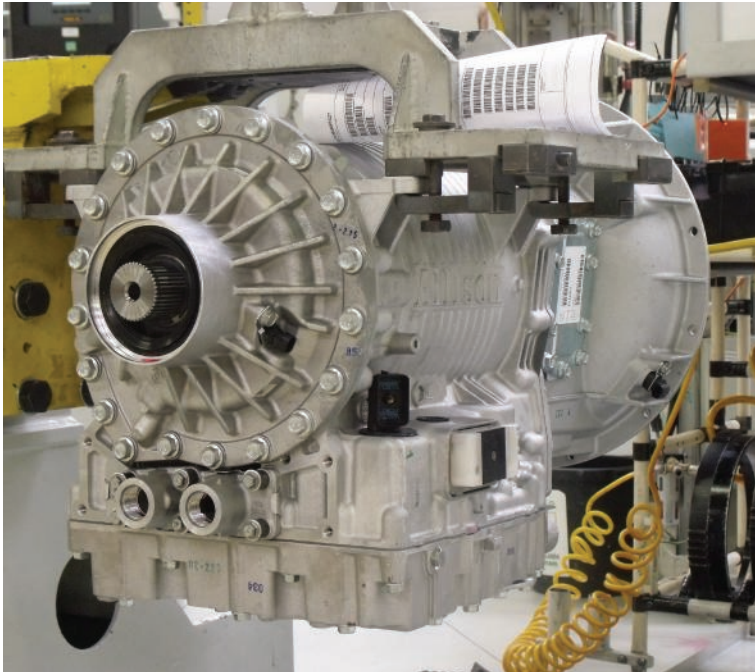
question why it wasn't introduced on lower gears, too.

Phil Moon, DAF's marketing manager in the UK, says that may come with time. "It does use the clutch with the constant-mesh box, but it employs a different logic in the shifting software, with the speed gained at the partial expense of the smoothness of change," he says. From the driving seat, fast-shift felt as smooth as all the rest, but the electronics may tell a more detailed story. As for reacting to a market that now takes 75% of its DAF tractors with ZF's AMT, Moon says: "There's no desire to reverse the standard manual gearbox specification in favour of the AS-Tronic AMT. What's important is that customers have a choice."

## Variations on existing themes

Pity the clutch. Arguably the hardest working component in a driveline, and not least because it's designed as a disposable, wearing item. That said, the arrival of AMTs has certainly extended clutch life, and in the harshest of environments – spot rental, for example – a more than doubling of the service life is not





uncommon. As developments in materials and software are progressively shielding the drivetrain from the shock and awe that has traditionally been deliverable by a driver's boots, clutches may one day join gearboxes as they become fit-for-life components.

Since AMTs came on the scene they have gathered a lot of smart additions. The two most influential are Eco-Roll, which allows intelligent coasting, and PPC (predictive powertrain control) that links cruise control to topography via GPS, for optimum shifting strategies. The fuel economy gains that come from these two transmission innovations alone are in the double digit percentages arena – a figure for which engine specialists would sell their grandmothers.

A road test conducted by *TE* on a 124km section of the A6 near Mannheim, in Germany, with Mercedes-Benz's PowerShift3 gearbox augmented by PPC, provided a genuine 9% fuel economy gain. I had previously tested Eco-Roll and, over a 228km (141 mile) mixed test route, 35km (21 miles) was covered in coasting mode, meaning that 15% of the mileage was run at tick-over.

But are these systems actually being bought by customers? Daimler's Nick Blake, sales engineering manager for Mercedes-Benz commercials in the UK, says most certainly. "PPC is currently being fitted to 35% of all production, and 80% of appropriate vehicles are being specified with it," he says.

What about dual-clutch systems? Proving that one plus one can make more than two, these have provided uninterrupted torque delivery to the car business, most effectively executed in the DSG (direct shift gearbox) used by VW. Now they've arrived in the

truck industry, too. First to get on the road was Daimler, with its Fuso Canter light truck, and Blake confirms that Mercedes-Benz is looking at the system for various heavy truck ranges, too.

DAF, however, remains unconvinced. Ron Borsboom, DAF's chief engineer, says there was more to it than speed. Asked if DAF will take on the obvious development from ZF – the dual-clutch version of its new TraXon family of transmissions, Borsboom said: "It's a good system, but it needs to shed some weight first."

Meanwhile, Volvo's 'I-Torque' dual-clutch transmission was promised as being "one year away" at the new FH launch in Goteborg, last November, and is now expected by the end of spring next year. All manufacturers are at different stages of introducing most of these features. Scania, for example, says it has no plans to move to constant mesh boxes for its automated Opticruise box, although it is now adding 'Eco-Roll' coasting – one of the last to do so.

All these devices will make introducing totally new transmissions a tough call, and the mountain is likely get even higher as AMTs mature further. At its core is the fear of anything new. Even when surrounded by electronic command and control, and ever-smarter peripheral systems that further increase productivity, at the heart of all AMTs is the traditional manual gearbox. It's a known quantity, understood and trusted by fleet engineers. That doesn't make them Luddites – just cautious.

### The nearly man

Occupying the middle ground between the jam tomorrow of Torotrak's variator and the delivered in-service AMTs from the European heavy brigade, is Allison's tantalising TC10 10-speed twin countershaft torque converter. Claiming a 5% fuel economy advantage over even the best AMTs, it seems to have been teetering on the edge of series production for some considerable time.

Speaking at the Brisbane truck show, in May this year, Allison Transmission's Jim Wanaselja, vice president of sales and service in North America, said: "100 major fleets throughout the US, representing a variety of applications, have been using our TC10 transmission over the last two years." Just how much longer these and other trials will go on before Allison hits the big green 'go' button on the assembly lines, it is unable to say.

In a conservative market, innovations like Torotrak's variator have a lot of explaining to do before fleet engineers will specify them. Being risk-averse is a default setting for engineers working in businesses with painfully tight margins.

It would be a shame, however, if a genuine engineering innovation that could shift the science of power transmission up a significant gear, failed for this reason. As Clint Eastwood's Dirty Harry might put it: "Do you feel lucky?" **TE**