THE MAGAZINE FOR INDUSTRIAL VEHICLE TECHNOLOGY, DESIGN & ENGINEERING

June 2015

iVT INTERNATIONAL

INDUSTRIAL

Eastern Europe in the spotlight
The best of the region's industrial vehicle design

Interview: **Teddy Wu, Dressta president**

Market Report: **The death of Russian off-highway innovation?**

Case studies
Zetor Forterra HD tractors
Dapper 5000 multipurpose loader

Industrial revolution?

This hybrid backhoe loader will change the way construction equipment is built, says Huddig

Intermat review
Five trends we spotted

Electronics
The next evolution of CAN

Mobile hydraulics
Off-highway steering made easy

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SUBSCRIPTION / CHANGE OF ADDRESS INQUIRIES TO:
Subscriptions Manager Suzie Matthews
suzie.matthews@ukipme.com
Circulation Adam Frost *adam.frost@ukipme.com*
Database Manager James Taylor
james.taylor@ukipme.com

Editor Richard Carr
richard.carr@ukipme.com

Production Editor Alex Bradley
Chief Sub Editor Andrew Pickering
Deputy Production Editor Nick Shepherd
Senior Sub Editor Christine Velarde
Sub Editor Alasdair Morton

Art Director Craig Marshall
Design Louise Adams, Andy Bass, Anna Davie, James Sutcliffe, Nicola Turner, Julie Welby, Ben White

Head of Production and Logistics Ian Donovan
Deputy Production Manager Lewis Hopkins
Production Team Carole Doran, Cassie Inns, Frank Millard, Robyn Skalsky

International Advertising Coordinators
Kevin Barrett (*kevin.barrett@ukipme.com*)
Michael Briant (*michael.briant@ukipme.com*)

Editorial Director Anthony James
Managing Director Graham Johnson
Chairman and CEO Tony Robinson

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FOREWORD

Back in the 1980s and 1990s it seemed we were continuously bombarded by a host of generally unflattering – to put it mildly – stereotypes and caricatures of the daily lives of the people from the Eastern Bloc. There was the gray, miserable 'architecture'; the gray, miserable food; butch female shot-putters who were said to be an accurate representation of all Soviet womanhood; and, most pertinently for us industrial vehicle types perhaps, jibes at the expense of its engineering and manufacturing prowess in the phenomenon of the Škoda or Lada joke.

So, in 2002, when I finally got my first chance to peer behind the old Iron Curtain in the form of a visit to the Volvo backhoe loader factory in Wrocław, Poland, I was in for a surprise. Not regarding the engineering, of course – this being Volvo CE, I'd entertained no expectations of the factory being built at the top of a hill to give the machines a helping hand in case they wouldn't start – but on my final night, I actually found myself giving semi-serious consideration to the idea of emigrating out East.

As occasionally happens in pubs, I suddenly became aware that I'd become separated from my colleagues and was engrossed in conversation with a bunch of total strangers, without any recollection of whether we'd been formally introduced or not. It turned out they were all American ex-pats out there teaching English as a foreign language, and after I'd expressed my delight in the unexpected beauty of Wrocław Old Town, and the gloriousness of that evening's cabbage soup with its 95:5 meat:vegetable ratio, they suggested I should apply for a vacant position. The US$100 a week (or was it a month?!) and free board and lodging didn't sway me however, so they played the ace up their sleeve: "And all the beautiful Polish girls love English guys," one of them said slyly. "Do you have an application form?" I asked – right before being hastily rescued by my good friend Punitha from *Southeast Asia Construction* magazine.

Anyway, this is all a rather long-winded way of saying – to quote Public Enemy – don't believe the hype. Putting together an issue with an Eastern European theme spurred me into spending more time checking out what the OEMs and designers over there are up to – and as our two case studies from the Czech Republic demonstrate, off-highway machines from that region may still not be chock-full of bells and whistles, but in no way does that mean they're unreliable, 'uninnovative', or even unattractive.

And even with those manufacturers and machines that do still seem to reflect that lingering Soviet impression of no-frills, rough-and-ready operation in grimy, smoky, mega-industrial applications – Poland's Dressta being a prime example (see page 24) – they have their own unique appeal and could still teach many western manufacturers a thing or two.

All that being said, perhaps some stereotypes are more accurate than others. The USSR may have stunned the world when it sent the first man into space, but as our feature on page 18 highlights, its innovations – from domestic off-highway OEMs, at least – have been few and far between recently, resulting in a major trend for the formation of JVs with western manufacturers. The latter greatly improve their access to a potentially huge, lucrative – not to mention geographically vast – market, while the Russians get their hands on the latest technology. It's just a shame I've lost the inclination to feature them over the last 15 months…

Oh well, might as well be hung for a sheep as a lamb then: Why do Ladas have heated rear windows? To keep your hands warm while you're pushing them…

Richard Carr, editor, iVT International

Coming up in the September issue of iVT

• Agritechnica Preview • OEM interviews • Less-cab systems • India and SEA in the spotlight • Market report – Indian construction equipment • Kaset Pattana rice harvesters

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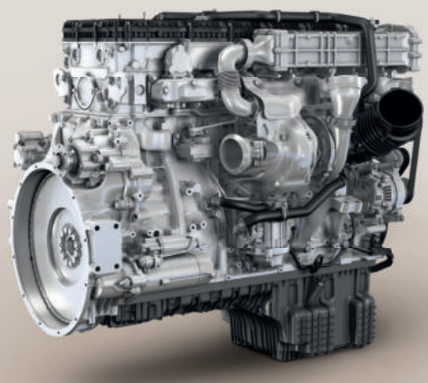


Series 1300

Power. Passion. Partnership.

Put a Tigon in your tank

HUDIKSVALL, SWEDEN – Huddig has launched Tigon Technology – a full hybrid technology it says will revolutionize the construction machinery industry, change the way machines are built, and provide up to 30% more output than a diesel engine alone is able to produce.

Built on a Huddig 1060c chassis, this prototype machine combines diesel and electric power to generate and regenerate energy in a way the OEM claims has never before been possible, providing higher torque and as much as 25% lower fuel consumption. The Stage IV Cummins QSB 4.5-liter four-cylinder engine offers the same 104kW maximum output as the Stage IIIA unit used in the 1060c, but also drives seven electric motor generators (EMGs), most of them delivering 30kW to the hydraulics.

With virtually every component between the engine and wheels, such as gearbox, propshaft and axles, making way for the new technology, three EMGs are attached to the splitter box, plus one at each wheelhub. Two of the EMGs at the engine are also connected to the hydraulic pumps, and can be used to supplement engine output or even charge the batteries when less hydraulic power is required.

"If necessary, the EMGs can also charge the lithium battery in the rear 'axle' – the wheelhubs, EMGs, inverters and batteries have been assembled separately for maintenance purposes, creating a subframe that looks rather like an overgrown axle," revealed Daniel Åkerström, development manager for Tigon Technology at Huddig.

All the hybrid components will also be suitable for future fitting in the larger 1260c.

The energy from the diesel engine and/or the battery (via a charging socket) can be used for either the working hydraulics or for propulsion – either of these tasks can be powered purely by electric when required.

"The battery pack offers another 25kWh – and depending on how demanding the application is, it will enable running in silent mode for approximately two hours – in some applications, significantly longer," Åkerström added.

In alternative operating situations, the EMGs draw on the output from both the engine and battery to supply higher output power than the engine alone can provide. The EMGs are claimed to be much more efficient than a conventional mechanical powertrain – and as the propulsion EMGs are connected directly to the wheels via hub reductions, parasitic losses are minimal.

"Tigon Technology is the result of several years of development in close cooperation with world-class component suppliers of, for example, the engine, the EMGs, batteries and several other hybrid components. What's unique is not the separate components, but the way in which we have combined them and can control them using our own management system," Åkerström continued.

"We developed the software for controlling the machine ourselves, so we can add just enough power from the battery to keep the engine at its most efficient speed. We can also control the speed and torque at each wheel, measure and match the steering angle and steering speed 100 times per second, and at the same time adjust the speed of the pumps to precisely match the hydraulic output required at the bucket."

"It feels fantastic to finally be able to show the world what we have been working on over the last few years," added Lars Lindahl, CEO, Huddig. "Our team has achieved something that has not previously been done and we are convinced that Tigon Technology will be received with great interest – not just within the construction industry, but also in other industries.

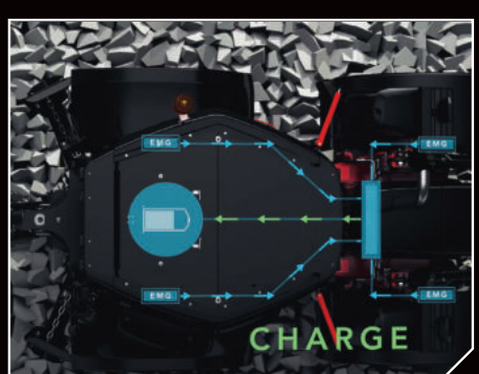
"We plan to evaluate the concept machine for up to two years, both from a market and technical point of view. By then we expect to have a base for building three to five preproduction units to be further evaluated by customers.

"When it will reach the market very much depends on the demand. At the moment we anticipate an additional price premium of 10-20%. Payback is highly dependent on the application, but for the average user we expect it to be between two to four years. But keep in mind that the hybrid also offers additional performance, which will be appreciated – but is difficult to value monetarily!"

ON THE WEB

Four animations at:
www.iVTinternational.com

The EMGs enable not only silent working but also finer control of traction and the working hydraulics – see the animations on our website



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For more information about the 2UF ultrasonic fuel level sensor please visit www.elobau.com

QUIETLY CONFIDENT

GANDERKESEE, GERMANY – Intermat saw the premiere of Atlas Maschinen's electrically powered material handler, the 350 MH E. It offers benefits such as near-silent operation, no refueling stops, reduced heat generation, and potential elimination of CO_2 emissions and non-renewable fuels.

Largely based on Atlas's standard diesel-powered model, the 350 MH E simply switches out the conventional engine for a 170kW electric powerplant. This provides 132kW from the main drive to power Linde's master hydraulic system, with an auxiliary drive sending the rest to the pilot control and steering.

The 35-ton machine requires a minimum load value on-site of 250KVA (90kW). The supply voltage via transformer is 24V/40A and is delivered via 80m of power cable, at the rear of the undercarriage, that can be reeled in at any time. This enables the machine to rotate 360° without restriction, while remaining fully mobile up to a maximum working radius of 75m. The power supply is optionally available via trailing cable or fixed connection – for stationary operation on a plinth, for example.

Maximum reach of the machine remains 18.2m, with all current attachments also being suitable for the electric model without requiring any modifications.

Driving comfort, however, is said to be better than ever due to the absence of noise making lengthy shifts more palatable. Control panels for the electrical system and HVAC are integrated into the existing operating panels on either side of the seat. The optional rearview camera with color display enables the operator to keep an eye on the main power cable.

CRAWLING WITH CLASS

DUBUQUE, IA, USA – As its largest, most powerful dozer ever built, John Deere's 1050K is "unlike any crawler dozer our customers have ever seen in this size class", said product marketing manager Mark Oliver.

Using an in-house 350hp PowerTech Tier 4F-compliant engine, the dozer features an Eco mode that is able to cut fuel consumption by up to 25% – with no loss of productivity – via the automatic adjustment of engine RPM and transmission settings based on load.

Its dual-path hydrostatic transmission also enables an operator to push a full load through turns with no loss of material – unlike competitive models with torque-converter transmissions, claims Deere.

The 1050K's controls enable high levels of customization to an operator's preferences. The maximum desired ground speed can be set before the task begins, with the power management system maintaining peak RPM and power efficiency without the risk of stalling. A decelerator can slow both ground speed and engine RPM, or ground speed alone, to help maintain traction. Its mode and response in terms of forward/reverse groundspeed ranges and steering modulation, etc, can be set via the exclusive TMC (Total Machine Control) monitor.

Inside the cab, the deluxe suspension seat adjusts seven ways for increased comfort, while the updated LCD monitor provides enhanced onboard diagnostics with real-time values for every temperature, pressure and speed sensor on the machine.

CONSTRUCTION FOCUS

JIM MANFREDI, *MACHINERY OUTLOOK*

A NEW LOW

Parker Bay's Surface Mining Equipment Index fell more than 10 points from Q4 2014 and now stands at 48.3 (Q1 2007 = 100), a 70+% decline from the Q1 2012 peak. The index measures shipments of the largest mining trucks, excavating/loading equipment and other production and support products used at the largest surface mines in more than 100 countries.

At its peak, equipment covered by the Index was valued at over US$3.5bn, in contrast to US$1bn in Q1 2015. Parker Bay said it now seems likely that 2015 will – at best – be only marginally better than 2014's depressed levels, with any sustained and substantial recovery unlikely until 2016 or later.

BRAZILIAN VENTURE

LiuGong has announced the opening of its first factory in Brazil. It will invest R$120m in the plant in Mogi Guaçu, SP, where it expects to produce 1,500 units p/a.

The factory – LiuGong's fourth outside China – will manufacture for the domestic market, including wheeled loaders and excavators.

DIGGING DEEP

Atlas Copco, along with global mining corporation Anglo American, is to begin testing a new type of mining vehicle set to 'transform the extraction process of ore from underground hard rock mines'. The two firms have cooperated in R&D since 2012 and their combined efforts, which center on mechanical excavation technology, are now in an advanced stage, with proof of concept testing set to start in late 2015.

In other news, Atlas Copco will cease all manufacturing of Powercrusher screeners and mobile crushers at its St Valentin, Austria plant during 2015.

"We're discontinuing this business as it does not fit strategically for us," said president of its Mining and Rock Excavation Technique business area, Johan Halling.

The Powercrusher business currently has 70 or so employees, with revenues of about €28m in 2014.

EXPORT TESTIMONY

According to AEM (citing US Department of Commerce data), exports of US-made construction equipment ended 2014 with a 13.2% drop over 2013, with sales of US$17.26bn. Exports to all world regions fell in 2014, with business to Europe, South America and Oceania/Australia being hardest hit.

Q4 2014 marked the eighth consecutive quarter of declines, though imports have been trending higher. Fast growth in the post-recession export figures (2009-2012) was a strong driver for US OEMs, but it appears the domestic market has now become one of the industry's more robust growth engines.

Spending US$6.66bn (a 2% decline), Canada bought the most (by dollar volume) US-made construction machinery during 2014. China, in ninth place, paid out US$367.8m, down 3.1%, while 10th-placed Saudi Arabia was up 10.7%, splashing out US$326.9m.

ASTEC BOSS DIES

Astec Industries has announced the death of chairman and former CEO Dr J Don Brock, following his diagnosis with cancer in 2012. He co-founded Astec in 1972, building it into a global company with 18 subsidiaries. He held about 100 US and foreign patents on construction machinery and drying equipment.

Components for your Equipment.

Components by Liebherr perform a wide range of different drive tasks in various applications in the fields of construction and mining. Examples include diesel engines in pipeline machines, axial piston pumps and motors in cranes, travel drives in crawler vehicles and hydraulic cylinders in excavators. The Liebherr common rail systems are ideal for engines used in heavy on-road and off-road applications.

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AEBI'S BACK ON TRACK

BURGDORF, SWITZERLAND – Aebi's VT450 Vario transporter was chosen for in-depth case study treatment in *iVT* Feb 2014 due to the enhanced traction delivered by its innovative hydromechnical powersplit transmission. Nevertheless, this machine still struggled when snow or wet ground could force a halt to municipal services or transfers to mountain huts and cable car stations.

But now, having catered for the wish expressed by many customers with the addition of crawler tracks, a meter's worth of snow is a pleasure to drive on, enabling cross-country ski trails, etc, to be reliably maintained – even with a GVW of 9.5 metric tons. The switch from wheels to tracks can be performed in less than two hours, providing a truly multifunctional vehicle that can be driven year-round, and removing the need to buy special snowmobiles.

With the ground pressure considerably reduced due to the enhanced contact area provided by the smoother-running tracks, performance on delicate or wet ground is now greatly enhanced. The tracks add a further 120mm of ground clearance, which ensures the vehicle doesn't become grounded on boggy terrain. With the crawlers on each axle running in their own track, this further reduces the chances of sinking, while the hydraulic torsion damping helps to ensure the best possible traction.

THE WHEEL DEAL

CHARLOTTE, NC, USA – As a replacement for the Cushman Turf-Truckster, Jacobsen's Truckster XD heavy-duty utility vehicle is claimed to set new standards for capacity, power, strength and comfort.

Its 3,550 lb standard load capacity is supported by the 'toughest bed in the industry', built with 12-gauge steel that is up to 75% thicker than that used in comparable boxes and providing 20% more volume.

There is a choice of three-cylinder gasoline (972EFI) or diesel (D1105) Kubota engines, providing the highest power and torque available for this type of vehicle (32.5hp/70Nm and 24.8hp/71.5Nm respectively). This enables effortless hauling, as well as towing up to 2,200 lb (or 3,500 lb with trailer brakes).

Maximum speeds of 23 and 21mph respectively are achieved via the five-speed manual transmission which boasts an optional fifth gear lockout. It also features a low-low (creeper) first gear, and a custom-designed 2-speed rear axle with an electric heavy-duty diff lock.

It is also claimed to offer the industry's roomiest operator platform, with 25% more room than the competition.

"The first thing we did was ask hundreds of [users] what they wanted from a heavy-duty utility vehicle," stated Chris Fox, product manager for Jacobsen. "The feedback was unanimous: they wanted a truck with more capacity, power and comfort."

AGRICULTURAL FOCUS

JIM MANFREDI, *MACHINERY OUTLOOK*

DATA DIRECT

AEF has set up two new project teams – Wireless Infield Communication and High-Speed ISObus. The former covers close-range M2M data transfer, directly in the field, where process data must be exchanged directly, at one second intervals. If this data is always up-to-date, the processes can be more controlled and stress-free.

The project group will not only select the suitable radio standards (WLAN, etc) but also examine encryption and functional reliability. It will also consider how data is transferred between the tractor/universal terminal and the office computer – until now, it was necessary to use USB sticks or memory cards, which is considered inconvenient.

Increasing demands on the quality of interaction between the driver and the tractor/implement mean an extension to the ISObus standard is necessary. The High-Speed ISObus project team is working on concepts for increasing bandwidth in the bus, as well as creating preconditions for integration of updated functionalities and assistance systems, such as the expansion of diagnostics, the support of electric drives, M2M communications, and the connection of real-time video systems. Another fundamental aspect is improving the graphic display on the screen, to make the systems more user-friendly.

JOB LOSSES AT CNH

Reports out of Canada say CNH has laid off 413 workers at its Saskatoon manufacturing plant, 338 of them temporarily (from May until August), and 75 of them indefinitely. The Saskatoon plant employs 700 people, and manufactures combine headers, air seeders, corn planters, grain drills, wheel and suspended boom sprayers, and heavy harrow bars for the New Holland, Case IH and Flexi-coil brands.

The operation includes a 780,000ft^2 manufacturing facility, an R&D center and a parts depot.

TOPCON DRONES ON

Topcon Positioning Systems has now received a national exemption from the FAA that allows for operation of its unmanned aerial system (UAS) in the USA.

The exemption covers the operation of the Sirius Basic and Sirius Pro for aerial data collection.

The systems are designed to produce the solutions for the automated mapping of a wide range of sites, including construction sites, mines and quarries, and for use in land surveying, transmission line and pipeline inspection, plus agricultural operations including field mapping and livestock management.

With the Sirius Pro model, Topcon eliminates the need for ground control points by combining RTK (real-time kinematic) GNSS solutions with precision timing technology to provide highly accurate mapping results.

JD INSURANCE EXPIRES

After just nine years, John Deere is officially out of the crop insurance business, having completed the sale of the John Deere Insurance Company to Farmers Mutual Hail Insurance Company. Despite its relatively brief time selling crop insurance, John Deere had become one of the top 10 providers in the USA. It announced the sale to Farmers Mutual in December.

Farmers Mutual is based in West Des Moines, Iowa.

HANDLING FOCUS

MICHAEL LEU, *FORKLIFTACTION.COM*

KION GETS SMART

Kion Group has signed a €72m agreement to buy the Egemin Group's Handling Automation division, which offers customized solutions for automation of logistics. It generated about €76m in FY 2014.

"[With this acquisition Kion] is strengthening its expertise and capabilities in the design and management of complex logistics automation projects," stated Kion CEO Gordon Riske. "Automated materials handling solutions will play a crucial role in Industry 4.0, facilitating the vision of the smart warehouse and factory."

Egemin Automation's CEO Jan Vercammen will remain in place and report directly to Riske.

AUTO PORT AUTHORITY

Kalmar will invest €3m in a port automation testing and development platform at its Technology and Competence Centre in Tampere, Finland. Set to be fully operational in early 2016, it will be mainly used for testing in customer projects and NPI.

Kalmar president Olli Isotalo explained, "In the past, a lot of time was spent testing and optimizing at customer sites after the equipment had been delivered. In an automation project, this can have a major impact on cost and implementation time.

"[Now] we can start the testing well in advance ... and keep the on-site testing to a minimum. This will result in faster implementation times ... and the shortest possible time to value in port automation projects.

"We will have the capability to test new product features to shorten time to market for our new products and further improve their reliability and quality."

Kalmar clarifies this will be a "complete end-to-end automation system", including automated and manual straddle and shuttle carriers for horizontal transportation, an automatic stacking crane system for yard operations, and automated truck handling for landside operations, all integrated with the Kalmar terminal logistics system and Navis N4 terminal operating systems.

HELI STILL FLYING HIGH

Heli Forklift says it has been named the top enterprise in China's industrial vehicle sector for the 24th consecutive year, based on the production and sales data of domestic forklift OEMs. Spokesman Songlei said the CCMA's industrial vehicles division had stated that the OEM's main economic indicators remained in the leading position in China.

Songlei says Heli realizes that independent innovation is the key to the global market and that comprehensive supplementary services are essential to development of its business overseas. It boasts 589 patents, with R&D investment standing at 4.3% of its sales revenue.

LINDE CO-DEPENDENT?

Customized Options (CO) made up almost a third of Linde's production last year – the fastest growth segment in its business. In 2004, less than 20% of Linde's trucks underwent modifications on the production line.

To be able to cope with thousands of customized solutions each year, the company has integrated the manufacture of these trucks into the series production process wherever possible. CO specialists accompany the process from order processing all the way through to manufacture, assembly, documentation and service.

Global materials handling online: www.forkliftaction.com

IT ALL STACKS UP

MONTCEAU-LES-MINES, FRANCE – The Liftace 5-31 reach stacker is the first of Terex Port Solutions' (TPS) new-generation heavy lift-trucks to hit the market, and offers low fuel consumption and wear, easier access to maintenance points, and new ergonomically designed cabs.

With a 6,200mm wheelbase, it can stack five high-cube containers in the first row, with a capacity of 31 metric tons in the second row and 15 metric tons in the third. Its top-pick spreader is an in-house development, coupled with an advanced boom design that provides improved inherent rigidity and increased radius enabling faster and more accurate operation.

Reducing TOC was high on the list of design priorities, and TPS says the interplay of the drive axle with the Tier 4F Volvo or Cummins engine options, specifically tuned to the Dana TE30 gearbox – together with the low overall weight and enhanced load distribution of the machine – result in particularly low tire wear. In addition, the load-sensing hydraulic system reduces fuel burn, which is further aided through the EcoPower operating mode and LED lighting system.

In other news, the four imminent models of Stackace empty container handler are set to combine the strengths of the PPM and Fantuzzi legacy brands with brand new innovations, while employing the same technologies used in the Liftace, as well as many identical configurations and components.

"The reach stacker platform provides a basis for all our other developments [such as] full and empty container handlers and forklifts," said Klaus Peter Hoffmann, VP and MD of TPS.

"Therefore, the machines have major technical points in common, enabling terminal operators to deploy their drivers and service technicians more flexibly and more cost-efficiently."

HEAVY METAL ON SONG

INCHEON, SOUTH KOREA – Doosan Industrial Vehicle's (DIV) 10- to 16-metric ton trucks have begun rolling off the production line, topping out the OEM's 7-Series line-up.

Boasting a strong and rigid chassis frame, plus a 'more metal than plastic' design for greater durability, the D100S-7 to D160S-7 models are claimed to be particularly suited to the most demanding industrial environments such as mining, construction, heavy manufacturing and the metals and timber industries.

The entire range has been fitted with Doosan's own G2 engine, which the company claims requires 23% less fuel than engines of comparable size. Combining DOC and EGR exhaust treatment technology provides longer maintenance intervals to further reduce the cost of ownership.

The new tilting Zeus cabin combines a superb 360° field of view with excellent ease of access and comfort for the operator.

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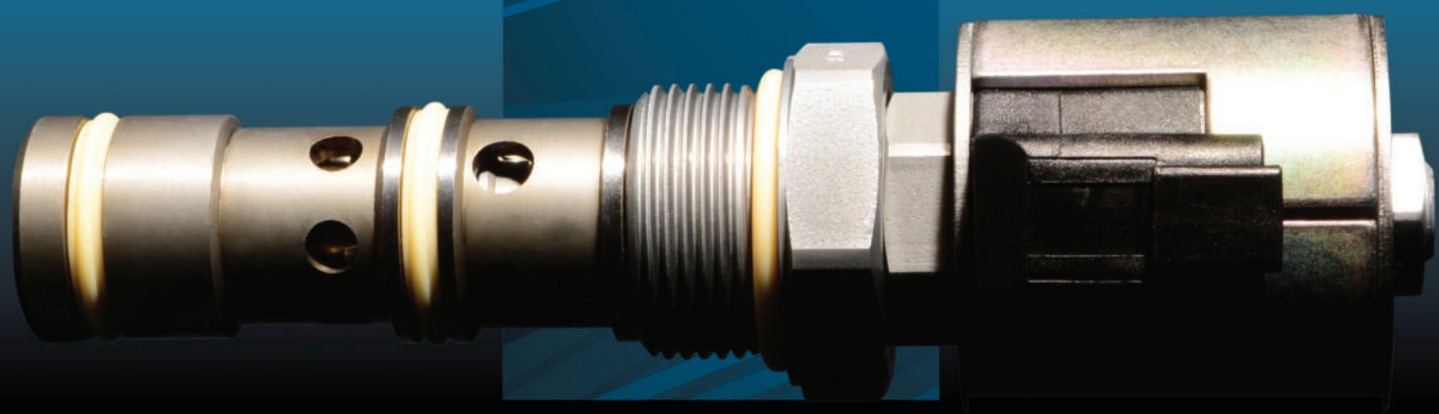

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RICHARD CARR, iVT INTERNATIONAL

5 THINGS WE LEARNED

SOME OF THE BIG OEMs MAY HAVE BEEN NOTABLE BY THEIR ABSENCE, BUT INTERMAT 2015 PROVED TO BE A REAL EDUCATION. HERE IS A HANDFUL OF THE MAJOR TALKING POINTS WE UNCOVERED...

1 THERE'S A RENEWED INTEREST IN HYBRIDS

Since the first hybrid toe was tentatively dipped in the off-highway ocean, these energy-saving technologies have undergone roller coaster levels of OEM interest, with very few high-profile launches – even in prototype form – in the past two or three years. So this year's exhibition was notable for a slew of new innovations that promised to deliver double-digit fuel savings.

Perhaps the most stylish of these was **Hitachi**'s **ZW220HYB-5**, the company's first mass-production hybrid wheeled loader. Drawing heavily on group technology proven in the bullet train and EH-series haul trucks, the ZW220HYB-5's smaller than usual four-cylinder engine powers a generator, which produces energy to drive two electric travel motors. When the machine is rolling or braking, it continues to store electricity in a capacitor. Under acceleration, it draws on energy from the generator and the capacitor, meaning fewer RPM are required to reach normal travel speed. The control units are the key to the electrical power process and engine operation – for example, when lifting and loading, the engine RPM automatically increases in response to the load as there is no need to use the accelerator pedal.

The main benefits of this hybrid system include reduced fuel consumption, less noise, enhanced reliability and safety, and easy operation. The ZW220HYB-5's hybrid system will improve fuel efficiency by up to 26% compared with the previous conventional ZW220 wheeled loader, while maintaining the same performance.

The company also highlighted its **ZH210LC-5** hybrid excavator. Launched a year ago, this adopts advanced technologies from hydraulic, electric and battery-powered excavators to reduce fuel burn by up to 31%. Its hybrid system uses a swing motor to convert energy from swing braking into electrical energy, which is then sent to the capacitor to help drive the engine and swing the superstructure.

Meanwhile, **Case Construction Equipment** displayed the **CX210 Hybrid**, a medium-capacity prototype hybrid excavator that uses the same 160hp Isuzu Tier 4i engine as its standard model, but in association with an electric motor acting as the swing device. Energy generated during the swing deceleration is converted and stored in the capacitor and used to assist the power of the engine via a generator motor. Although the cycle time of the hybrid remains the same, it enables greater fuel efficiency (+15%) and higher productivity.

This appears rather similar to the operating principle behind **Komatsu**'s **HB215LC-2** third-generation hybrid excavator – and there could be more to come from the Japanese OEM, as *iVT* discovered when asking Keiko Fujiwara, managing director and CEO of Komatsu Europe, about the company's plans for the hybrid technology.

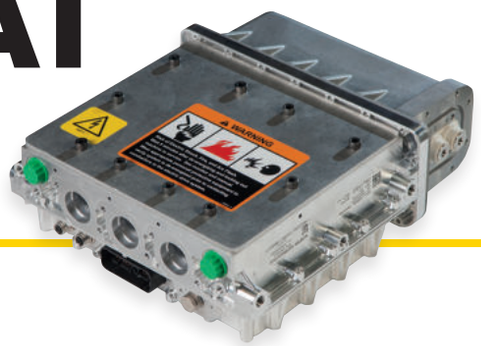
MAIN: **Hitachi's ZW220HYB-5 can improve fuel efficiency by 26%**
BELOW: **The Trias HX hybrid system can reduce Hitachi's ZH210LC-5's thirst by 31%**

First launched in 2008 as the PC200-8, sales of this hybrid machine have steadily grown, with a working population of approximately 3,200 now in the field – 220 of those in Europe – and fuel savings now approaching 40%. So, given that proof of concept, we asked if it was now time to extend the reach of that technology. In short, the answer was 'Yes', as Fujiwara revealed that development is currently ongoing to extend the technology to other sizes of excavators in the line-up. Though reluctant to reveal when we might see these launched, Peter Howe, managing director at Komatsu UK, suggested it would be reasonable to assume that development could be complete within one or two years.

And even the dealers are at it, as **Manu Lorraine** highlighted with its modified hybrid **Atlas 220W** wheeled excavator, which is claimed to offer up to 50% fuel savings through use of the eco'nergy solution, which offers a return on investment within 12-18 months. Unlike most other concepts on the market, this does not draw on swing technology at all – rather, it uses gravitational force from the lowering of the boom. The dead weight energy of the boom and empty bucket is recovered, using oil at the bottom of the recovery cylinder, and stored in a series of nitrogen accumulators. These, under the effect of the compressed gas, then release hydraulic oil according to the bucket's activity and the recovered energy is then used to lift the weight of the arm, with the hydraulic pump only being needed to cover any energy shortfall to lift the load and cover any pressure drop in the hydraulic circuit.

And of course, the suppliers were also in evidence with their solutions. **Dana**, for instance, highlighted

AT INTERMAT



LEFT: **The PD400 modular inverter from JDES**

the **Spicer PowerBoost** hydraulic-hybrid system, which is now available for OEM field testing. Its own engineers have conducted extensive field tests of the system integrated with a dual-motor hydrostatic transmission in a series configuration. These tests of typical duty cycles have verified fuel savings of over 20% for a front-end loader, and over 25% on a telescopic boom handler, with an expected payback in under 18 months for both applications.

This technology is ideally suited for hydrostatically driven drivetrains, and works by capturing hydrostatic energy in an accumulator from the powertrain during low-power operation of the engine and when recuperated from braking.

Deployed through series or parallel hybrid configurations that fit into existing vehicle designs with minimal adaptation, it supplements all types of transmission architectures. By capturing kinetic energy otherwise wasted throughout the drivetrain and working hydraulics, and then using this recuperated energy to help power the vehicle, fuel consumption can be reduced by 20-40% compared with conventional drivetrain concepts, depending on vocational application and duty cycle.

When additional power is required, such as accelerating from standstill, lifting a load, or driving into the pile, the advanced energy management system uses the stored energy in the accumulator to provide an additional source of power for improving performance, increasing productivity, and reducing fuel consumption.

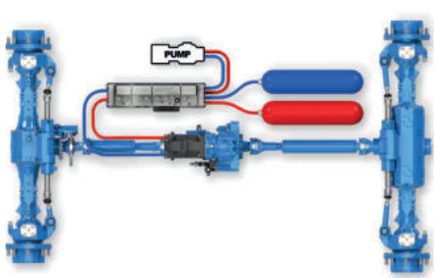
It can also be configured to minimize idling by shutting off the engine and accessing power in the accumulator for vehicle operations that consume low amounts of energy.

Last but not least, **John Deere Electronic Solutions** (JDES) introduced the **PD400** modular inverter for high-voltage/high-power hybrid electric vehicles. This all-in-one solution eliminates the need for multiple interfaces while matching exact system requirements, simplifying work and enabling system designers to optimize machine performance in extreme conditions in off-highway and heavy-duty applications.

The PD400 modular design can be configured with a single or dual inverter, optional brake chopper, optional DC-DC converter, and an available integrated isolation monitoring feature. It also eliminates multiple connector and cooling interfaces to improve cost, minimize space requirements, and reduce losses for improved efficiency.

The PD400 has a common electronic control architecture that supports the full suite of JDES advanced motor control software to optimize performance of permanent magnet or induction motors in hybrid electric applications. PD400 software has been designed to work at maximum efficiency with complete monitoring capabilities to enable precise control under various operating conditions. The thermal management system is liquid-cooled for robust and reliable performance over the life of the system.

CLOCKWISE FROM LEFT: **Case CX210 Hybrid excavator; Dana's Spicer PowerBoost system; and a modified Atlas 220W wheeled excavator**



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2 THERE'S A NEW GAP IN THE GRADER MARKET WAITING TO BE FILLED

It may just be a coincidence that, following Volvo's decision to transfer production of its motor graders to SDLG, several OEMs not noted for their involvement in this area – in Europe at least – chose the show to announce the availability of new models of this type.

Case Construction Equipment, for instance, launched two models of the **C Series**, its first European grader range – albeit one built on the previous developments of Frisch, Faun and O&K.

With operating weights of 13 and 16 metric tons, each model is available in 6x4 or 6x6 All Wheel Drive versions and features FPT Industrial's Hi-eSCR engine technology for Tier 4 Final compliance. The absence of exhaust gas recirculation means the cooling requirement is lower, so the graders feature smaller radiators with lower power absorption, while the reduced size of the aftertreatment system enables better visibility to the rear and easier access for maintenance.

The Ergopower transmission with torque converter and automatic mode ensures smooth shifting and optimally matches the speed and power to the application for perfect controllability and smooth operation. The No-Spin technology of the 100% differential lock ensures the power is automatically transferred between the two sides of the tandem whenever there is a loss of traction, resulting in best-in-class drawbar pull in all soil conditions. Its outstanding traction is also due to the positioning of the cab further to the rear of the machine and on top of the tandem.

The moldboard frame is designed with A-shape technology that constantly compensates for traction effort, drastically reducing the twisting effect when the grader is working with the blade off-set.

Both AWD models feature a standard creep mode with fully integrated electronic control to provide greater controllability during precision work, and in applications such as compaction that require high engine RPM at low speed. In creep mode, engine RPM can be separated from linear speed so the required oil flow can be supplied independently.

The load-sensing hydraulic system's pressure compensation allows for simultaneous movement, which is key to the grader's controllability. The control levers are directly connected to the main valve and the lever stroke required to activate the functions is shorter. As a result, the operator enjoys a faster blade reaction with a better feel for its action, and moldboard controllability is maintained for the whole duration of the grader's life. The machines can be ordered factory-ready for all the most common blade control brands.

Another surprise new entry came from **Komatsu**, with part of the discussion in its press conference revolving around the desire to make its graders available in Western Europe, hot on the heels of the launch of the **GD675-6** in Japan earlier this year. But when asked whether the company was moving in to fill the void left by Volvo CE's withdrawal, it was pointed out that – with sales of graders already ongoing on a country by country basis in much of Eastern Europe – this would not represent any significant change of policy.

Finally, **Hidromek** highlighted its **MG 330** and **MG 460** grader models, following its acquisition of that machinery line from MHI in 2013.

3 GOING HALVES COULD BE THE NEW TREND IN MOBILE CRANES

Following on from the LTM 1300-6.2 telescopic mobile crane launched at Bauma 2013 – see *iVT* June 2013 – **Liebherr** showed its **LTM 1160-5.2** five-axle model (above right) for the first time in Europe, following its launch at ConExpo 2014.

Both of these machines are notable for switching from the more traditional dual-engine layout to a simplified single-engine driveline, which uses a mechanical shaft to transfer power from the chassis-mounted engine to the superstructure. This produces savings in terms of fuel consumption and engine maintenance, while enabling additional load-bearing components to be fitted to boost capacity. But are there any disadvantages to this approach? We'll find out in a future article…

Along similar lines, the company unveiled the **LTC 1050-3.1** compact mobile crane (below right) at the show. Boasting improved performance over its predecessor – the LTC 1045-3.1 – by virtue of the partial use of a stronger, fine-grain structural steel and improvements in the boom telescopes, its load capacity has been increased while the dimensions have stayed virtually identical.

But, like its predecessor, the machine is notable for making do with one cab, rather than the more usual two – and rather than operating the boom from a typical driver's cab, Liebherr has provided a cab more like the type usually found on the superstructure from which to carry out both driving and lifting operations.

For driving on the road, the cab is moved up to the front of the vehicle using a telescopic arm, providing the driver with better visibility and a good driving position, particularly at high speed. The optional lift facility can take the operator to an eye level of 7.8m, opening up new areas of use and several advantages over conventional machines. The greatly improved line-of-sight to the assembly situation enhances safety for many tasks, which is why the majority of LTC 1045-3.1 owners went for this option.

With its active, speed-dependent rear-axle steering, the new model offers good lane stability at high speed and is also very maneuverable at low speed. The vehicle dimensions and turning circle radius have not changed, meaning the turning circle radius over the telescopic boom with 385/95 R25 (14.00) tires is just 7.5m.

In particularly constricted areas, the boom can be luffed upwards to bring the turning circle of the chassis into play. The chassis length is 8.9m and can be reduced to 7.7m by removing the front storage box. Even with 16.00-size tires, the vehicle width stays within 2.55m.

4 STAGE V EMISSIONS REGULATIONS IS ALREADY A MAJOR TOPIC

While the legislation is not yet set in stone, the final (or perhaps just 'next') installment of European emissions compliance was a hot topic in Paris, with several suppliers promoting Stage V-ready models, and **Cummins** hosting a seminar to explain the finer points of the subject to the assembled press pack.

Richard Payne, Cummins' off-highway regulatory affairs director, Europe, began by observing that many EU states face legal action over their air quality, which is driving demand for the near-elimination of PM emissions from diesel engines. The PM problem from construction equipment in cities is also increasing, especially from compact machines, which is why the COM (2014) 581 proposal for a Stage V will also affect the previously unregulated 0-19kW and over-560kW sectors – regardless of the type of fuel used – bringing them broadly into line with North American requirements.

The proposed timeline for engine production will be January 1, 2019 for the 0-55kW and over-130kW segments, followed by the 56-129kW segment a year later.

The new legislation will not just require a reduction in PM mass, from the current Stage IV limit of 0.025 g/kWh to 0.015g/kWh – but more crucially, a maximum PM count of 10^{12}/kWh will also be implemented, effectively eliminating 99.9% of particles in the 23nm to 2.5μm range. The 0-19kW and over 560kW sectors will be required to meet limits of 0.4 PM/7.5 NOx and 0.045 PM/3.5 NOx (g/kWh) respectively.

"The rules don't specify that a filter is required – however, this is the only way to ensure particle-counting compliance," Payne explained.

Further complications include the abolition of the existing 'flex' arrangement, and that of a transitional 'sell off' – in other words, the length of time an engine can be held before it is installed and the machine placed on the market. This will require a 12-month engine transition, and 18 months for equipment transition.

So, given that Payne spends an enormous amount of his time working with the legislators in Brussels, *iVT* therefore asked which part of the current proposals he would most like to see changed.

"The engine industry is generally happy with the proposals from the overall view of the levels and dates," he responded. "The major concern is the removal of replacement engine options. From the Cummins point of view, that affects our reconditioning business if those engines get new identities, and from the owner/operator's point of view, it could have severe consequences if they have to buy a new engine.

"For example, take a [broken-down] combine harvester in the middle of the season – they don't want to have to rebuild that engine, but rip it out and put a new one in."

The **Committee for European Construction Equipment**'s (CECE) press conference carried on along these lines, with its president Eric Lepine pointing out that the construction equipment industry already produces the cleanest and safest machinery in the world and is committed to further support the legislator in this field – but in order to do that, the industry also needs the support of the legislator.

"We need the regulation to be approved by the end of 2015, otherwise our industry will not have the time to implement all the necessary changes in the engine and the machines to comply to these new, very stringent emissions standards," he said, adding that an appropriate replacement engines provision should be inserted in the legislation. Furthermore, CECE is requesting the legislation's transition period to be extended by six months.

And finally, with about 75% of the world only at Stage IIIA levels or below, he called for global alignment, saying that as the global market for highly regulated products is still quite small, Europe cannot afford to deviate too much from requirements in other ambitious nations in this field. He therefore urged the EU to maintain alignment in standards and limits with other regions, notably with the USA, and actively promote worldwide alignment.

Provisions: What's Different

Provision	Stage IV - current	Stage V - 2019
Flexibility program	Available	**Removed**
Transitional engines & equipment	Available	**More Limited**
Replacement engine	Available	**Removed** – alternative under debate
Engine type	Diesel	Diesel / **gaseous fuel / petrol / dual-fuel**
Fixed speed engines	Different regulations apply	**Same** Stage V as variable speed engines
Power categories	Under 19 & over 560 kW excluded	**All** engine ratings included
Engine rebuild	No limitations	No limitations

STAGE 5

5 STEEL COULD BE THE NEW 'COMPOSITE'

With the launch of Strenx, a new high-strength structural steel product brand, SSAB believes it is opening up some new competitive possibilities for its customers to make stronger, lighter and more sustainable off-highway machinery.

Strenx has been designed for sectors where structural strength and weight savings are key competitive factors, particularly in the lifting, handling and transportation industry. The product is also well-suited for agriculture, the frames of heavy mobile machines, rolling stock, offshore, and construction sectors. Now customers will be able to design more competitive and sustainable products.

"We estimate moving from 355 standard steel to Strenx could mean a 35% weight reduction," stated Gregoire Parenty, head of market development at SSAB. "This opens up new possibilities, far beyond the usual norm – cranes that reach further, trailers with more payload, and trucks that use less fuel. For customers, this is a totally unique product as Strenx now covers the three product brands – Optim, Weldox and Domex – that are well-known trademarks of SSAB and the former Ruukki."

Strenx offers a vast choice of high-strength structural steels, both in terms of strength and dimensional range. Yield strengths range from 600Mpa to 1300Mpa, which is the strongest steel available on the market. The steel is available in plate, strip and tubular products in thicknesses ranging from 0.7-160mm, enabling it to meet virtually all structural demands.

"We give full support to designers and customers to help them upgrade to Strenx. By sharing our in-depth experience and wide knowledge of steel, we can guarantee the best results for end-product performance," Parenty added. **iVT**

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EVER SINCE THE END OF THE SOVIET UNION, MAJOR INNOVATIONS IN THE RUSSIAN OFF-HIGHWAY VEHICLE INDUSTRY HAVE BEEN RARE. GLOBAL OEMs, HOWEVER, STILL STRUGGLED TO TAKE ADVANTAGE – UNTIL THE TREND FOR JOINT VENTURES REALLY TOOK HOLD

Russian roulette

The development of the Russian off-highway vehicle industry is inextricably linked to the joint ventures of its domestic companies and their partners – primarily from the European Union and USA – according to predictions from the country's Ministry of Economic Development.

That is backed up by numerous market studies, which have shown that Russian OEMs have experienced problems due to low efficiency over recent years, which has significantly cut their volume of investment in R&D. To stay afloat, most of them have had no other choice than to import technologies, usually by inviting foreign partners into a cooperation. In exchange, they provide access to a large sales market and state support, which the Russian government often allocates for this type of project.

In particular, over the last couple of decades, the country's OEMs have made such little progress in the area of development support software that customers often complain that, after their employees have operated imported machinery, it becomes very difficult for them to go back to using the more clunky domestic machines – especially with larger vehicles.

Several opinion polls among major customers reveal that most complaints refer to problems with the efficiency – the ratio of fuel consumption and working hours to the actual work that has been done. This is also closely related to another complaint – that because domestic vehicles almost invariably have fewer operating modes, imported machinery often appears to be a far more flexible option.

Some of the local manufacturers' machines face the problem of high fuel consumption with relatively low productivity. In general, customers say that, compared with imported models, some domestic off-highway vehicles usually have not one, but several, problems.

Of course, not all Russian OEMs suffer from all of these problems – in fact, some of their machines are successfully competing with imported models. However, there are very few such examples and without the benefits of high import duties and logistic issues, Russian OEMs would probably have a much smaller share of the domestic market than is currently the case.

Recent years have therefore witnessed a growing number of industrial machinery joint ventures, with many technologies that have been developed exclusively for the local market, given its specifications and climatic conditions.

The desire of the foreign players to gain a foothold using the existing production capacities in the former Soviet Union has a clear economic background, as the Russian-led Customs Union is a huge market, which today greatly relies on imports of industrial machinery. However, even after joining the World Trade Organization in 2012, import duties on off-highway vehicles remain high, so the opening of localized capacities in the region appears to be an increasingly attractive option.

Investment areas

Expert estimations suggest that, since 2010, several dozen JVs with a total investment of about RUB200bn (US$7bn) have been created. The largest of these have been in the agricultural and mining equipment industries, which should remain the locomotive for the development of most regions for the coming decades.

Perhaps one of the largest is the Komatsu cooperation with local OEM Kranex in Yaroslavl Oblast, launched in 2011. In 2014, the company's plant in Russia was expanded in response to growing domestic demand.

As company representatives stated, the most important part of the expansion is that the plant will start to produce hybrid models and technologies. The company also recently started to equip all of its machines produced in the country with the Komtrax telematic system.

TOP: **Komatsu is considering the expansion of its Russian division**

ABOVE: **The plant of Komatsu in Yaroslavl Oblast has been created jointly with Russian firm Kranex**

This technology could well give the company a very useful competitive advantage over its main rival in the territory of the former USSR – Belarusian company BelAZ.

Komatsu Russia predominantly specializes in medium trucks and excavators, and after expansion this strategy will not be changed. For instance, the most powerful of its Russian-assembled excavators is the 42-ton PC400-7, which digs to a depth of 7.8m. But it seems that, in recent years, BelAZ is also putting the emphasis on the size of its machines – in 2013, the company created the world's biggest dump truck – the BelAZ-75710 with a capacity of 450 metric tons.

Notably, all Russian-assembled Komatsu excavators are equipped with buckets developed by Kranex, which are more solid than those of most other producers, bringing more loading capacity to the vehicle.

Agricultural projects

Komatsu representatives remain convinced of the project's success as the production of coal and minerals is of growing importance within the Customs Union. The same level of importance also probably applies to agriculture, where several enormous projects are currently under implementation.

Therefore, in January of 2015, AGCO and the Russian Machines (RM) corporation created AGCO-RM, a large JV which involved the expansion of RM's 12.5ha assembly plant near Golicyno, with the addition of production lines for several types of self-propelled machinery – in particular keypad-operated Massey Ferguson 7347 and 7370 combine harvesters, as well as Massey Ferguson 7000 and 8000 series tractors.

The semi knock-down (SKD) equipment of the Challenger series is already produced in Russia, and by the end of 2015 production of Fendt and Valtra models will also begin. At the same time, one of the most important novelties of AGCO-RM is the new Challenger MT775E tractor, which was awarded Machine of the Year XXL and named King of the Field at SIMA 2015 and, in the opinion of the experts, could well become the most popular tractor in Russia within several years.

The Challenger MT775E features a 9.8-liter, seven in-line cylinder AGCO Power engine, which makes it fully adapted to Russian conditions. Compared with the earlier MT765D, the fuel consumption of the new machine has decreased by 5%, while maximum power has increased by 15% to reach 438hp. Torque has increased by 25% (up to 1,921Nm), hydraulic performance has been raised by 43% (to 321 l/min) and the fuel tank capacity increased by 53% (to 659 liters).

Rob Smith, senior vice president of AGCO Corporation and general manager for the EAME region, said this type of equipment offers local producers efficient and innovative solutions that would improve the performance of their business.

FAR LEFT: **Russian off-highway vehicles often suffer from a lack of innovations**

LEFT: **AGCO-RM has also presented Valtra N-series tractors**

BELOW: **Fuel consumption of the new Challenger MT775E has decreased by 5%, while maximum power has increased by 15% to reach 438hp, meaning it could soon become Russia's most popular tractor**

In terms of localized players, AGCO-RM's main competitors could be Claas, which is investing €120m (US$130m) in the construction of a second production unit in Krasnodar Krai by October 2015. Claas already produces several types of combine harvesters in Russia – totalling 1,000 per year – and the second plant is likely to double this figure. However, the company has not yet announced whether the new plant will produce other types of vehicles.

Also, there are rumors that the S&H-Kamaz Industries joint venture, which produces tractors in Tatarstan, may also expand the range of production in the near future.

Transportation and construction machinery

However, foreign investments in the Russian industrial vehicle industry are not purely restricted to mining and agriculture – a number of other segments are also witnessing new projects of late.

In particular, another of RM's joint ventures is RM-Terex– as the name suggests, a cooperation with Terex Corporation.

"Due to the boom in the construction of residential and industrial projects, the current demand for construction and material handling equipment in Russia is greater than ever, and the specialized equipment rental industry has become a profitable business," stated the RM-Terex press release.

Under the agreement, Terex has provided technologies, with RM bringing experienced professionals, equipment and access to the local market. The joint venture developed around the use of four RM plants, while the new production lines produce 20 types of industrial machinery for construction and material handling. The capital gains of the project are likely to amount to US$1bn.

In 2013, RM-Terex began the production of TC 100 dump trucks and TLB 825 backhoes. It has also been reported that, based on the successful development of the GS series graders, the specialists at Terex have since created the innovative TG model – a powerful grader that employs Deutz engines and automatic transmissions. These new machines are intended for export, with the planned production volume being about 1,000 units per year.

The cold war

It is noteworthy that a large proportion of machinery in these joint ventures is produced taking into account the peculiarities of the country's climate, especially if the vehicles are intended for sale not just in the European part of Russia, but also in Siberia and the Far East, where a large part of the territory is situated close to the Arctic Circle with very low average temperatures throughout the year.

TOP: **RM-Terex will supply equipment not only to the Russian market, but also for export**

ABOVE: **Kässbohrer is producing two new products in its plant in Yasnogorsk, Russia**

TOP RIGHT: **With the 75710, Belarusian OEM BelAZ claimed the title of the world's largest series production haul truck (see *iVT* Nov 2012, p6)**

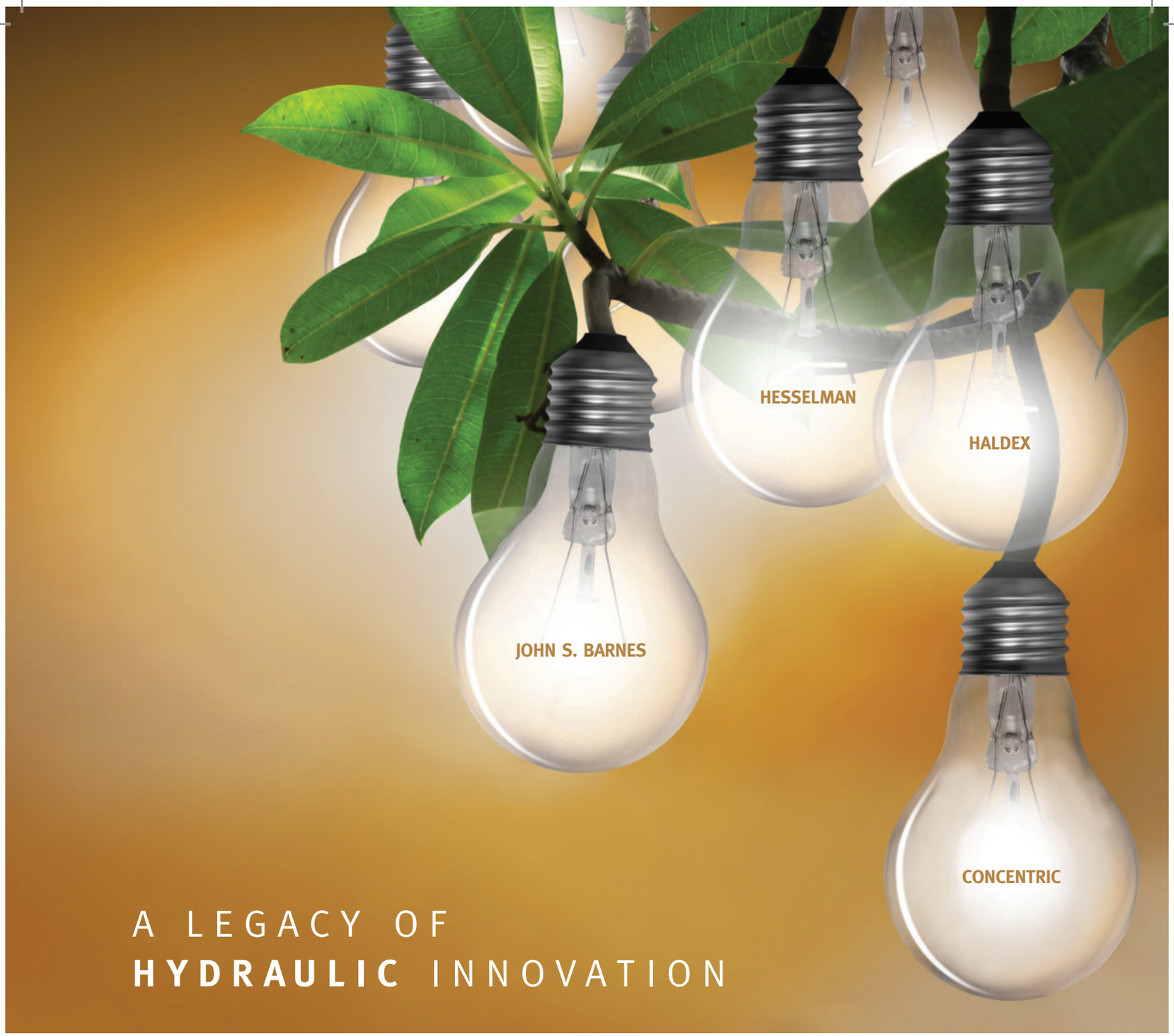
In particular, Kässbohrer's plant near Yasnogorsk produces material handling equipment with the requisite level of technology to safely operate in even the most difficult conditions. The plant now produces two new products – the SLS L3 low loader and the K SPL 3 semi-trailer platform. The SLS L3 trailer is equipped with ramps of a special design that allows it to carry high loads. A new trailer from the company has a 9-ton load capacity and boasts enhanced safety due to the latest Wabco EBS brake system.

Also worthy of note is the joint project of Meusburger and Russian Novtrak, initially launched in 2009 and intensively developed in recent years. The company imported the production technology for its TR-473 low loader sliding trailer, capable of carrying huge loads, to its Russian facilities. The total weight of the rig is 18 tons, while a loading width of 3.17m permits the transportation of military tanks and other heavy equipment.

It also seems that the Russian construction machinery industry is of interest for John Deere which, in March 2015, expressed the intent to implement a project for the construction of domestic facilities for the production of roadbuilding equipment such as motor graders, scrapers, 315SK backhoe loaders, and 318D and 326E skid-steer loaders, in Moscow Oblast, in a US$2m cooperation with the local company JSC Professional. However, it is still not reported exactly what machine technologies will be produced at the new unit.

In all, there are several dozen projects on the go with almost the exact same strategy – the foreign companies bring their technology and experience, while their Russian partners provide access to the market and part of the required investments. Most experts believe that this trend is unlikely to change anytime soon.

However, in the near future, the growing activity in the country's market is likely to attract more Asian companies – in particular, a number of Chinese players have already expressed some interest in opening production capacities in the country. **iVT**



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Poles apart

DRESSTA MAY HAVE EVOLVED FROM AN EASTERN BLOC MANUFACTURER OF MILITARY EQUIPMENT, BUT TEDDY WU, PRESIDENT OF THE POLISH OEM, IS KEEN TO POINT OUT THAT ANY PRECONCEPTIONS OF BRUTAL, UGLY EQUIPMENT LACKING IN FINESSE ARE LARGELY UNFOUNDED

EASTERN EUROPE

For those of us just about old enough to remember the end of the Cold War, there's something particularly appropriate about the type of equipment Dressta produces. As befits the portrayal of life behind the Iron Curtain fed to us by the western mainstream media, this Polish OEM has long built real men's machines – primarily huge, utilitarian bulldozers and wheeled loaders that are never happier than when hard at work in the harsh conditions of a dusty mine or the blazing heat of a foundry.

These are not machines for the faint-hearted – if you're looking for a stylish, plastic-fendered compact machine to act as a tool carrier at your garden center, look away now. Or if you want the refinement of CVT, or enhanced fuel efficiency of a hybrid, for example, then you're best off going elsewhere.

Or are you?

MAIN IMAGE: **A picture that screams 'Dressta' – machines don't get much more hardworking than this**

ABOVE: **Teddy Wu draws on a variety of experience, including human resources and hydraulic manufacturing, in his role as Dressta president**

International recognition

Originally known as Huta Stalowa Wola (HSW) due to its location 250km southeast of Warsaw, the company was set up in 1937 to focus on military production. A series of licensing agreements

eventually followed, but the first great leap forward came with the cooperation with International Harvester in 1972, which gave HSW the ability to produce IH-branded crawler dozers, crawler loaders and pipelayers for sale in Central Europe and the Soviet Union. Further cooperations – with Dresser (giving access to its wheeled loader designs) and Komatsu – came in the 1980s, with the joint-venture company Dressta being formed in 1995. Ten years later, HSW became sole owner of Dressta and then, in 2012, that business was acquired by Guangxi LiuGong Machinery.

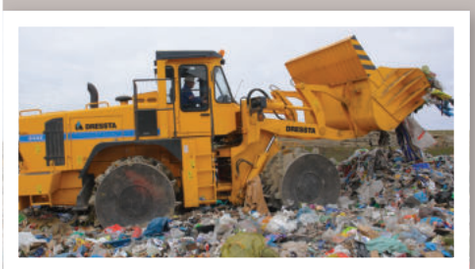
Since then, we've seen the Chinese OEM's involvement in Dressta grow considerably, not least with former LiuGong HR director – and, before that, deputy director of its hydraulic manufacturing division – Wu Yindeng (Teddy) becoming president in 2013.

ABOVE: **At over 41 metric tons and 330hp, the TD-25M is only the second-largest dozer produced by Dressta – but still holds its own against this bucket-wheel excavator**

Now he's based in Poland, backed up by all the clout and ambition that only LiuGong can provide. So my first question to him was: what sort of changes has the Chinese parent brought to the Dressta dependent?

"As with any M&A, changes have impacted all areas of the business, but one notable area is in R&D where

THIS IS WHAT DRESSTA MEANS BY 'COMPACT'...



While 13 dozers (plus three forthcoming hydrostatic models) and four standard wheeled models constitute the bulk of Dressta's current line-up, that's not its full extent. There are also four pipelayers, plus three dozer derivations for landfill and one for conveyor belt shifting.

But rather more incongruously, there is also a backhoe loader, the 95hp 9.50M.

"Backhoes are an important product in our home market," Teddy explains. "HSW entered this market more than 10 years ago to satisfy local market requirements, and meet military product needs. It has been successful in the Polish market as well as in the CIS region – but it is not a priority product line for us at this time."

The OEM also recently marketed a pair of motor graders, sourced from a company close to the Dressta facility, until market requirement changes and a lack of updates on the graders halted that arrangement.

But back on more familiar territory is the final part of the puzzle, the 534LA landfill compactor. Superficially this may appear to be a 534E wheeled loader with a 2-speed gearbox fitted and its wheels switched for a set of drums, but there is a lot more to it than that: "In the past, there have been several instances where a manufacturer has tried to convert a wheeled loader into a landfill compactor – with disastrous results!

"So there is a lot of commonality, but the differences are big and important. The engine [a 227hp Cummins QSC8.3] remains the same, but the transmission, axles and wheels are different. The base weight of the 534LA is about 4 tons more than the 534E, so various components and structures have been beefed up to accommodate the weight.

"Various options are required to make it suitable for landfill applications, such as better air filtration, better sealing against airborne trash, extra cylinder guarding, remote lubrication, various counterweight options and much more!

"There is a market for other sizes of landfill compactors, but it is fragmented because of the huge legislative differences around the world. We do have interest in producing other sizes of machines, but there are a lot of projects that are ahead of this in our short- to medium-term plans."

Sadly, those do not include wheeled dozers, about which Teddy describes his interest as "purely academic".

Dressta has benefited from processes such as LDP [LiuGong Development Process] to improve efficiency," he responds. "In the new R&D center in Liuzhou, we have state-of-the-art test labs and a world-class industrial design studio. Our engineers will continue to be sent on assignment to work with the engineers there to build out the dozer platform."

One thing that's become clear this year is that Dressta is vigorously pushing its Special Features Requests (SFRs) concept, a customer-centric approach to manufacturing that encourages potential clients to outline their needs early on, and have the necessary customization built in at the manufacturing stage. Around 30% of its wheeled loaders and 20% of dozers are now supplied this way, featuring, for example, fire suppression systems on hot slag dozers and wheeled loaders, a mild detergent spray system to disperse flies in landfill sites, and even a compaction system mounted to a dozer to eliminate air pockets in coal stockpiles and reduce the risk of spontaneous combustion.

"We've certainly benefited from LiuGong's input in this area, but providing specialized equipment with modifications has always been part of Dressta's chemistry in its traditional markets," Teddy clarifies. "Now we are leveraging SFRs across our other markets, such as forestry and landfill. Our purchasing, production and design are all developed to support the process, and models with heavy modifications and attachments still enjoy a full warranty. This philosophy will remain the cornerstone of the Dressta business."

The LDP mentioned earlier plays a part here, with a crucial feature of the production process being the enhanced attention paid to each serial number as it enters the production planning phase, which continues right until the machine leaves the factory.

"Proper organization and planning is required to be able to build many different configurations, especially when there are only a few of each special configuration being built at a time," he emphasizes. "So there is a learning curve on every customized machine we build. Obviously, we cannot 'practice' on some of those

"PROVIDING SPECIALIZED EQUIPMENT WITH MODIFICATIONS HAS ALWAYS BEEN PART OF OUR CHEMISTRY IN OUR TRADITIONAL MARKETS. THIS PHILOSOPHY WILL REMAIN THE CORNERSTONE OF THE DRESSTA BUSINESS"

BLADE EXPECTATIONS

With much of Dressta's success riding on dozers, Teddy is no doubt relieved that the global market for that product is traditionally relatively stable. "There are changes in individual markets driven by local economic conditions and local infrastructure investment, but by and large the market size will not change much," he predicts. "Growth in large dozers is typically driven by commodity pricing and mining demand.

"One way to understand future changes is to look at specific market requirements. North America is a very large market with some unique elements. First, it has a demand for all sizes of dozers, due to the wide variety of applications. Second, it is the major market for 70-120hp models as its jobsites are typically bigger than in Europe, so finishing work around commercial and residential jobsites is typically done with dozers. So those finishing dozers must have precise controls, and must be very nimble.

"Contrast this with China, the only other market of similar size and scale, where the jobs are typically large-scale clearing and leveling. Only a few sizes of dozer are required, and the precision requirement is not so high.

"So we can expect hydrostatic machines to become more prevalent in advanced markets, and the hp level using those drive systems will increase. Electric-over-hydraulic controls are becoming more sophisticated and will be increasingly adopted. 3D grade control systems will advance and their application be much more widespread. Intelligent machine control, taking some of the high skill requirements away from the operator and putting them under computer control, is a big opportunity. Fleet management via wireless communications will grow, and we will see more autonomous operation in the mining sector.

"Developing markets will see big changes as well. The applications will not change so much, but customer requirements are advancing quickly. China is set to go to Tier 3 engines within a year; Tier 4 will follow in the not too distant future. Finding skilled operators there is becoming more difficult, driving customers to demand more operator comfort features, as well as tools to enable less-skilled operators to be more productive."

And while pipelayers may appear to be little more than a dozer with a boom on one side, the market could hardly be more different. "It is very cyclical – it is small, and completely driven by projects," explains Teddy. "We do not anticipate great changes in the overall size of the market, but do expect periodic surges and troughs. There are not many competitors so it is quite profitable, and its synergies with the dozer product line make it a good fit in our business.

"One important operational feature is the ability to travel in a 'perfectly' straight line for long distances. It also must be a simple machine that can be serviced and maintained in remote regions. Hydrostatic pipelayers are difficult to maintain and repair outside of a clean workshop, however, and 'go straight' technology is only achievable using computer and GPS technologies – which aren't conducive to reliability in the remote areas where pipelayers are typically used. So we'll stick with our current pipelayer technology."

machines – everything must be right first time. Our innovative practices revolve around communications, training and ensuring every team member – from planning, purchasing, engineering, manufacturing, quality and sales to aftersales – completely understands the steps required for every single configuration that comes down the assembly line."

Such attention to detail does not come cheap – though it is inevitably a little cheaper than most Western OEMs will manage. So, price and SFRs aside, what else attracts customers to Dressta machines?

"They look to us for durable products that deliver maximum productivity in demanding and arduous applications," he states. "Our products are derived from the old International Harvester line of construction equipment. This is more than just a bit of interesting history; certain elements of machine design optimization – such as weight and balance, structural endurance and power-to-weight ratio – can only be gained through long experience. All the experience developed over the years has been carried into our modern dozers and wheeled loaders. We have several special versions of machines such as hot slag handlers, landfill dozers and conveyor belt shifters that we can provide as part of our normal production scheduling. Our attention to detail, and individual attention to every serial number we build, sets us apart."

That attention to detail will likely become increasingly important as LiuGong ramps up plans to use Stalowa Wola as a base for European manufacturing, providing greater economies of scale and enhanced support for its customers. Currently, the 856H wheeled loader is its only model built there, but more Tier 4 Final wheeled loaders and crawler excavators will soon enter production before being sold throughout Europe and the Middle East.

Transfer case

Technology transfer is another area in which the Polish organization is benefiting. Teddy says "superficial" transfers have already taken place, e.g., improved wheel technology from China in the Dressta wheeled loaders, and the standardizing of small electrical components.

"In future there will be a great deal of technology transfer," he reveals. "The core technologies are very different, so it is very difficult to extract parts of one brand's technology and plant it into the other brand without going deeply into the machine architecture to make changes. So meaningful technology transfer can only be done efficiently during the course of major design projects – we have such projects underway currently, and our next generation of crawler dozers will feature significant shared or exchanged technologies.

"But each brand will carry its own specific styling cues – the aim is for a LiuGong machine to be recognizable as a LiuGong, and a Dressta machine to clearly be a Dressta."

The arrangement hasn't been all 'receive' on Dressta's part, however. LiuGong has gained access to Polish large crawler dozer technology – in particular, drivetrain components and final drive systems – which will be utilized in its next-generation dozer range. But what is noticeable about those machines – and the wheeled loaders for which LiuGong is more noted – is that there is very little overlap between the two brands in terms of capacity, avoiding many of the complications a dual-brand approach can often create. I did, however, feel duty-bound to ask if there were any plans to review that; at the very least, branding machines sold in Europe as Dressta, and Asian models as LiuGong, for example?

"No, there isn't," Teddy confirms. "We're very happy with this approach because both brands are unique and distinctive, each offering customers the specific products they need in their categories.

"The LiuGong brand is well established and we are happy with its progression in the global market place. Likewise, the Dressta brand has application worldwide, especially in applications where extreme heavy-duty machines are required. And we are currently working on plans to introduce the brand to the Chinese

THE FIRST OF THE FEW?

The first of Dressta's three new hydrostatic dozers, the 93hp TD9 is equipped with a Cummins Tier 4F engine, with other key driveline components supplied by Rexroth. The variable bidirectional dual-path hydrostatic drive is controlled by a programmable ECM, providing the perfect match between load and ground speed, regardless of the ground condition or specific dozing application.

Operators can also adjust the presets to meet the requirements of the task at hand, e.g. by programming variables such as forward-to-reverse speed ratio, or by enabling Power, Normal and Economy modes. Independent track control delivers the required speed changes to each side and enables smooth, full-power turns. Maneuverability is further enhanced with the stable counter-rotation feature.

A newly designed ISO-mounted operator cab with positive pressure is protected by a robust external ROPS for optimal safety, while the new HVAC system features multiple vents to provide large volumes of fresh air quietly and efficiently. Ensuring the crawler dozer performs as a mechanical extension of the operator's skill was an essential consideration in the design – the hydraulic controls have therefore been tuned to perform seamlessly and enable long hours of fatigue-free usage.

OPPOSITE PAGE, TOP: **A coal compaction system is one intriguing Special Features Request for dozers**

market, where there is potential in the landfill sector, and the oil and gas sector with our pipelayers. We also see potential in the small crawler specialty market of ship trimming, with our new hydrostatic models."

Changes afoot

Yes, as I alluded to earlier, things are changing at Dressta (but apologies if you've read this far expecting an announcement on compact loaders or CVT/hybrids – there's nothing likely on this front yet). Breaking with (its) tradition, the company is to produce three hydrostatic dozers covering the lower end of its range currently occupied by the 74hp TD-7R up to the 101hp TD-10R, with the first of them – the TD9 – being launched in Q3 this year (see *The first of the few?*, p29).

"Hydrostatic drive is dominating the small crawler markets around the world – even developing markets are moving toward those transmissions," says Teddy, explaining the rationale behind the move. "They will be used in other-sized machines, without a doubt. [His views on the trends in the global dozer market appear in the sidebar on page 28.]

"Years ago, during the Dressta/Komatsu JV, there was development work on hydrostatic transmissions in Stalowa Wola, but it was stopped before production. Hydrostatic drive is now a mature technology, and the hardware is essentially off-the-shelf. The real magic of a hydrostatic system lies in the control of the machine it offers, and the secret is the successful integration of the components. That's all down to the software, so the controller is the critical element. But our field staff and engineers have so much experience and knowledge of dozer operation and the desired control characteristics, that it has been relatively easy for us to work with the software programmers to optimize the system integration and the controllability on the TD9."

Given this new direction, I ask Teddy if there are any other areas of technology Dressta will be looking to improve upon in the near future.

"We're pretty happy with the basic performance features of our products," he states. "They're efficient, reliable, productive and extremely durable; they're well suited to the market conditions around the world, and we have a pretty complete line-up.

"But we have lagged behind in manufacturing technology. Our basic designs are old, and manufacturing capabilities have changed a lot since those products were designed. So we will be updating to take advantage of sophisticated machining centers, advanced weld robots, better casting technologies for enhanced weight optimization, and improved forging capabilities. So we expect to have greatly improved manufacturing efficiency and, at the very least, maintain the same productivity, reliability and durability advantages we enjoy today.

"We also expect to move more into hydrostatic technology. We are also looking at larger drivelines, and updates to transmission technology for machines that will not convert to hydrostatic drive.

"Finally, we talked earlier about the development of a Dressta-specific styling, and hand-in-hand with that is an opportunity to update our cabs and operator comfort features."

But don't be fooled into thinking Dressta is going soft – that hard man image is here to stay, creature comforts notwithstanding. It's arguably more necessary in those extreme-duty machines anyway – and vital if its plans to regain market share in the West – North America in particular – are to be successful.

"North America was a historic stronghold for us that was nearly lost after the wind-up of the Komatsu JV," Teddy concludes. "As our distribution was weakening there, the market was also changing to hydrostatic drive for the smaller machines. We still have a presence there, but in the larger machines, tied to mining and coal yards. So when we launch the TD9 hydrostatic machine, we will begin aggressively rebuilding the North American market.

"In Western Europe, the crawler dozer market is relatively small, but we are developing it, and have had quite a bit of success in the UK lately. Several of our Tier 4 development projects are now in the preproduction verification phase – and as we launch them we will focus on increasing the European distribution again." **iVT**

MAIN IMAGE: **Yet another intriguing Dressta SFR – this TD-20M with a blade plow is being used for land reclamation by cattle farmers in Queensland, Australia**

INSET: **In its HSW guise, Dressta has long concentrated on dozers and wheeled loaders**

BELOW: **The SB-85PT conveyor belt shifter combines high stability with low ground pressure**

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MAIN IMAGE: **Zetor's new top-end versions of its established Forterra tractors bring more power and more technology to the range**

INSET: **The distinctive front-end styling has been retained, with clear road and worklight lenses**

CZECH OEM ZETOR MADE ITS NAME PRODUCING SIMPLE, STRAIGHTFORWARD TRACTORS. BUT AS IT CONTINUES TO CLIMB THE HORSEPOWER SCALE, IT HAS ADDED A TOUCH OF SOPHISTICATION TO THE MOST RECENT VERSION OF ITS FLAGSHIP FORTERRA RANGE

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EASTERN EUROPE

CASE STUDY

in HD

For the average arable farmer who often has to spend long seasonal hours in the operator's seat while cultivating for the next crop, putting it in the ground, spreading fertilizer and spraying, the latest tractor technology has gone a long way toward making such tasks easier, less tiring and more productive. Automatic powershifts and CVT transmissions, data monitoring and recording systems and automation of operations have all played their part in this progress.

The livestock farmer, however, makes very different demands of a tractor. The nature of the work, often comprising short bursts of intensive activity with the operator hopping in and out of the machine at regular intervals, means there's little that such tech can bring to simple yet crucial everyday tasks such as operating a front-end loader, pulling a feeder or hauling a trailer. Simplicity and ease of use are key.

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In short, cost, complexity and concerns over reliability all mean that there remains plenty of farmer demand for simple, straightforward tractors – albeit coupled with a growing demand for more power as modern implements become more capable, yet more demanding. This is a sector that Czech OEM Zetor has almost made its own, and the recipe for the latest HD version of its range-topping Forterra – still simple, but with a bit more power and a few new features to ease the operator's lot – suggest it's not straying far off course.

With the 121-160hp tractor power segment in many European countries reckoned to be bigger in sales volume terms than either the 61-100hp or 101-120hp brackets, marking the continuing climb of average tractor size sold, it's here where Zetor is placing its focus.

Style with substance

Now in their third incarnation since their 1998 launch, the Forterra tractors introduced sleek new style from a manufacturer previously more associated with functionality than with form. While the first generation featured a sheet steel hood, the revised range unveiled in 2001 brought with it curvaceous polyethylene panels and a headlight and radiator grille arrangement that gave the tractors a gap-toothed grin, which remains in today's third generation, launched in 2009.

But underneath the cladding and inside the cab, the technology remained relatively simple.

That began to change with the 2012 addition of higher-spec HSX variants to that third generation. The key upgrade, in place of the standard Forterra 4-speed gearbox with high/low range, manual 3-speed splitter and mechanical shuttle, was a new 5-speed transmission with the same high/low range, but this time being coupled to an automatic 3-speed powershift, hydraulic shuttle and wet twin-disc clutch.

The most recent introduction of a third variant, the top-spec Forterra HD version, sticks with that same transmission arrangement, but in other areas Zetor has made major steps to enhance and extend the tractor's specification, which has also enabled it to enter new power territory as a result.

"The HD doesn't merely rank as the bigger brother to the existing Zetor Forterra HSX model, but is a completely independent model in our offering," maintains David Kollhammer, Zetor Tractors' project management manager. "With its inclusion, we have also been able to expand our line-up in terms of performance, with the Forterra HD's design meaning we can now offer a machine in the 150hp category for the first time."

ABOVE: **Rear lift capacity from the upgraded Category 3 rear linkage is 8,500kg, an advance of 1,500kg on the figure for Forterra HSX models**

Do it yourself

While it recently announced a deal with Deutz to source three-cylinder engines for its smaller tractors (an arrangement likely to extend to six-cylinder powerplants when longer-term plans to enter the higher-hp market come to fruition), for four-pot power, Zetor continues to prefer to develop and build its own units. In fact, the OEM reckons to have manufactured the largest number of compression ignition engines in the Czech Republic, in a history dating back to the 1920s.

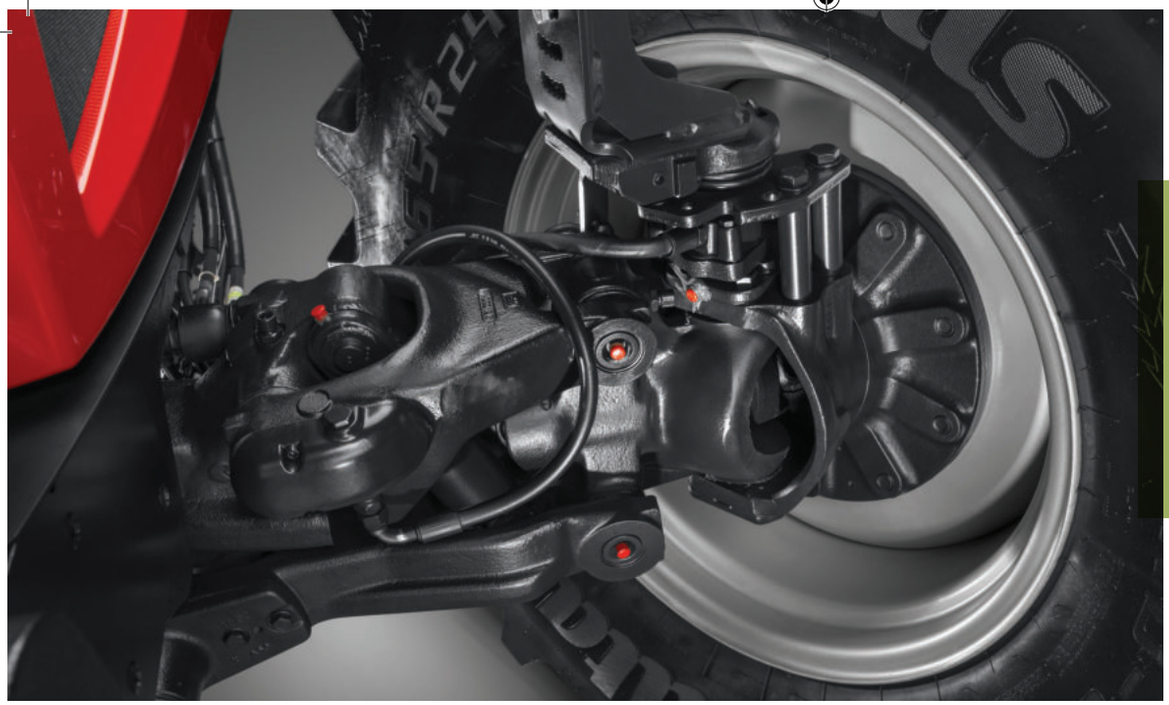
The top two models in the existing Forterra line, the 127hp 130 and 136hp 140, can now be bought in standard, HSX or new HD specification, but the enhancements have allowed even more power to be extracted from the four-cylinder turbocharged engine that powers all Forterras, and there is now a new 147hp 150 range topper, which comes in HD spec only.

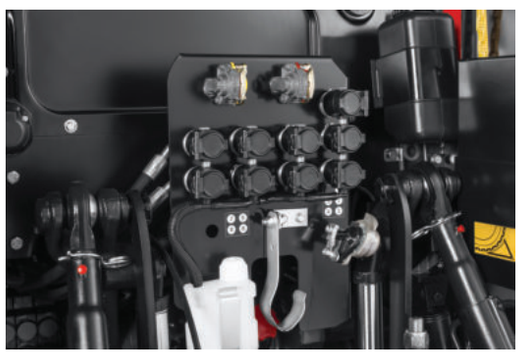
KEEPING IT IN CZECH

Since being purchased in 2002 by Slovakia's HTC Holding, Zetor has renewed or updated virtually all of its product range, while pushing upwards into new power territory and introducing multiple new features to its tractors.

The OEM began producing tractors in 1946, since when it has produced over 1.2 million units and exported to more than 90 countries. Production of both tractors and engines takes place in Brno, the Czech Republic's second largest city, where the OEM combines components manufactured in-house with parts sourced from outside suppliers.

The engineering department is Zetor's long-standing permanent research, development and testing facility, comprising a team of development engineers engaged in high-level specialist research, drawing on a wide knowledge base and professional skills, supported by state-of-the-art technologies. The department provides comprehensive, systematic research and development of the production program – from concept, design, construction and the production of functional samples and prototypes, right up to testing tractors and motors in the laboratory and in the field. Recent investment has seen the building of a new R&D center, and reconstruction of existing production halls. Since 2010, Zetor reckons to have more than doubled its annual R&D spend.





TOP: **The new hydraulically damped front axle is from Carraro, and an option in place of the mechanically sprung unit**

ABOVE LEFT: **The lack of a power boost feature doesn't seem to hamper transport operations**

ABOVE RIGHT: **Up to four double-acting spool valves, now fully electronically controlled via a Bosch-sourced system, provide external hydraulic power**

To produce this extra power, the engine, with its 105mm bore and 120mm stroke resulting in a total displacement of 4.1 liters, has also undergone significant modernization. Chief among the enhancements is a modified cylinder head which now features four valves per cylinder across the range. Rated speed is 2,200rpm, while the Forterra 150 produces a maximum 589Nm of torque and has a torque rise of 30%, with comparable figures of 581Nm and 38% for the Forterra 140 HD understudy.

"The focus of our engines has always been on low fuel consumption, high reliability and simple design," claims Kollhammer. "These traits mean not only a low pricing, but also low operating costs and better machine reliability. The 16-valve engines produced one of the best performances recorded in testing by the DLG, the German agricultural society. And by developing and manufacturing our own engines, we can guarantee precise workmanship using quality materials."

Staying with its simplicity theme, the engine relies on a mechanical rotary fuel-injection pump. Each cylinder has its own glow plug, for full pre-heating to ensure reliable starting at low temperatures, while an optional coolant heater reduces warm-up time, thereby helping to save fuel. Pressurized oil-cooled piston crowns are claimed to increase combustion efficiency and prolong engine life, while a pair of balance shafts also help with the latter, by reducing vibrations and making the engine run more smoothly.

However, there is no power boost – i.e. extra power available only for transport or PTO applications – so full power is available regardless of forward speed or whether or not the PTO is engaged. Neither is there (currently) any need to worry about filling a diesel exhaust fluid (DEF) tank – the engine meets Stage IIIB emissions legislation through the use of EGR and a DPF. During 2015, though, with a step up to Stage IV necessary, the engine will gain a DEF/AdBlue system.

Heavy-duty addition

Wheelbase of the HD models has been increased over that of HSX tractors by 130mm, to 2,720mm. Coupled with the new heavy-duty rear axle, the result is improved efficiency of power transfer to the ground, according to Zetor. These modifications could certainly make the tractor suited to the fitment of a six-cylinder engine in future.

Delivering that power to the ground is the same two-range, 5-speed, 3-split transmission that was introduced in 2012 with the Forterra HSX. Offering a total of 30 speeds in both forward and reverse, it incorporates a pair of wet disc clutches for smooth engagement. In the all-important 6-12km/h field working range, there's a total of nine speeds available.

Up front, meanwhile, there is now an optional hydraulically damped front axle, a first for Zetor. A Carraro-sourced unit, the axle is an option in place of the mechanically sprung unit already available, but in key western markets this is likely to be standard fitment on many HDs. There are three switchable settings – low (limited travel), high (full travel) and automatic.

Strongest link

At the rear, lift capacity from the upgraded Category 3 rear linkage is 8,500kg, an advance of 1,500kg on the figure for Forterra HSX models, while a 3,500kg-capacity front linkage is a further option.

Operation of the rear linkage is via the Bosch-sourced HitchTronic electronic control system, which Zetor was the first tractor maker to adopt. Once working depth for a task has been set, it continuously measures soil resistance and provides automatic draft control. The system is activated by turning the potentiometer (power/position control) to its red region and using it to set the working depth.

Once set, the soil resistance is measured and used as the initial value for the automatic control of the rear linkage. Whenever the setting or conditions change, the soil resistance is measured again and the data fed back to the controller.

New load-sensing hydraulics are claimed to have improved starting response, while hydraulic outputs have been boosted on HD models, with up to 85 l/min provided by a

gear pump, or 120 l/min from an axial pump option.

Providing external hydraulic power are up to four double-acting spool valves, which are now fully electronically controlled via a Bosch-sourced system operated through electrohydraulic toggle switches, plus a joystick that can be used to operate two of the four if required. These, along with flow/timing and the rear linkage controls, represent a considerable electronic upgrade for the OEM.

"The robustness and reliability of linkage and hydraulic outlet operation via electronic controls is now well-proven," states Maros Karabinos, of Zetor UK."That's why we are now choosing to include them as standard specification on our largest tractors. But other Zetors will retain mechanical systems.

"The Forterra HD also features, for the first time on a Zetor, a simple headland management system, that automates a number of processes as the operator approaches the end of a bout of work in the field. For example, lifting the rear linkage, which is now done via a switch rather than a lever, can be recorded as the trigger point to disengage the PTO, turn off the four-wheel drive and differential lock, allow the driver to make the turn, and reverse the process as the linkage is lowered for the next bout."

ABOVE & BELOW: **There's no fancy right-hand armrest here, but then simplicity is a Zetor hallmark**

BELOW RIGHT: **Wheelbase of the HD models has been increased by 130mm to 2,720mm, and there's a new heavy-duty rear axle too**

Right move

While much of the cab stays the same as on established Forterras, the key change is to the operator's right, where there is now a complete new operating console, angled to allow unimpeded access through the right-hand door as required. What Zetor refers to as a 'multifunctional panel' provides easy operator access – without lifting an arm from the seat armrest – to spool valve switches, a small joystick for controlling two spools, time and flow controls for the spool valves, and a number of switches for various functions.

A considerable upgrade is the move of the hand throttle to this console, away from its long-held spot protruding from the dash on former Forterra tractors. It remains mechanical in design, but is now operated by a slider.

Control of the rear PTO has been made smoother through the use of a new clutch, which now provides feedback-controlled starting that feathers-in drive to the shaft over a three-second period to reduce the shock loads on both tractor and implement. Independent PTO speeds comprise the usual 540- and 1,000rpm, plus economy versions of both for less power-hungry, but still speed-crucial, machines. A wet-plate oil bath design is used to increase service life.

Areas such as these have helped the OEM reduce in-cab vibration and noise – it says it has cut levels of the latter to 76dB(A). Additionally, new flooring has helped to muffle transmission of noise and vibration from the drivetrain below, while the mechanically sprung cab suspension improves operator ride and lowers vibration levels. It all adds up to a package of small innovations that takes Zetor ever closer to the tractor big league, without losing sight of its 'keep it simple' mantra. **iVT**

TECH SPEC

ZETOR FORTERRA HD 130/140/150 TRACTORS	
Engine	93.2kW, 100.2kW, 108.2kW
Transmission	Five-speed synchromesh automatic three-step powershift
Powershuttle	Can be used under load at 10km/h
No. of speeds	30/30 (F/R)
Max. speed	40km/h
Rear PTO RPM	540/540E/1,000/1,000E, optional 540/1,000 + dependent
Front PTO	1,000rpm, max. output up to 90kW
Hydraulics	Bosch electrohydraulics with HitchTronic, two auxiliary cylinders
Hitch	Three-point, Category 3
Control	Electronic
Max. lift force	85kN
Operating pressure	20 + 0.2MPa
Pump capacity	85 liter (gear) /120 liter (axial)
Operating weight	4,800-5,500kg
Max. front ballast	900kg
Max. rear ballast	472kg
Max. length	5,766mm

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DAPPER BY NAME...

...AND DAPPER BY NATURE! IF THE THOUGHT OF EASTERN EUROPEAN ENGINEERING EVOKES IMAGES OF RATTLING PLASTIC FENDERS, THINK AGAIN. THIS MULTIPURPOSE LOADER FROM A CZECH STATE-OWNED OEM IS SET TO GIVE ITS WESTERN COMPETITORS A RUN FOR THEIR MONEY

Forklift Driver Klaus is now a cultural phenomenon. Fifteen years ago, this fictional character made his debut in a German instructional video with a quirky combination of gore, macabre humor and genuine advice on how not to have your hands chopped off. The short film has since gone viral, with more than two million online hits, and has spawned many imitations across the world. In one of them, a chirpy but nameless operator can't wait to go to work in the morning to impress his mates with his brand-new multipurpose loader. But what the video lacks in gory humor, it makes up for in curiosity value – an Eastern European state-built piece of machinery looking that slick?!

Based in the Czech Republic, the state-owned VOP CZ boasts a long tradition of mechanical engineering, mostly for the military. Two key projects for the Czech Army – the modernizing of the T-72 Cz tank and the Pandur II Cz transporter – were overseen by the company's engineers. In the 1990s, the firm extended its portfolio to include non-military machinery. Now, two decades later, it has expanded to 1,600 employees and manufactures €500m worth of machinery for a broad range of sectors including agriculture and construction. Its partners include the Czech Ministry of Defence, the Ministry of Industry and Trade, and NATO. VOP also has its own development center at its headquarters in Šenov at Nový Jičín, about 100 miles east of Prague.

Built on experience

Jan Šafařík is an engineer and head of the marketing department at VOP. His assessment of the company's multipurpose loader is factual but confident. "The Dapper 5000 is designed for gardening, for small and bigger farms, for agriculture,

EASTERN EUROPE

OPPOSITE PAGE: **Articulated steering gives the Dapper 5000 a tight internal turning radius of just 925mm**

LEFT: **The telescopic boom, quick coupler and compatibility with a huge range of attachments makes it a truly multipurpose machine**

municipal work such as cleaning roads, plowing snow in winter, cutting grass in parks, construction work, and the maintenance of industrial complexes," he explains.

The Dapper loader was delivered by a 60-strong project team which makes use of the group's long years of producing components for OEMs such as Linde, Caterpillar and Wacker Neuson. But even though VOP has supplied parts for this sector for decades, the Dapper 5000 is the first complete vehicle the company has designed.

Officially described as a 'multifunctional loader and carrier of material or tools', the machine is equipped with a telescopic lifting arm and universal quick-release coupling. This enables the operator to connect an extensive range of attachments such as a multipurpose bucket, palette fork and backhoe, all of which are manufactured in-house.

Other tools (supplied by external suppliers) are also available, including a road sweeper, lawn mower, earth auger, snow sweeper, stump cutter, winter salt spreader, snow blower, snowplow, single-axle trailer and a silage fork with grab.

All devices are driven by the onboard hydraulics that deliver 70 liters per minute at 200 bar – the Danfoss system in operation is complemented by DIN standard components throughout.

The vehicle's use of hydraulics isn't just restricted to the tools, of course. Its Kubota V1505 diesel engine also powers the hydrostatic all-wheel drive through Poclain hub motors. With an output of 36hp, it won't break the land speed record just yet, but does propel the Dapper to a steady 17km/h.

More impressive is the loader's maximum lifting capacity of 1,250kg. As the compact vehicle weighs only 1,640kg itself, plenty of rear ballast was needed to minimize the risk of tipover – especially when it is making use of the maximum lifting height of 2.73m.

The Dapper's brawn, however, comes as a stark contrast to its petite dimensions. For instance, its 1,260mm width and tight 1,200mm wheelbase would hardly be out of place on a lawn mower; and on 26x12.00-12in tires, it produces a respectable inner turn radius of 925mm thanks to its articulated steering.

The latter is a key advantage, according to Šafařík. "It makes the vehicle easier to control in rough terrain, in comparison with skid-steering. The loader has a higher speed and causes less damage to tires and the surfaces being driven on, such as pavements or grass.

"Reduced fuel consumption also makes it much more economical and environmentally friendly," he adds.

The engineer is pleased with the way the loader has now broken into the western European and other international markets, leaving all the stereotypes of Eastern Bloc mass production behind. He believes the machine strikes the ideal balance between versatility, quality and price, which should suit both Western and Eastern markets.

"Clients in Eastern Europe demand the lowest price, while clients around the world demand good quality at a fair price. So we're striving for the best compromise," he elaborates.

Accordingly, the machine boasts a good range of optional extras. It can be delivered with either an open or closed cab, both tested according to Steel Products for Rollover Protective Structures (ROPS) and Falling Object Protective Structures (FOPS) standards.

On request, VOP furnishes its little flagship with a rear hydraulics connector, LED lighting, and a hinged windscreen.

Where possible, the company's designers have chosen metal, rather than plastic, fairings, providing the loader with a solid appearance and feel. "Compared with plastic, the steel sheet laminate casing is more robust and withstands the elements better. It doesn't crack or break easily and can be repaired quickly if it suffers mechanical damage," Šafařík explains.

BELOW: **The ergonomic joystick provides smooth and comfortable control of attachments from within a comfortable, safe operator's cab**

Cutting-edge technology

Shedding any preconceptions of Cold War methods, the Dapper 5000 is the result of state-of-the-art design. "Virtually the entire project was created in a 3D CAD application with Siemens Solid Edge software," says Pavel Mikunda, director of research and development.

"Initially, 3D models of individual parts were formed, and the subsequent composite assemblies were also tested using the machine kinematics, verifying that there were no collisions of parts, such as during the turning of the machine or when operating the telescopic arm, for example."

VOP's engineers used Solid Edge for design, Teamcenter software for product data management and NX for computer-aided engineering, all from Siemens PLM.

"Modern design tools are a necessity today as they allow us to speed up work," explains Mikunda. "We can use the time saved by our engineers for further development of new machinery and equipment, or to educate them, which is

necessary in the development of new products.

"The largest increase in efficiency came with the transition to Solid Edge with synchronous technology, in which new features and a more user-friendly environment helped our engineers to work faster," he continues.

CAD systems were first used at the company in 1995 to modernize the T-72 M and T-72 M4 Cz tanks.

ABOVE: **VOP says the design of the Dapper 5000 'was conceived so that the modern appearance emphasizes its dynamic properties and power. The shape also gives the impression of an elegant and useful helper'**

Solid Edge also played a part in the modernization of the Czech Army's wheeled Pandur II APC.

"Our calculation specialists are now familiar with the software in detail," Mikunda adds. "For simpler calculations during the design of fixtures, metal parts and small assemblies, our designers have a simulation module available directly via Solid Edge. We acquired NX CAE for complex calculations, such as stressing the arms of the Dapper. A big plus is the integration of all these tools with Teamcenter," he adds.

Choosing NX CAE, says the R&D director, achieved closer integration of the entire process, as it was also necessary for the new application (which uses finite element analysis for strength assessments) to be fully synched with Teamcenter.

"We're aiming to use Teamcenter throughout the entire company so that personnel in other departments have access to the results of the FEA analyses according to assigned rights," he states.

"We want to be able to read the data from Solid Edge natively rather than by importing it through the conversion files for CAD geometry. From experience, we know that such transferred geometry is not always accurate after importing," he adds.

All files created by the company's designers are also eventually used by the logistics support department to create accompanying technical documentation.

In just a couple of months, VOP CZ is expecting an addition to the Dapper family – the 3000. The 5000's little brother will feature a Kubota V1005 engine with 25hp and a maximum lifting capacity of 750kg. In terms of lifting height it is even predicted to outshine its bigger sibling, with a claimed 2.74m.

In the long run, the company is planning for a third model, above the 5000's spec, with an estimated 40hp+ engine. "In future, we want to develop and offer a full range of this vehicle, from small to large machines," Šafařík concludes. **iVT**

DESIGN

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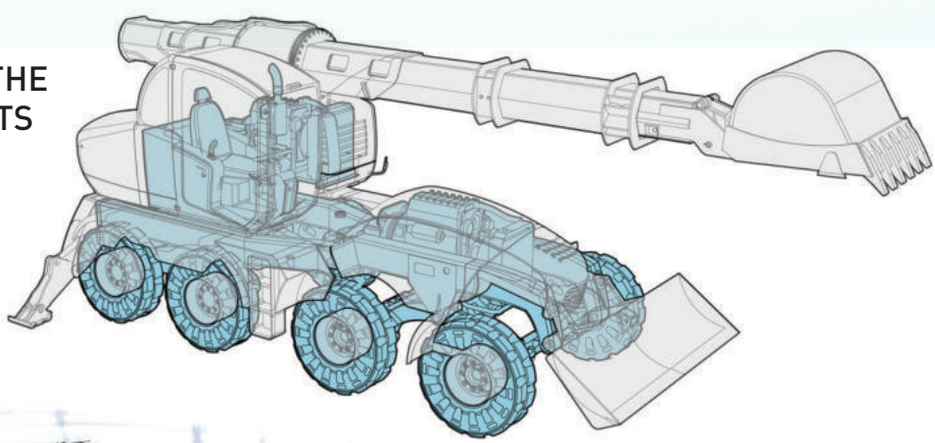
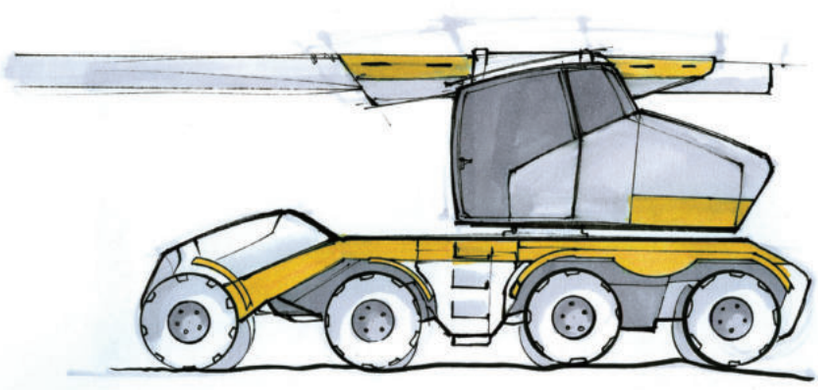




The creation process started with sketches and ended up with a 1:10 mock-up model

DISTRICT

EASTERN EUROPE

Jan Ivan, Bratislava, Slovakia

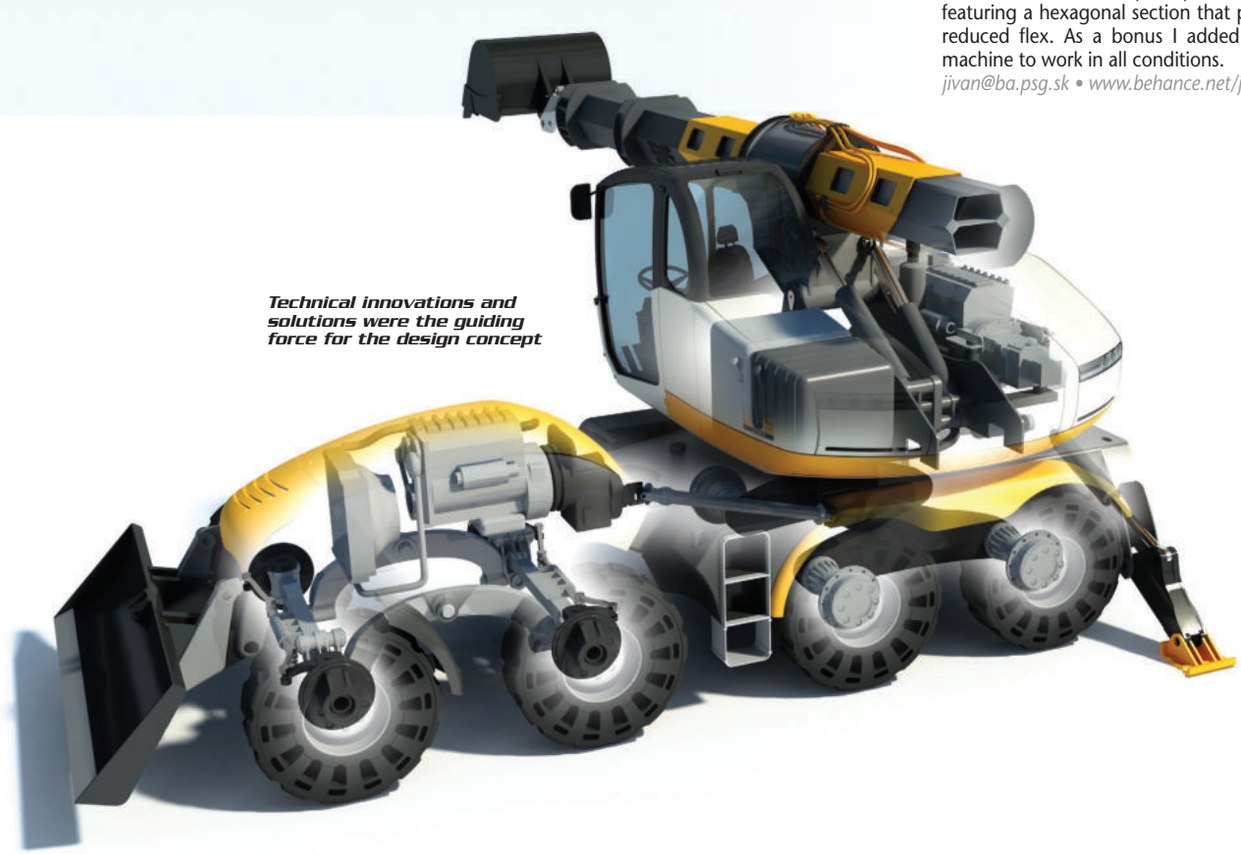
The aim of this design project was not simply to create another futuristic construction machine – I undertook this challenge to design a completely functional object. So the SUS multipurpose telescopic excavator maintains its original purpose while also boasting some innovative features. Luckily I had the chance to collaborate with two engineers in terms of implementing my ideas within real parameters – who at the same time contributed some technical innovations of their own.

We decided to look at the excavator because in Slovakia most of these machines not only look bad but perform poorly too. These telescopic kind of machines are usually mounted onto a truck chassis, with no real concept behind them.

One of the main challenges was to unify the bottom part, i.e. the chassis and main motor, with the upper movable part and its boom. I therefore balanced the mass of these parts so as to create a more dynamic composition – the chassis begins at the front bucket and finishes up at the rear legs to provide a solid, compact base. The superstructure houses a lot of components and technology, so I wanted to make it slick and elegant so that even hard tasks would be just as appealing as simple ones. The cabin is a modular part that can be exchanged or upgraded as necessary.

The boom arm was perhaps the major technical innovation, featuring a hexagonal section that provides more strength and reduced flex. As a bonus I added airless tires to enable the machine to work in all conditions.

jivan@ba.psg.sk • www.behance.net/janivan



Technical innovations and solutions were the guiding force for the design concept

Slava Saakyan, Moscow, Russia

This project was implemented for Rostselmash, a leading Russian producer of combine harvesters. My goal was to demonstrate to the management an outside point of view on the development of the brand.

I decided to work mostly with style, taking a few liberties in terms of the technical aspects. In the early versions of the design, I concentrated on the proportions, composition and lines. The final version takes a deeper approach: it affected not only the appearance of the combine harvester, but the whole structure of the object.

The harvesting machine is divided into two parts by a curved strip, with the front area containing the driver's workplace and the rear section being the technical compartment in which the processing of the crop takes place. This concept allows for the creation of a visual division between the human and the machine, so the operator feels more like an office employee, rather than a harvester driver.

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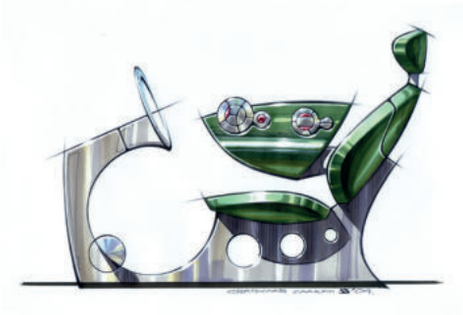
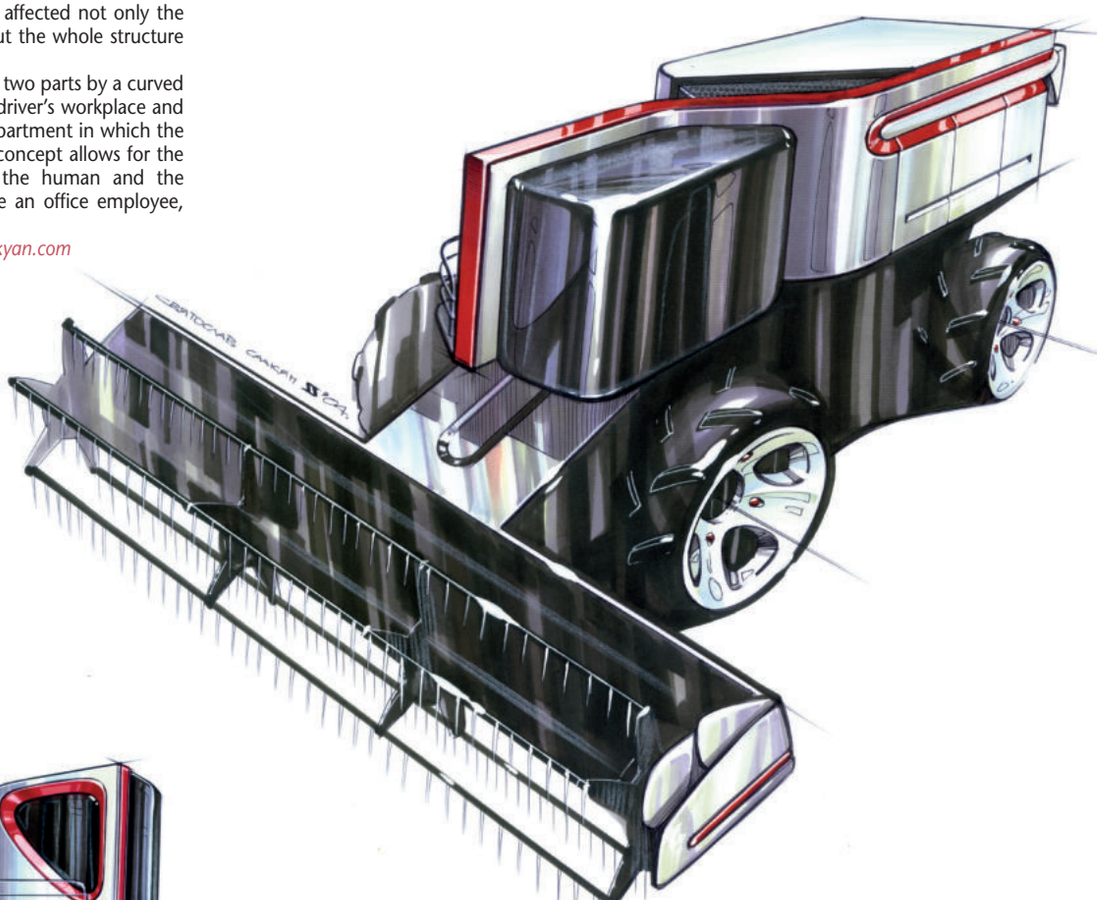
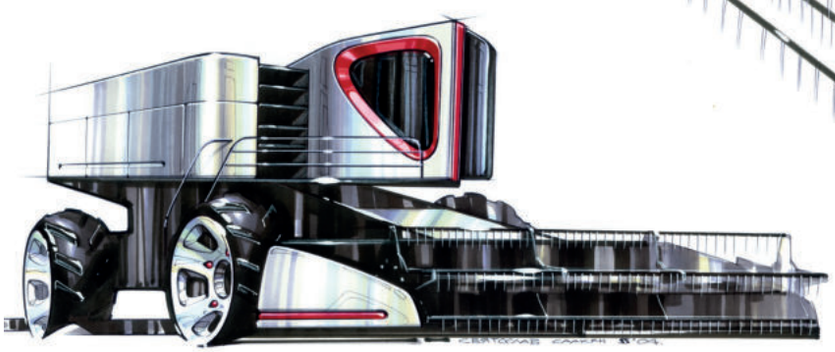
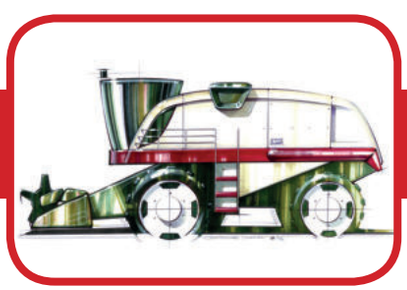


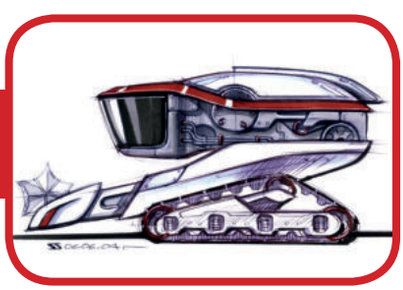
Left: ***Impression of the operator's workplace***

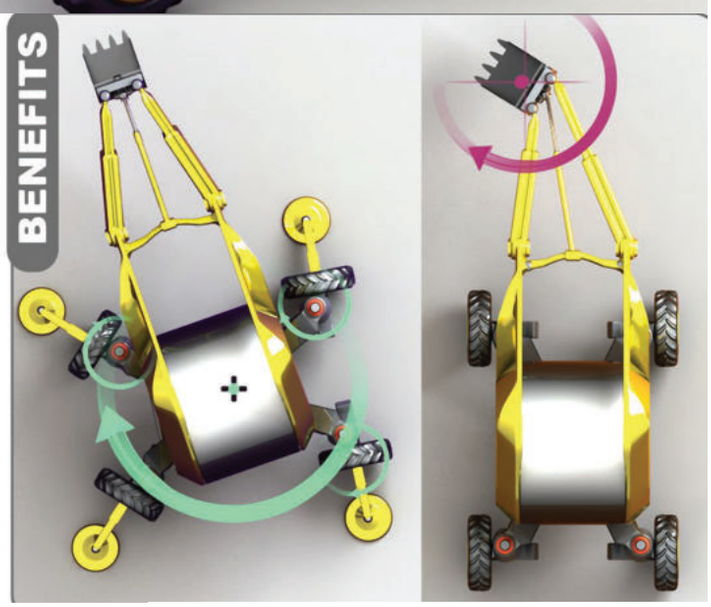




Below: ***Three early iterations of the design were primarily focused on styling***







Ivan Lipkov, St Petersburg, Russia

My concept for a lightweight excavator was designed for work in dense urban areas, particularly tiny streets and squares. I worked on this project together with my mentor, and from the start we decided to use wheels instead of tracks. This is a big advantage, as it means the excavator can arrive at the working area by itself, without the need for an additional truck.

The key idea of this project is the drive wheel/outrigger combination. A power unit under the cabin supplies each drive wheel through an electric motor installed inside its shock absorber, which then transfers power to the wheel via shafts and cogs – the main cog is placed inside the rim. Each outrigger is moved via a telescopic hydraulic cylinder. This package allows the outriggers to rotate separately in any position and to optimize machine positioning in dense urban areas.

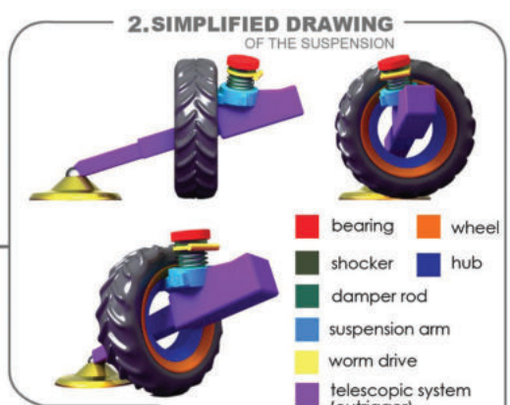
The bucket has three dimensions of movement, helping the operator to excavate faster and easier, with relocation during the work process becoming less essential.

The chassis also transforms easily from digging to driving mode. To activate the road mode, the driver rotates 180° and effectively sends the bucket to the rear of the cabin.

ivanlipkov@gmail.com • www.lipkov.com

The bucket is controlled with three hydraulic cylinders (left and right beams are telescopic) and can move left and right, up and down. In road mode, the driver rotates 180° so that the bucket is behind the cabin

The electric motor is installed inside the shock absorber; its twisting movement is transferred to the wheel via three cogs



ON THE WEB

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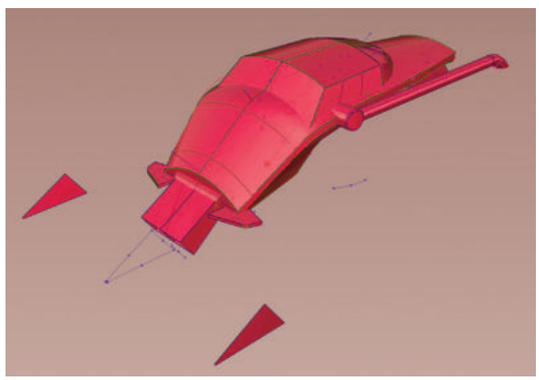

Above: ***Initial sketch and early design stage***

Below: ***Vertical take-off with anti-gravity engines – successfully tested by Russian scientist Vladimir Leonov – could be employed to make ground pressure and crop damage a thing of the past***

Elias Design, Pyatigorsk, Russia

The power and performance of combine and forage harvesters is growing year by year – which simultaneously increases the mass of the machines and the pressure they place on the ground. Therefore, to reduce the compaction of soil, manufacturers of these machines are increasingly employing low-pressure tires, twin wheels or semi-tracked configurations.

Imagine instead, however, a harvester completely eliminating the pressure on the ground via an anti-gravity engine, providing a 'lifting force' that avoids damaging the crop. The harvester would be managed remotely, using satellite guidance and video cameras. It is plausible to assume that harvesters of the future will be similar to a great 'shaver'.

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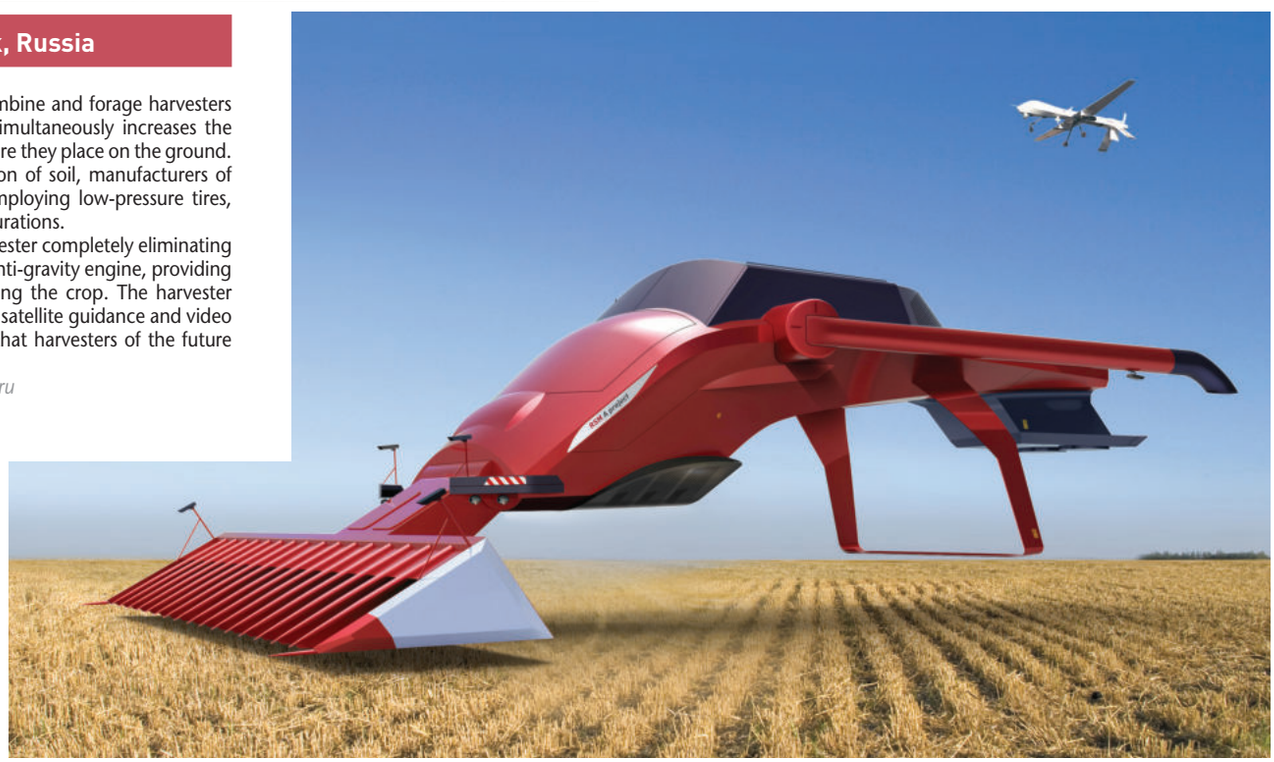

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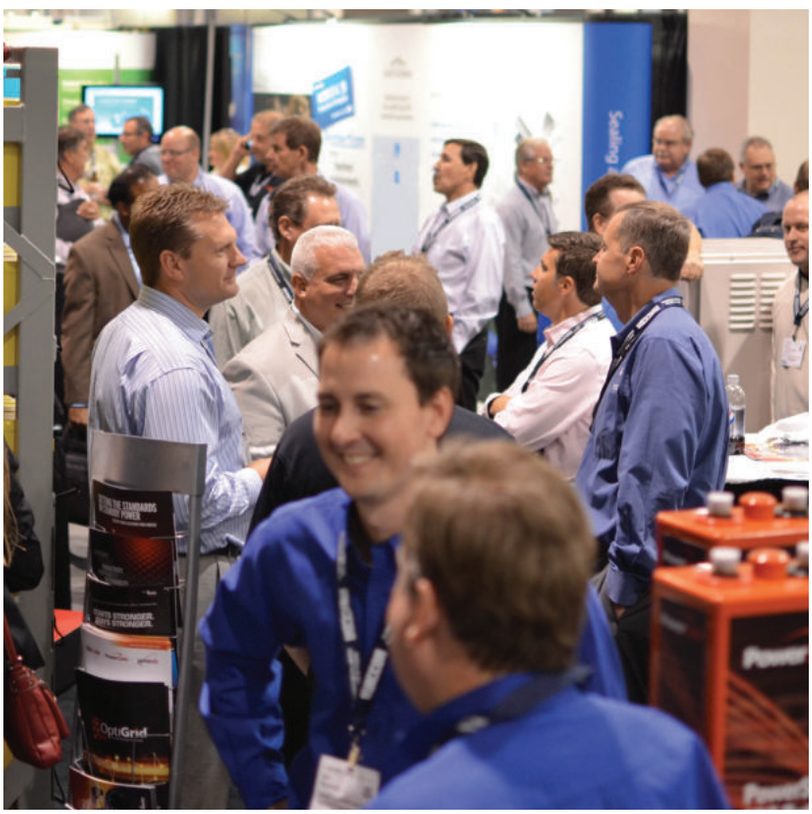

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AS THE LATEST EVOLUTION OF 'CLASSIC' CAN, THE CAN FD (FLEXIBLE DATA) DATALINK LAYER PROTOCOL IS VIRTUALLY GUARANTEED TO MEET OEM DEMANDS FOR GREATER BANDWIDTH AND MORE FRAMES IN THEIR INDUSTRIAL VEHICLES

For many years, industrial vehicle OEMs have used CAN-based networks for several purposes. Typically, the SAE J1939 application profile was used for diesel engine powertrain applications and CANopen used for more machine-oriented applications. Recently, the CAN FD datalink layer protocol has been introduced, which allows higher throughput and longer frames.

The CAN FD datalink layer protocol will be internationally standardized in the forthcoming revision of ISO 11898-1. It supports data rates higher than 1Mbps and data fields (payload) up to 64 bytes. The related transceiver chips will also comply with the updated ISO 11898-2 standard.

Some construction machinery and other high-end industrial vehicle OEMs are already looking for higher bandwidth and for messages with more frames. CAN FD is an ideal option to satisfy such requirements without requiring changes to the well-established communications system, as its controllers will also support the Classic CAN protocol.

Next stop please

Officially introduced at the 13th international CAN Conference organized by CAN in Automation (CiA), CAN FD is accepted by car manufacturers worldwide as the next-generation bus system for substituting Classic CAN networks. The basic idea of CAN FD is simple: after the arbitration phases, when just one node is transmitting data, the bit rate is increased – the CAN FD protocol does not specify any limitation. In the arbitration phase, the data rate still depends on the


IFS
EOF
ACK Field
CRC Field
Data Field
CTRL Field
ARB Field
SOF
IFS

network length (e.g. 500Kbps at about 100m), but after arbitration, the CAN controller transmits with the data-phase bit rate (e.g. 2Mbps or higher). Switching of transmission speeds is performed during the newly introduced BRS (bit rate switch) bit in the control field.

In order to distinguish between the CAN and CAN FD frames, the formerly reserved bit is transmitted recessively. In CAN FD, the control field following the arbitration field comprises several additional bits. Besides the BRS bit, this includes the ESI (error state indicator) bit and an additional reserved bit. The ESI indicates if the transmitting node is in error-active or error-passive state. From a system design point-of-view, it could be useful to know when a node is in error-passive state. In this state, the transmission of its passive error flag is not guaranteed.

Prolonged improvement

The other improvement is regarding the data field, which has now been prolonged to a maximum length of 64 byte. This allows for a better protocol efficiency (i.e., the ratio between payload and protocol overhead). Due to the requirement for the same transmission reliability, the CRC (cyclic redundancy check) protection needed to be improved. For frame length of up to 16 byte, the CAN FD protocol therefore uses a 17bit checksum, and for larger frames a 21bit polynomial.

In order to overcome an error detection weakness in the Classic CAN protocol, in CAN FD so-called fixed stuff bits have been introduced in the CRC field. Additionally, a 3bit stuff bit counter and a parity bit have been introduced, which guarantees that all single-bit failures are detected. The residual error detection capability is therefore now even better than in the Classic CAN protocol.

During the CRC delimiter bit, the CAN FD controller switches back to the arbitration bit rate limited to 1Mbps. This is necessary because, in the ACK slot bit, all nodes send a dominant state when they have correctly performed the CRC check. The following end-of-frame field and the intermission field (IMF) are the same in CAN FD and Classic CAN. This means that in CAN FD, it is also possible to receive the exact same data frame twice, which is why it is recommended for transmitting only absolute data. Relative data requires a sequence number or, at the very minimum, a toggle bit, in order to detect a double reception.

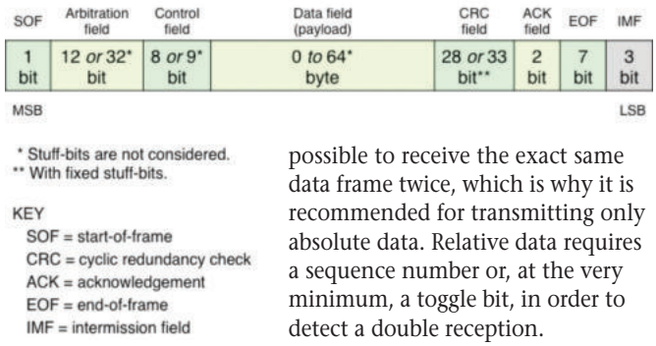


FIGURE 1: **Structure of the CAN FD frame**

Network topologies and their impacts on robustness

The CAN FD datalink layer does not specify the data-phase bit rate. Of course, it depends on the chosen network topology as well as other parameters, especially the impedance of the selected physical layer elements such as cables, connectors, I/O ports and transceivers. In general, the design of the physical layer needs to be more precise than in Classic CAN networks.

It is required that all nodes use the exact same bit-timing settings. This starts with the oscillator frequency: allowed are 20MHz, 40MHz, or 80MHz. The time quanta should be exactly the same in all nodes – it is recommended to use the same time quanta definition in arbitration as well as the data phase. The system designer or higher-layer protocol (e.g. CANopen FD) in use should also define the sample points and the resynchronization jump width.

Under laboratory conditions (e.g. consistent 20°C), transmission speeds higher than 10Mbps have been achieved using line topologies. In the plug-fests organized by CiA, bit rates up to 8Mbps worked without a significant number of error frames. Realistic data-phase bit rates using qualified transceivers will be 5Mbps for point-to-point connections and line topologies with very short stub-lines. Star topologies are limited to 2Mbps (depending on the length of the unterminated cable length).

The device designer should also consider that the nominal internal capacitance of the CAN node is 20pF, and the nominal differential internal capacitance will be 10pF (of course, these values could be zero). The maximum tolerable values are determined by the bit timings and other parameters such as the cable drop length. Proper functionality can be guaranteed if any cable-reflected waves do not suppress the dominant differential voltage levels (V_{diff}) below 0.9V and do not increase the recessive differential voltage level above 0.5V at each individual CAN node. In addition to the internal capacitance restriction, a bus interface should also have an inductance as low as possible – this feature is particularly important for higher bit rates.

In order to cover the higher bit rates in the data phase, the dynamic parameter of the transceiver needs to be specified in greater detail to achieve a robust communication. In the current ISO specification, as well as in the data sheets of transceiver products, the transceiver loop delay is specified.

According to the existing ISO 11898-2 standard, 255ns is proposed. A transceiver has two different loop delays; namely, the loop delay of the recessive-to-dominant transition

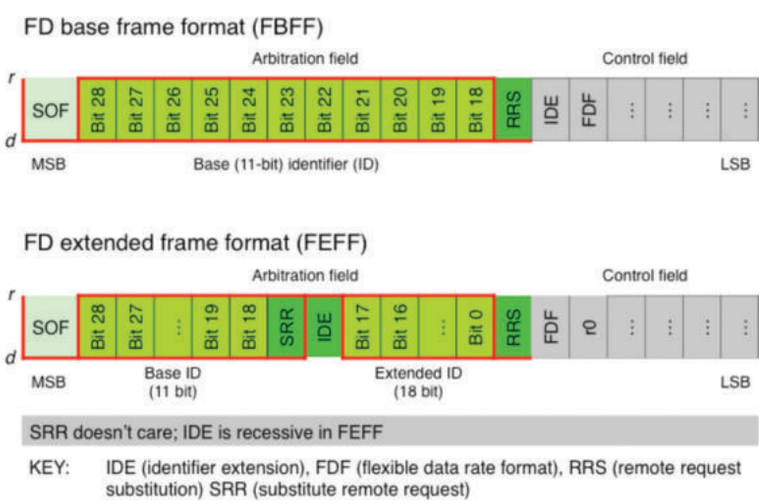
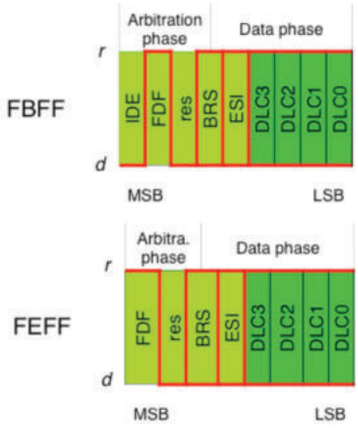


FIGURE 2: **CAN FD arbitration field for base and extended frame formats**



No. of data bytes	Data length code (DLC)			
	DLC3	DLC2	DLC1	DLC0
0 *to* 8	As in Classical CAN			
12	r	d	d	r
16	r	d	r	d
20	r	d	r	r
24	r	r	d	d
32	r	r	d	r
48	r	r	r	d
64	r	r	r	r

KEY: IDE (identifier extension), FDF (flexible data rate format), BRS (bit rate switch; recessive, if alternate bit-rate), ESI (error state indicator; recessive, if error passive)

FIGURE 3: **CAN FD control fields for base and extended frame formats**

and the loop delay of the dominant-to-recessive transition.

The symmetry of the loop delay depends on the symmetry of the internal transceiver delays and/or on the busload. The asymmetry of the transceiver loop delay shortens or expands the bit in the arbitration phase and the data phase. If the bit rate in the data phase is faster than the bit rate in the arbitration phase, the asymmetry becomes more and more important. For the CAN FD transceiver, the symmetry of the loop delay is now specified in the reviewed ISO 11898-2 specification.

The transmitter loop-delay symmetry characteristic (see Table 1) is required for the second sample-point calculation. For checking the performance of the transceiver, the specification defines the recessive bit time after five dominant bits. If the transceiver is very asymmetric, the recessive bit time will either be extremely shortened or expand.

In general, an asymmetric behavior comes from the busload (resistive and capacitive) and the maximum differential voltage for the dominant bit. A systematic asymmetry comes from the CAN transceiver transmitter concept.

To support the arbitration phase, the CAN transceivers feature open-drain or open-collector output stages only. With this concept, the transmitter is able to control the recessive-to-dominant transition, but is not able to fully control the dominant-to-recessive transition.

For this dominant-to-recessive transition, the transmitter can limit the maximum slew rate, though not the minimum slew rate. The high physical busload will dominate the slew rate of this dominant-to-recessive edge and will extend the dominant bit time or – better still – will shorten the recessive bit time.

In general, the CAN transmitter concept leads to an asymmetry in the propagation delay due to the maximum dominant differential voltage and the receiver thresholds.

The receiver propagation delay mainly depends on the V_{diff} slew rate, the thresholds and temperature dependencies, as well as some other factors. However, it is difficult to specify real conditions for a receiver – the best solution is therefore to use the existing transceiver characteristics and calculate receiver performance accordingly. The transceiver loop delay symmetry is given (t_{rec}) and the transmitter loop delay symmetry is also available. The formula used for calculating the receiver loop delay symmetry is:

$\Delta t_{Rec} = t_{bit(RxD)} - t_{bit(Bus)}$

For the receiver, the timing parameters given in Table 2 are recommended.

Regarding the configuration of the transmitter loop delay compensation there are two options:

- Automatic measurement by the CAN FD controller;
- Manual configuration by the system designer.

In the first option, the CAN FD controller measures the transmitter loop delay (TLD). The TDC offset defines the secondary sample point (SSP) position in relation to the beginning of the received bit. It is recommended to set the TDC offset to a certain value, so that the SSP is at the same relative position in the received bit as the data-phase sample point, relative to the transmitted bit.

Of course, with the manual configuration, it is possible you may achieve better results – but it is not

Bit rate (data phase)	$t_{bit(RxD)}$ min	$t_{bit(RxD)}$ max	t_{bit} nominal	t_{loop}	Load on CAN	Load at RXD
1 Mbps	745ns	1,255ns	1,000ns	<255ns	60Ω||100pF	15pF
2 Mbps	400ns	550ns	500ns	<255ns	60Ω||100pF	15pF
5 Mbps	120ns	220ns	200ns	<255ns	60Ω||100pF	15pF

TABLE 1: **Transmitter loop-delay symmetry characteristic (Source: CiA 601-1)**

Bit rate (data phase)	$t_{bit(receiver)}$ min	$t_{bit(receiver)}$ max	t_{bit} nominal
1 Mbps	n/a	n/a	1,000ns
2 Mbps	-65ns	40ns	500ns
5 Mbps	-45ns	15ns	200ns
8 Mbps	-25ns	10ns	125ns

TABLE 2: **Receiver parameter recommendation**

convenient for repairing and device substitution. If you use third-party products, you would need access to the low-level driver software, or the TDC offset should be configurable by a special protocol.

System designers should also consider the minimum distance between nodes – in particular, if there are clusters of nodes and single nodes at the far end of the bus line.

If other than line topologies will be required, it is recommended to suppress the ringing on the bus lines as much as possible. In fact, Denso has proposed a specific circuitry that does this, and is specified in the CiA 601-4 document. This circuitry may be integrated in the transceiver chip. Two of them should be placed in the appropriate locations in the network.

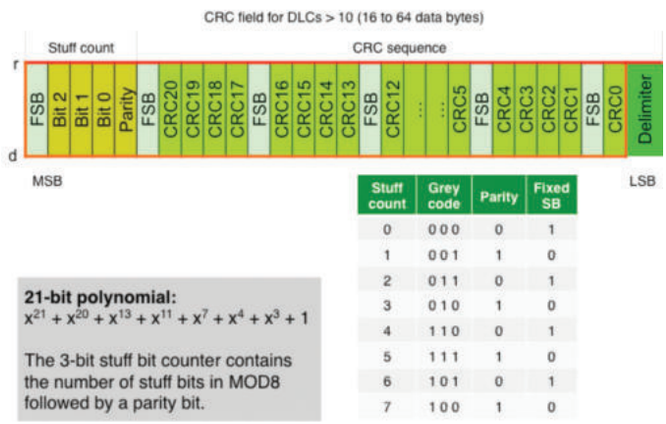
Integrating Classic CAN nodes into CAN FD networks

In construction equipment and other mobile machinery, it might be necessary to use Classic CAN nodes and CAN FD nodes in the very same network segment. However, because the Classic CAN nodes will transmit error frames when they detect CAN FD frames, additional circuitry therefore becomes necessary.

There are a variety of proposals on how to operate Classic CAN and CAN FD devices together within a network system. The cleanest way is to separate the CAN FD and Classic CAN devices into two network segments interconnected by a bridge device. Where this is not suitable, the user should 'hide' the CAN FD frames from the Classic CAN nodes.

NXP has introduced the FD shield transceiver. In case of FD frames, it forwards dominant bit values to the Classic CAN controller. This causes error frames, but these are not forwarded to the bus lines – the transceiver just transmits recessive state, and the Classic CAN controller will run into error passive state. To avoid data inconsistency problems when Classic CAN communication starts again, the FD shield transceiver has its own 'receive error counter' and sends an active error frame on behalf of the Classic CAN chip, in case the first received or transmitted is detected as not correct.

Kvaser has presented an alternative solution: the FD 'bridge' circuitry



Stuff count	Grey code	Parity	Fixed SB
0	000	0	1
1	001	1	0
2	011	0	1
3	010	1	0
4	110	0	1
5	111	1	0
6	101	0	1
7	100	1	0

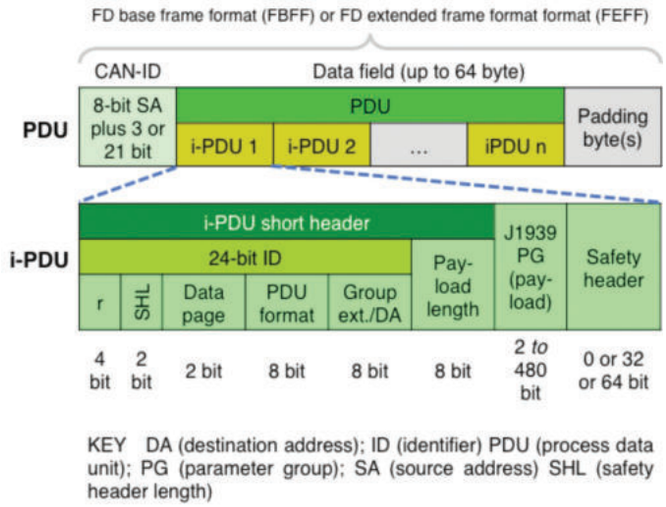


FIGURE 4 (TOP): **CRC field for 16 byte and larger data fields including 3bit stuff-bit counter**

FIGURE 5 (ABOVE): **Proposal for the application layer making use of SAE's PGNs**

transforms the received CAN FD data frame into a Classic CAN frame with no data field (DLC = 0). This circuitry can also be used to implement a bridge device connecting CAN FD and Classic CAN network segments. This solution requires a preconfigured bit timing of the 'bridge' circuitry. The delay caused by the added logic is in the range of a few nanoseconds.

Of course, these migration options will only be necessary in the near future, when not all devices will be using CAN FD-capable controller chips. In due course, the chipmakers will begin supplying only CAN FD-capable modules.

Higher-layer protocols using CAN FD

CANopen, as specified in CiA 301 and EN 50325-4, will be updated in the direction of CAN FD – in fact, the CANopen FD application layer is already under development. Most of the protocols will be adapted as they are – for example NMT, Heartbeat, SYNC, EMCY, and Time.

PDOs (process data objects) will make use of the 64-byte data frame. Nevertheless, the PDO mapping will support just 64 mapping entries – which means bit-wise mapping of process data is not recommended. The SDO protocols will therefore be substituted by a more efficient and easier to implement protocol.

For SAE J1939 networks, the CiA has developed an application layer (CiA 602-2), which will contain a PDU (protocol data unit) compliant with Autosar. This is structured by means of i-PDUs comprising a short header and PGN (parameter group number) information. In the future, PGNs with a length different from today's 8-byte may be specified by SAE, so the CAN FD frame may be filled with padding bytes. The i-PDU may also comprise a safety header with 32bit or 64bit, as transport protocol ISO 15765-2 has been selected, which already supports CAN FD frames.

CiA also specifies the physical layer for such networks (CiA 602-1). It will support 250Kbps and 500Kbps as the arbitration bit rate and 2Mbps in the data-phase bit rate. A line topology with short stubs is the preferred solution.

Leading the charge

The next generation of passenger cars will make heavy use of CAN FD networks. Daimler, Volkswagen and GM have already started internal projects, while other automotive OEMs such as Fiat/Chrysler, Nissan, PSA (Peugeot and Citroën) and Renault are evaluating its use. Most of the leading manufacturers of microcontrollers (such as Cypress, Infineon, Microchip, NXP/Freescale, Renesas, and ST Microelectronics) are already providing them with engineering samples.

Machine builders, especially in the Far East, are highly interested in CAN FD. CiA has already organized several events in China and Japan to introduce CAN FD. This next-generation CAN technology will also be discussed in greater detail at the 15th international CAN Conference (iCC) which will take place in Vienna, Austria, on October 27 and 28, 2015. **iVT**

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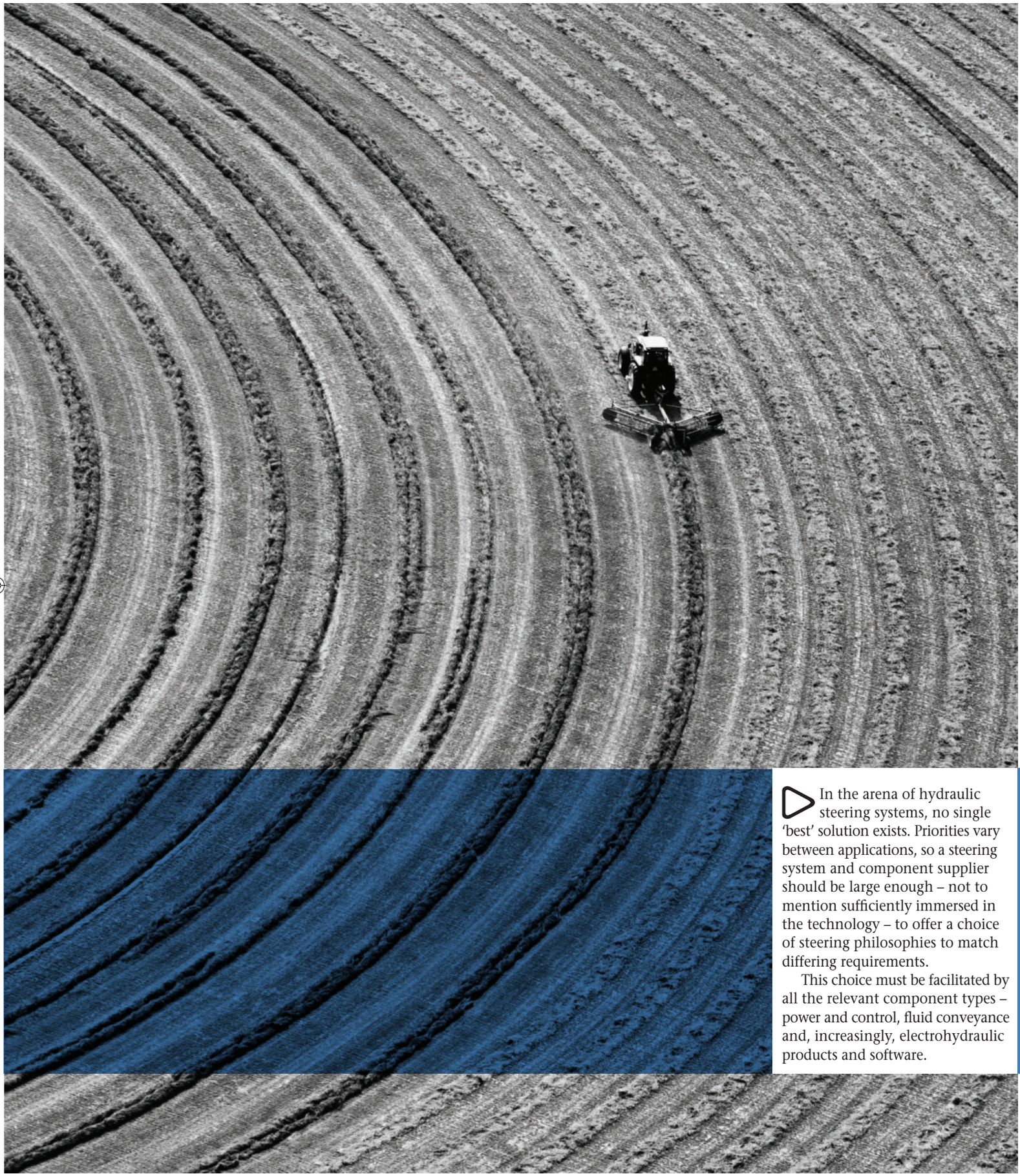
TURN AFTER READING

OUR INVESTIGATION INTO THE CONTINUING EVOLUTION OF HYDRAULIC STEERING TECHNOLOGY SHOULD INSPIRE EVEN GREATER STRIDES IN THE DESIGN OF EFFICIENT AND ERGONOMIC MANEUVERING SYSTEMS



In the arena of hydraulic steering systems, no single 'best' solution exists. Priorities vary between applications, so a steering system and component supplier should be large enough – not to mention sufficiently immersed in the technology – to offer a choice of steering philosophies to match differing requirements.

This choice must be facilitated by all the relevant component types – power and control, fluid conveyance and, increasingly, electrohydraulic products and software.

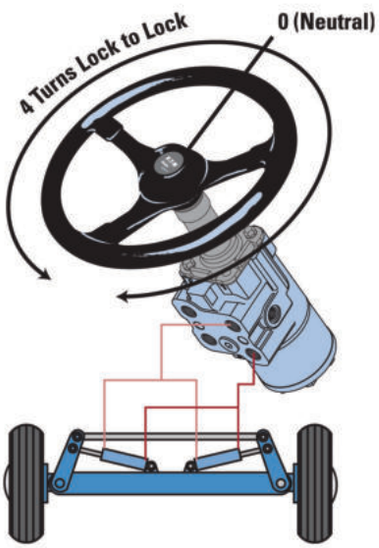
While steering applications may differ in their priorities, they mostly conform to a basic underlying pattern. Operators of tractors, construction vehicles and many other off-highway machines will typically drive at a reasonable speed to their jobsite – once there, they engage in intensive steering and maneuvering to perform agricultural, excavating, lifting, moving or other functions – demanding activities that typically last for several hours.

Additionally, all vehicles must conform to local safety standards in every mode of operation.

During longer journeys, the steering should feel smooth and responsive while avoiding excessive sensitivity to operator handling or imperfections in the road. However, during low-speed, intensive work activities, drivers need to achieve greater steering effect from reduced steering wheel movement and effort; this lowers fatigue and increases overall productivity.

Although generally sharing these objectives, many applications differ in the degree of 'steering amplification' they require, how it is implemented, and in the associated features or options they choose.

FOR FAST TURNS, ADDITIONAL ORIFICES IN THE SCU SPOOL OPEN UP, ENABLING UP TO 60% EXTRA FLOW – WHICH BYPASSES THE GEROTOR, INCREASING STEERING SPEED AND WORK EFFICIENCY. THE LOCK-TO-LOCK TURNS REQUIRED CAN DROP FROM FIVE TO THREE

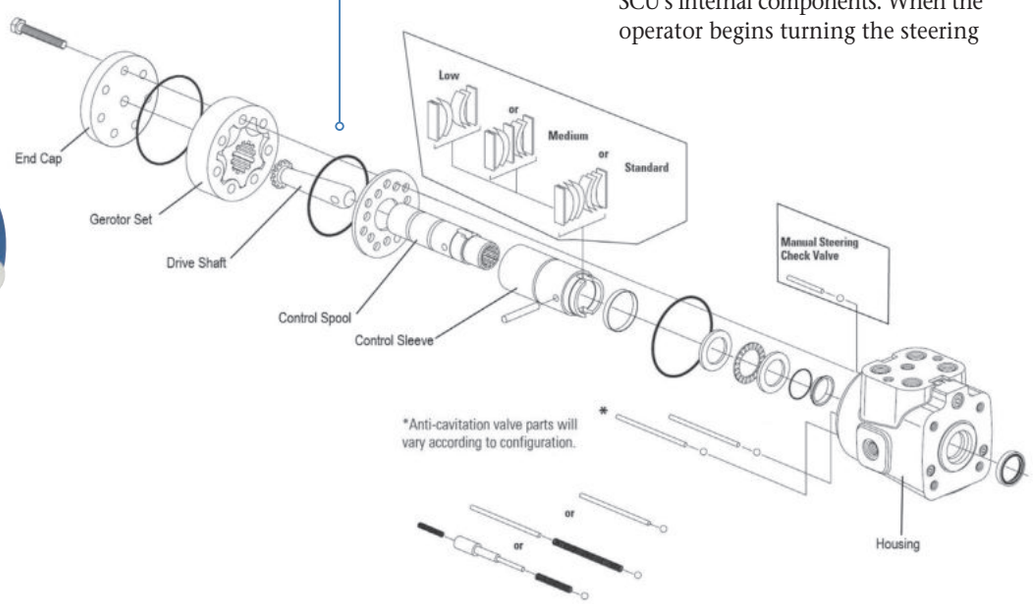


ABOVE RIGHT: **Auto-guidance valves can really benefit from the increased use of electrohydraulics**

RIGHT: **Eaton VersaSteer system**

BELOW: **Eaton VersaSteer control unit**

BELOW RIGHT: **Internal components of an Eaton Steering Control Unit**

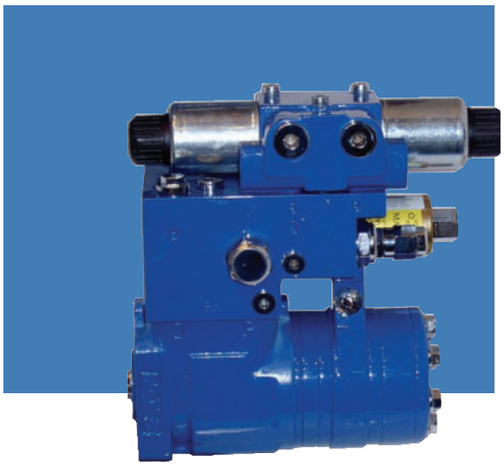


The steering control unit

According to Eaton, off-road steering in its modern form began with Lynn Charleston's development of the first Orbitrol steering unit in 1957. Eaton purchased Char-Lynn in 1971, and is now one of the world's top-three manufacturers of steering control equipment, with agricultural tractors and construction vehicles being its most important segments.

The company's offering centers around its steering control unit (SCU), a single device comprising a rotary servo valve mechanically connected to a feedback meter or gerotor. It connects hydraulically to the road wheels, with no mechanical linkage required between them and the steering wheel.

The image below shows the SCU's internal components. When the operator begins turning the steering



wheel, the spool compresses centering springs against the sleeve. Valve passageways between the spool and sleeve begin to open, connecting pump flow to the gerotor. When the gerotor star rotates, it turns the sleeve in the same direction as the spool, while oil displaced by the gerotor star is sent to the steering cylinder(s). When steering input ceases, the sleeve catches up with the spool, closing the valve passageways, and when the steering wheel is released, centering springs return the spool to neutral.

A unit like this provides smooth and reliable steering – even in the event of a power failure, and will typically achieve lock-to-lock in about four to six turns. However, it also provides a platform that can accept extensions to optimize it for different applications. In row crop farming, for example, operators will greatly benefit from subtly increased steering effect during end-of-row turning; this can be achieved by Eaton's Q-Amp variable ratio steering. During normal operation and slow turning, the steering cylinders receive only oil displaced from the gerotor. For fast turns, additional orifices in the SCU spool open up, enabling additional flow – typically up to 60% extra – which bypasses the gerotor, increasing steering speed and work efficiency. The lock-to-lock turns required can drop from five to three.

Can't turn you loose?

In many off-highway applications, the reduced gerotor displacement facilitates manual steering during a power failure, eliminating the cost of a back-up electric pump as well as complying with safety standards.

Further savings accrue because Q-Amp allows gerotors of smaller size to be employed.

Articulated vehicles such as wheeled loaders or skidders with high-inertia loads can benefit from Q-Amp systems with added cylinder damping. A controlled bypass from steering cylinder to tank dampens instability, smooths steering and reduces jerking motions. Lateral jerk can also be halved, and system stability improved by using wide-angle steering; this is achieved through lower gain on the spool valve slots. The steering response is still fast enough to make the reduced gain hardly noticeable to the driver.

Larger vehicles, such as tractors of 100hp or more and backhoe loaders, can eliminate the need for a back-up emergency system, and to meet ISO/TÜV road regulations, by using a

ALL QUIET ON THE STEERING FRONT

Ergonomics and economy were two key requirements highlighted during the development of Deutz-Fahr's high-performance Series 6 tractors. Therefore, to reduce the noise level inside the cab, the OEM chose the Rexroth Silence Plus pump to drive the hydraulic steering circuit. A clear objective was to achieve noise levels similar to those in modern trucks as, especially on long summer days, the operator may well spend 12 hours or more in the cab. That makes every decibel in reduction important.

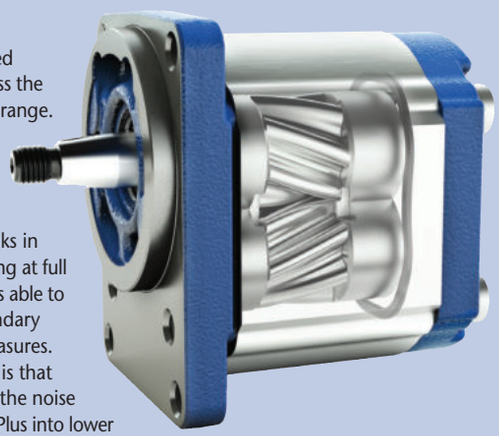
Noise is, of course, generated primarily by the diesel engine, but the hydraulics shouldn't be overlooked either. A separate hydraulic pump is used for the steering circuit in the Series 6 tractors – and, because that pump is located below the cab, it is especially close to the driver. However, by specifying the new Silence Plus external gear pump, Deutz-Fahr got right to the heart of the problem – it generates up to 15dB(A) less noise than conventional pumps, making a dramatic contribution to reducing the overall noise level.

In conventional external gear pumps, the individual teeth make a seal only at the leading surface. But, due to the high-precision machining with minimum tolerances, the teeth in the new pump have, by contrast, a permanent seal. In addition, Rexroth has adopted the principle of helical toothing. The non-involute helical toothing moves the fluid continuously and without trapping any fluid. This makes for virtually silent running and also generates far less oscillation, which could excite noises in the hydraulic system being served.

A direct comparison with conventional external gear pumps demonstrates that the flow exiting the Silence Plus is far more uniform, with pulsation reduced by about 75%. This results in considerably reduced working noises across the entire performance range.

Noise reduction in spite of its location right beneath the cab – the Silence Plus external gear pump used for the steering circuit makes secondary noise-damping measures superfluous

In addition, as the Silence Plus reduces average sound emissions and trims noise peaks in the cab when running at full load, Deutz-Fahr was able to do away with secondary noise-reduction measures. One further benefit is that Rexroth has shifted the noise level for the Silence Plus into lower frequencies, making the emitted sound far more sonorous and pleasant to human ears.



Steering in the Series 6 tractors is not only very quiet, but surprisingly effortless too. When out in the field, the driver can reduce the steering ratio by half, using push button control, which increases travel comfort in difficult terrain. Deutz-Fahr refers to this function as Steering Double Displacement.

TOP: **The Danfoss OSPU is an alternative to dual-displacement steering units**

ABOVE: **Concentric's new EHS (electrohydraulic steering) unit is designed primarily to improve servo steering applications in trucks, buses and off-highway applications**

dual gerotor SCU. In an unpowered or emergency mode, a logic valve engages only the lower-displacement gerotor, which allows manual steering.

Dual gerotor systems can also be used for two-speed steering, with an operator-selectable displacement and steering ratio. For example, an operator could switch from six turns lock-to-lock when in road mode, to two turns for the work cycle. Other applications include telehandlers, forestry machinery, sweepers and vehicles with Ackerman steering.

For applications that require really dramatic results, with lock-to-lock achieved by turning the steering wheel by as little as ±45°, Eaton offers VersaSteer. During normal driving or emergency steering, the SCU can be operated in metered steering mode, using the SCU's gerotor. For working with repeated, fast turns the operator can simply switch to quick steering mode, in which the gerotor is bypassed – the rotary servo valve alone controls oil flow to the steering cylinders.

Unlike traditional joystick-controlled dual-mode systems, VersaSteer operates from a single steering wheel, eliminating the cost and space requirements of a joystick and all of its associated mechanical, electrical and hydraulic components. Applications such as sweepers, pavers, ADTs and forestry equipment can benefit from VersaSteer.

Feel the turn

Providing an internally amplified steering unit in a compact package for responsive and easily maneuverable machines of most sizes, the OSPU steering unit is the latest addition to the Danfoss dual-displacement steering product line. Designed as an alternative to dual-displacement steering units, the load-sensing unit can provide a flow amplification factor of up to four times. The OSPU has therefore been designed to provide fully linear flow curves at all amplification factors.

The unit provides manual steering over a wide range of use, with a compact design that allows for easy installation across these applications. The OSPU's progressive displacement option provides smooth steering throughout the full range of steering speeds, giving the operator precise, optimal control in any given system and operating condition. When it comes to the design of Danfoss steering units, operator comfort and safety are invariably given the utmost consideration.

A FAST TURNAROUND

Last year, Hubtex updated its three-wheeled multidirectional DS 27 sideloader designed for handling pallets and long and medium-weight loads up to 2,700kg. At first, the OEM planned to design the truck according to the 'keep it simple' principle, though this concept was soon abandoned in order to meet the price/performance expectations of its customers.

"We found out that they did not want to make do without, for example, a state-of-the-art display for indicating the steering mode," explains Achim Otterbein, head of construction. "And they also wished the steering system to be as sophisticated, fast and flexible as possible.

"Our standard control system is designed for eight axles, but this seemed rather over-engineered in terms of function and price," he adds. "So we decided to develop a new steering system."

The German OEM therefore commissioned Curtis to design the complete control system for the electrical and hydraulic drive, steering and working functions. The supplier then delivered a fully customized vehicle drive system in just two weeks, selecting off-the-shelf components from its broad range of CANopen controllers and instruments.

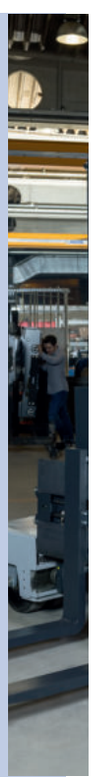
This enables a solution where all the drive, steer, load control and operator interface functions are handled perfectly by the Curtis system without the need for any additional electronics or software. A Model 1234E AC controller handles the vehicle traction and acts as overall system master, issuing commands to the other system components.

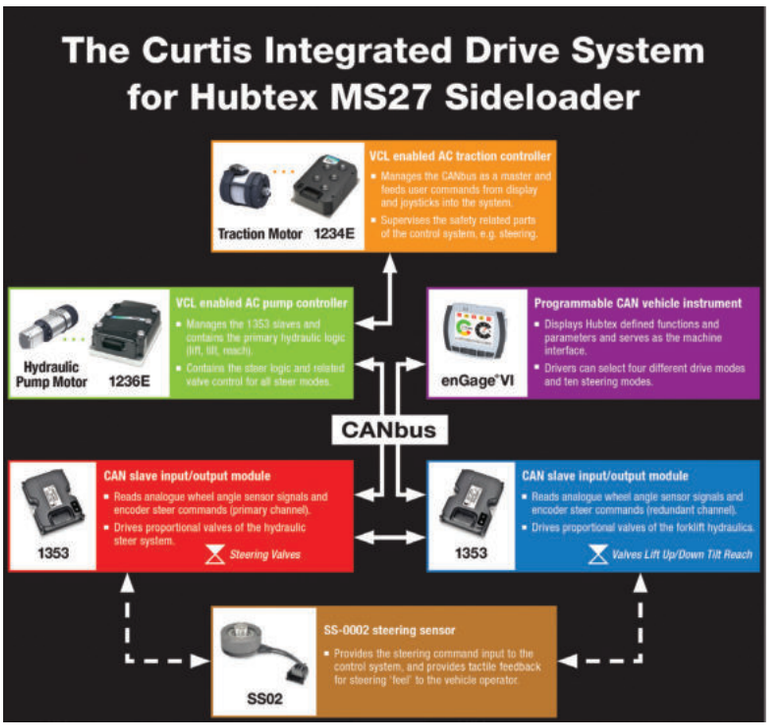
A larger Model 1236E AC controller drives the hydraulic pump, while two Model 1353 I/O expansion modules drive the many proportional valves needed by the load-handling hydraulics and the complex steer-by-wire electric-over-hydraulic steering system.

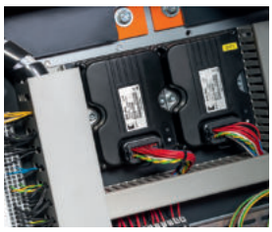
The large, full-color Curtis enGage VI display enables the driver to easily select between the different steering and driving modes, and feeds back comprehensive vehicle status and diagnostic data. This comprehensive, compact and cost-effective systems solution is capable of handling four different drive directions and up to 10 different steering modes. The control system ensures smooth and precise conversions from one mode to another; it also optimizes driving, steering and working functions as all are controlled by a single system.

Thanks to the advanced steering system, the three-wheel universal sideloader offers the fastest available direction switchover times between lengthwise drive, crossdrive, diagonal drive and circle drive. "This enables more precise maneuvering and faster positioning of the load when compared with standard vehicles that do not allow for diagonal drive," explains Jürgen Keller, general manager.

A more detailed report of this project can be seen in the forthcoming *iVT Advanced Lift-truck Technology Annual*, published in July.







LEFT & ABOVE: **A wide selection of off-the-shelf components from the Curtis range were quickly employed to redesign the Hubtex DS 27**

The OSPU has been specifically designed to meet the regulations for emergency/manual/steering capability without additional emergency pump flow. Combining reliable performance with high safety standards, ease of operation and installation, and low operating noise, it is a convenient option for many applications, such as tractors, backhoe loaders, combine harvesters, telescopic handlers and wheeled loaders.

Electrohydraulic components create new opportunities

Electrohydraulic components are becoming increasingly popular, especially on large farming vehicles, due to the possibilities they create by connecting hydraulic steering systems with electronic computing and communications systems. Sensors and actuators can both be integrated with the hydraulic system. GPS steering can be set up with bolt-on additions using proven industrial valves. Fast steer, variable rate and drift-correction systems can also be controlled.

Switchable load reaction also becomes possible: in load reaction mode, the operator can feel feedback from the road surface, as with a car, while non-reaction maintains the steering axle position, even in rough terrain. Joystick steering now becomes an option for applications where it is favored, and systems can be designed to be compliant with Agricultural Performance Level d requirements.

Newer electrohydraulic systems feature components such as pumps and valves with built-in intelligence, sending commands and sharing control inputs via a common CANbus infrastructure. Although such decentralized systems add complexity, they also offer several benefits. Reaction times are generally shorter, so the vehicle seems more responsive. Troubleshooting can be more focused and faster, while upgrades can be made incrementally, helping to control equipment service costs. The higher-precision farming enabled by advanced control systems also improves yields, while reducing associated energy and labor costs.

Concentric AB recently launched its EHS (electrohydraulic steering), designed primarily for servo steering applications in trucks, buses and off-highway applications. EHS offers system power savings through its variable pressure- and speed-control capability with the option of low-noise pump technology and direct electronic control features via CAN communication. It also offers on-demand steering and variable speed capability, down to a low of 350rpm in typical steering cycle mode.

Depending on application, the unit can be rated up to 276 bar, with flow from 12 to 80 l/min and peak output from 1.5 to 7kW.

The base components for the EHS product embody an advanced development of Concentric's current DC electric motor pump technology, which has established a well-founded reputation for reliability and build quality in steering applications, both on- and off-highway, around the world.

The new EHS product range allows CANbus communication between the motor and the vehicle's main control system, so as to control pressure and flow on demand. This considerably reduces system losses in comparison with traditional mechanical drive systems, thereby ensuring optimum performance from the steering system.

The EHS has been developed in collaboration with a leading supplier of electric motors, resulting in a permanent magnet, brushless DC motor with integrated motor drive electronics. The elimination of brush wear contributes to the unit's ability to operate continuously and without problems. Optional features include IP69K protection and CANbus control (either J1939 or CANopen). **iVT**

All in good time

APPLICATION- AND PERFORMANCE-BASED HOSE SELECTION SPEEDS AND SIMPLIFIES HYDRAULIC SYSTEM DESIGN – SO IT SHOULDN'T BE LEFT UNTIL THE END OF THE DESIGN PROCESS. CONVENIENTLY, THE GLOBALCORE FAMILY MAKES HOSE SELECTION EVEN EASIER

The important task of selecting the hose and fittings for a hydraulic system is often one of the final steps in the design process. The correct hose and fitting combination is, however, vital for the overall functionality, long service life and reliability of the complete system. The need to give earlier and more focused attention to this is accentuated by the fact that the demands placed on hydraulics systems have gradually increased due to the ever more powerful machines used in the most challenging and aggressive industrial and outdoor environments.

To help hydraulics systems designers, specifications have become better aligned to their 'real world' needs in recent years. This has helped simplify and speed up the accurate selection of components for a given application. For many years, the most important specifications for hydraulic hoses were based around their detailed dimensions and construction, but the concept for new specs more usefully now references key aspects of the application such as working pressure, temperature and product life expectancy.

The ISO 18752 isobaric specification was released in 2006 and soon led to hose manufacturers migrating from well-established standards. It was subsequently refined and updated in 2012, and then 2014. It followed the philosophy of a specification based on how hoses are used, specified and their performance – as opposed to their construction. This made the standard appealing, and it was quickly adopted by customers worldwide to the point where it has now become the new reference for hydraulic hoses.

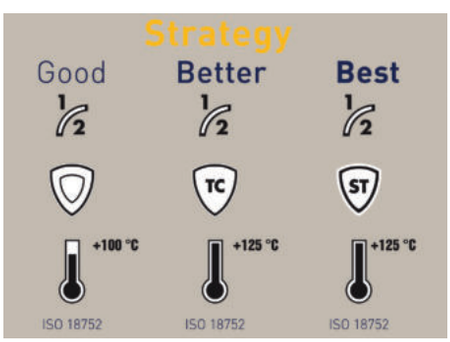
Unified system

Parker Hannifin's GlobalCore family offers just five hose types combined with two series of fittings as a unified system that is built to ISO 18752, and has been tested to double the requirements of the standard. A smaller breadth of range helps customers reduce inventory and part number complexity, while spanning the most common working pressures for use in the toughest conditions.

The GlobalCore range is available in three easily understandable versions to enable straightforward matching to a wide range of potential applications. 'Good' features a standard cover rated up to 100°C; this is essentially a durable synthetic rubber that provides protection from light abrasion, as well as other harmful environmental conditions such as UV and ozone. 'Better' offers a tough cover (TC) rated up to 125°C and 80 times more abrasion-resistant than the standard cover. For the most demanding applications, 'Best' uses a super-tough (ST) hose cover some 450 times more resistant to abrasion than the standard material. Choosing the version with the most appropriate specification helps ensure reliability and minimizes planned maintenance frequency while also avoiding extra costs due to over-specification.

FIGURE 1 (ABOVE): **Parker's GlobalCore range has been designed to offer users options that span the most common working pressures**

FIGURE 2 (BELOW): **The GlobalCore range offers Good, Better and Best variants, giving increasing levels of temperature- and abrasion-resistance performance**



The selection of cover material is just one of many important considerations when selecting a hose. For example, sizing it correctly will minimize pressure loss and ensure damage is avoided during heat generation or excessive turbulence. Similarly, choosing hoses of the appropriate internal diameter is vital for maintaining correct system flow velocity. Other primary considerations include temperature- and pressure resistance, and hydraulic fluid compatibility.

If the selection of hydraulic hose is now easier and better aligned to the real application needs, then so is choosing the fitting. Parker's 43/48 Series offers more than 2,500 configurations with stainless-steel options for corrosive environments and is a permanent, crimp-style hydraulic fitting that facilitates rapid assembly without the need to remove the hose outer-cover. This eliminates premature hose failure through skiving too long or too short.

For higher-pressure applications, the 77 series is available in more than 500 configurations. A shorter fitting height and a smaller hose outside diameter results in reduced straight lengths to bend, enabling the use of more straight (as opposed to shaped) fittings, giving better flow, reduced heat and pressure loss, not to mention potential cost savings. **iVT**

Luca Pozzi is product manager, hydraulic hoses, and Alain Chaurand is business development manager, South Europe, for Parker Hannifin

CHRISTOPHE NATTER

The tool on the hill

DAY AFTER DAY, ALONE ON A HILL, STEEP-SLOPE TREE HARVESTERS WITH A CUSTOM-BUILT CONTROL PACKAGE ARE KEEPING PERFECTLY STILL – ENABLING ONE NEW ZEALAND OEM TO DELIVER SOME MAJOR IMPROVEMENTS TO OPERATOR SAFETY

The ClimbMAX steep slope tree harvester is developed specifically to maneuver safely on steep slopes – unlike most traditional machinery used to help lumberjacks efficiently harvest trees. Designed and manufactured by Trinder Engineering Ltd, a New Zealand-based company that specializes in serving forestry customers, the machine relies on a complete hydraulic control system developed by Eaton and delivered by Fluid Power Solutions Ltd.

On flat ground, forest owners typically rely on harvesting machines to increase yields while enhancing safety. On steep hills, however, traditional harvesting machines are not suitable due to their lack of stability; the acute angles can create problems with traction control and engine and hydraulic oil levels.

Trinder knew that attaching a winch cable to the machine would provide the traction necessary to counterbalance the steep incline, but safety concerns were still an issue. If a cable broke, for example, it could be dangerous for workers, so the harvester would need to stay in place. To enhance worker safety, the machine needed to function safely at extreme angles with heavier construction and different boom geometry. For the Trinder team, the new machine also had to include complex logic control and sensors for self-monitoring to ensure the machine stayed in place regardless of conditions.

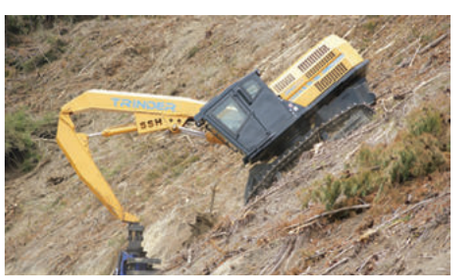
To achieve this, the harvesting machine's hydraulics needed a redesign to manage the winch system, as well as to handle the sharp angles of the boom, which holds the felling head that is essential to the whole operation.

The complete works

So, working with distributor Fluid Power Solutions, Eaton delivered a complete control solution package. In addition to a 7in color touchscreen, Eaton recommended three controllers, as well as directional control valves, hoses and fittings, and slip-in and screw-in cartridge valves for hydraulic control – all of which help to ensure precise control even under the toughest conditions.

"There were two big challenges with this design," says Gary Allen, technical sales and service, Fluid Power Solutions Ltd. "First, we wanted the winch to be controlled automatically, allowing the operator to concentrate on driving the felling machine.

ABOVE: **A logic control solution using Eaton's Pro-FX portfolio aided development of this one-of-a-kind machine**



ABOVE: **The ClimbMAX helps improve safety on steep terrain where traditional harvesters are unusable**

"The second challenge was achieving a high standard of safety, giving the operator the confidence to operate the machine on the steepest of slopes with differing ground conditions. Thanks to the system's technology, we can now safely operate a complex hydraulic system with a high level of confidence."

With Eaton's control solution, the winch and tracks work in unison, with the operator having the ability to change modes for different terrain and maneuvers via three buttons on one of the joysticks. The ClimbMAX also features the option of using the boom to stabilize the machine. The software program embeds the monitoring of all electrical hardware components to ensure that everything is working correctly. There is also a blade on the machine which doubles as a safety device and is automatically driven into the ground to provide stability in the event of a power failure.

"This harvester is the first of its kind in New Zealand," says Mike Grooby, senior sales engineer in Eaton's hydraulics business. "Forest owners in the country are already stipulating that a winch-assisted machine be used on slopes above a certain angle, and this is likely to become an industry-wide standard. Ultimately, the benefit for the forestry market is that harvesters will operate more safely and efficiently."

Though it will take years to fully determine exactly how much this new harvester is helping to reduce forestry accidents, its use has already helped minimize the number of lumberjacks who have to work on steep slopes, thereby increasing safety by reducing the potential for accidents. **iVT**

Christophe Natter is EMEA product manager – mobile controls at Eaton

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iVT INTERNATIONAL INDUSTRIAL VEHICLE TECHNOLOGY

SILVIA PECORARI

All hands to the pump

SUPERB TEAMWORK AND MAJOR INVESTMENT HAS RESULTED IN A NEW AXIAL PISTON PUMP THAT COMBINES HIGH PERFORMANCE WITH COMPACTNESS AND COST-EFFICIENCY TO SET NEW STANDARDS

Supplying a great number of manufacturers of tracked and wheeled vehicles in the worldwide agricultural, construction and urban material handling markets, the Hansa-TMP brand is rapidly becoming an increasingly well-known player in the hydrostatic transmissions business.

The Hansa-TMP mechatronics research center, situated in Modena, Italy, has been a pioneer in developing what it claims to be the first variable-displacement closed-loop axial piston pump that is able to combine compact size with top performance and cost-efficiency.

Top performer

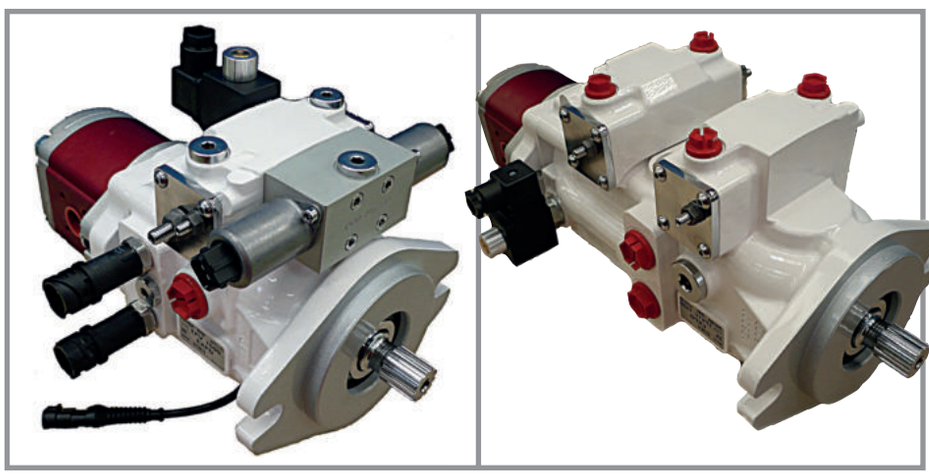
The high power density TPV 1500 pump series, with 17-21cc/rev displacement, is among the top performers in its category, reaching a peak pressure of 400 bar. This is an essential feature if it is to be able to carry out demanding duties without any performance loss, even under the most difficult working conditions, such as steep slopes on a construction site or extreme temperatures inside a mining tunnel.

Resistance to this high pressure range is ensured by an accurate tolerance design of both the external structure and the internal components of the pump. This results from a software-based structural study and digital simulation study during the design phase.

Even though the pump can reach 400 bar it is noiseless while delivering the highest performance possible, making it especially suitable for applications operating in residential and urban areas.

Moreover, controllability and reliability have truly become consistent themes in Hansa-TMP's line of pumps – and this latest TPV 1500 series certainly does that reputation justice. On the one hand, the power and strength of the pump are perfectly controlled by an integrated feedback control along with a full range of onboard electronic sensors, including pressure sensor, speed/RPM sensor and swashplate angle sensors. On the other hand, this pump series has been equipped with an embedded operator-on-board device to guarantee the highest level of safety for the user. This combination of sensors is suitable for application on high-tech machinery and is highly customizable to customers' needs.

Remote controlled tracked mower using TPV 1500 with embedded feedback control and electronic sensors



The high power density TPV 1500 series is a compact variable-displacement closed-loop single or tandem axial piston pump with onboard electronic sensors and a peak pressure of 400 bar

Small is beautiful!

Compact dimensions and light weight are highlights of the TPV 1500 series. The single pump is 170.5mm long and the tandem pump is 285mm long – the latter being about 60mm shorter than many competitive models. This compactness has been achieved by utilizing a 'back-to-back' structure with a central distribution line – a technique first introduced by Hansa-TMP in the TPV 1200 series, marking it out as a novelty in the world of closed-loop pumps.

In fact, as a result of its ability to endure the most challenging working conditions, the TPV 1500 series is able to increase machine uptime. In particular, the high pressure level (up to 400 bar) allows for the downsizing of the power transmission components. This means that even the axial piston motor connected to the pump can be of reduced size, ensuring a lower consumption of fuel and energy, while reducing environment impact. The reduction in energy consumption is approximately 8%, meaning this pump is setting new standards in terms of power and fuel saving, as well as maintenance.

This jump in technology has been achieved as a result of Hansa-TMP's major investment in the brand-new mechatronics research center. The company's research engineering team makes use of the most advanced software, right from the development of the project's concept through to the fluid simulation and a cutting-edge prototype technique. Moreover, the high-tech testing benches ensure a direct power of 150kW and 230kW with a regenerative system. The testing benches are equipped with sensitive software and sensors for the input analysis, with an analysis frequency of 0.1ms. This system has been customized for the production of Hansa-TMP pumps, to reduce their time to market, enable cost-effective production, and ensure the highest level of quality is maintained throughout all the production cycles.

Hansa-TMP is certified for the quality of products and process with ISO 9001 certification, and for the sustainability of its operations with ISO 14001. **iVT**

Dr Silvia Pecorari is head of corporate strategy and business development at Hansa-TMP

MARK BENNETT

After the gold rush

GOLD MINING IS MUCH LESS HECTIC THAN IT USED TO BE – BUT ON THE OTHER HAND, THE PRESSURE TO ENSURE MACHINES PERFORM CONSTANTLY IS HUGE. SO IT REALLY HELPS WHEN THE ENGINES THEY USE ARE ABLE TO MEET TIER 4 FINAL WITHOUT AFTERTREATMENT

In 1874 a rich gold deposit was discovered deep in the Black Hills of South Dakota, which led to one of the last major gold rushes in the USA. Prospectors flocked to the area and founded the legendary town of Deadwood. When the gold rush subsided, Deadwood's rowdy characters moved away but hard rock mining in the area never stopped.

Today, nine miles away in Lead, the quest for gold is still going strong. The Wharf mine is South Dakota's only operating gold mine, with an overall production capacity of three million tons per annum and 2,500kg of the prized metal likely to be extracted this year.

With so much important work to be done, every piece of mining equipment must be ready to perform, especially the blasthole drill rig that starts off the mining process at each new level of the pit. The Wharf mine counts on the Atlas Copco DM45, equipped with the first MTU Series 1600 mining engine put into service in North America.

Equipped with crawler tracks, the mobile rig moves into position atop the mine's face. Its 30ft tower houses a carousel-type drill pipe changer that is designed to drill a hole to depths of up to 175ft. With a bit load force of up to 45,000 lb, the DM45 produces a hole approximately nine inches in diameter. A sample of the earth is taken from each hole, to determine if any precious metals are present. The operator then trams the DM45 to the next position, creating a pattern that is ideal for blasting. Then, when all equipment and people are a safe distance away, the holes are filled with explosive material and detonated, before excavators and haul trucks transport the rock and ore for processing.

But for the DM45 blasthole drill rig, the hard work barely stops – the machine is in operation six days a week, and mine operators estimate that it will perform 6,000 hours of work this year.

Meeting tough standards

Atlas Copco collaborated with MTU to provide diesel power that not only met stringent EPA Tier 4F emission standards that became effective in North America this January, but could also meet the extreme demands of surface mining.

"We teamed up with Atlas Copco and carefully reviewed the DM45's performance requirements. It had to meet the most demanding loads – drilling

The DM45 can drill holes 175ft deep. A core sample from the hole indicates whether precious metals are present

RIGHT: **A 12v Series 1600 mining engine is available in Atlas Copco's DML drill, but a 17.5-liter, 567kW 10v Series 1600 engine powers its DM45 blasthole drill rig (above)**

deep, large-diameter holes through hard rock at an extremely high rate," says Roger Rymarz, application engineer, MTU America.

"But performance requirements are only part of determining engine selection for such a demanding application. Other factors also need to be considered – engine displacement, available options, time before overhaul, fuel burn, overall engine size and weight, to name just a few."

The team soon decided the new 17.5 liter, 760hp 10V Series 1600 engine was the perfect fit for the DM45 blasthole drill. "We worked closely with Atlas Copco to ensure a seamless installation, from the initial 3D design to final testing," says Rymarz.

The Series 1600 for power generation applications was introduced in 2009 and subsequently followed by versions for railcars, locomotives, agricultural and forestry vehicles, construction machinery and now mining machines, marking the first time the mining engine has been used in North America.

The implementation and testing of the new 10-cylinder Series 1600 mining engine took nearly a year to complete. The engine was installed in June 2014 and then, after more testing, was delivered to the Wharf mine in July 2014.

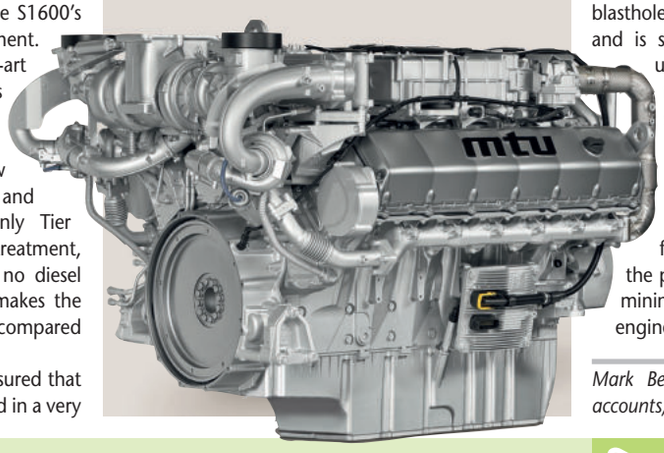
The Series 1600 offers many advantages to mining customers, including low lifecycle costs, enhanced fuel efficiency, reliability and durability in a package that meets Tier 4F emission standards without requiring exhaust aftertreatment.

In a drill operation, cost is measured in dollars per foot drilled at specific diameters, so it therefore becomes extremely important to mine operations such as Wharf that the engine stays productive.

Uptime is crucial at the mine – and as these machines kick off the process on each new level, any problems would bring the whole operation to a halt and leads directly to lost revenue. Atlas Copco was therefore drawn to MTU's excellent track record of providing reliable engines.

Atlas Copco was also impressed with the S1600's ability to meet Tier 4F with no aftertreatment. This is made possible by MTU's state-of-the-art diesel technology package which includes EGR, two-stage turbocharging and a high-pressure common-rail fuel-injection system, enabling combustion with extremely low generation of nitrogen oxides (NOx) and particulate matter. As the industry's only Tier 4-compliant engine in its class without aftertreatment, the Series 1600 has no particulate filter, no diesel exhaust fluid, and no SCR muffler. This makes the maintenance requirements much lower compared with engines with aftertreatment systems.

Installation is easier as well. MTU has ensured that the engine's EGR components are integrated in a very compact way so that the size of the engine and the exhaust piping are not adversely affected.



Easy to work with

The Series 1600 was easy for Atlas Copco engineers to integrate into their drill rigs. No aftertreatment greatly reduced engineering costs, while its customers benefit from lower operating costs and reduced downtime compared with engines that require aftertreatment in order to meet Tier 4F standards.

Fuel consumption is also optimized as a result of the Series 1600 technologies, such as common-rail fuel-injection and two-stage regulated turbocharging. Field testing continues, but early fuel consumption is proving to be much better than earlier Tier products.

The operators of Wharf's DM45 are positive about the new engine too. Considering the long hours the machine is in operation, engine noise could be an issue, while hydraulic pumps and the air compressor run tirelessly. Fortunately the advanced technology of the Series 1600, along with Atlas Copco's improved mount system, has made the cabin noticeably quieter.

The Series 1600 represents the latest in MTU technology. Engineered for the future, the engine is ready to meet the demands of tighter emissions regulations without complicated modifications. Any operation that powers its machinery using these engines stands to benefit from this forward-thinking engine concept.

Certainly MTU and Atlas Copco have struck gold with the Tier 4F Series 1600 – so far the Wharf mine's blasthole drill has reached 5,000 hours of operation and is still going strong. After a year of testing, updates and calibrations, the engine is ready for widespread production. Wharf received a second DM45 equipped with the Series 1600 in April. Soon, other mining sites in North America will put the Series 1600 engines to work.

Wharf mine has great expectations for the future, and so does Atlas Copco. MTU is in the planning stages to equip more of the OEM's mining equipment with a wide range of Tier 4 engines. The Series 1600 is only the beginning. **iVT**

Mark Bennett is senior manager of global mining accounts, MTU America

The DM45's big brother

The DM45 is just one of many blasthole drill rigs offered by Atlas Copco – at the larger end of the scale, you'll find the Pit Viper 311. Capable of drilling a clean 65ft hole in a single-pass, the powerful rig has a 110,000 lb bit load capacity. Three MTU Series 2000-powered Pit Viper 311s are currently in operation in the USA – at mining sites in Arizona, Utah and Wyoming. The Tier 4-compliant 16V 2000 C66 engine boosts productivity and drilling efficiencies, delivering 1,300hp (970kW)@1,800rpm.

Like the Series 1600-powered DM45, Atlas Copco's Pit Viper 311 is manufactured in Garland, Texas.

DANIEL HENN

A sense of self

BY GIVING OFF-HIGHWAY MACHINES A BETTER GRASP OF THEIR SURROUNDINGS BY CLOSING THE GAP BETWEEN OPTIMAL PERIMETER RECOGNITION AND FURTHER PROCESSING, SMART 3D SENSORS GREATLY INCREASE EFFICIENCY

The cost pressure felt by the manufacturers of construction machinery and agricultural engineering technology is increasing. To stand out from the crowd, machines are being developed that not only meet the highest quality requirements, but will also contribute to a considerable increase in operational efficiency. Just like optimizations in engine management for the reduction of fuel consumption, intelligent sensors are now becoming increasingly important for automation solutions.

With this in mind, ifm electronic offers intelligent sensor functions, for example for automatic line guidance in the field or on the street. This ensures that the operating time of the mobile machine is optimally used and does not depend on the routine of the machine operator.

The automation of features in industrial vehicles also provides a supporting effect for the operator. Monotonous tasks, such as following windrows on fields for hours in order to press hay bales, can be solved by ifm's O3M 3D sensor system and an intelligent algorithm. The driver only has to monitor the process and can therefore focus on the operation of other machine parts during that time. The sensor system moreover provides the vehicle with abstract distance information. So, the machine controller obtains a 3D image of the surroundings and can actively support the operator, for example when maneuvering the machine.

During driving on construction sites, but also in mines – under and above ground – collisions occur again and again, particularly when using larger, more complicated machines. Here, the O3M sensor system serves as a collision warning device. An algorithm from the automotive industry not only detects the surface areas, but also calculates the probability of collision. Different parameters such as the vehicle's speed, presumed path, as well as speed and direction values of up to 20 approaching vehicles or objects are taken into account. A highly precise probability of collision is calculated from all this in a split second.

The O3M smart 3D sensor system

With the first time-of-flight-based PMD 3D sensor system for industrial vehicles, ifm offers wholly new opportunities for object and perimeter recognition, in particular for vehicle automation. The sensor features integrated functions solving a multitude of different applications. Highly developed algorithms from the automotive industry are used, for example for the reliable detection of 20 objects simultaneously.

ABOVE & TOP: **Automatic line guidance by means of intelligent 3D sensors**
LEFT: **Perimeter recognition as an assistance function for the machine operator**

Communication is either via the CAN interface with the common protocols CANopen or SAE J 1939, and/or via Fast Ethernet UDP. The robust and compact design of the system is impressive – and the sensor has no moving components, which makes it particularly resistant to shocks and vibrations, and virtually free of wear. Simple installation software and CODESYS programming examples round off the package.

A photonic mixer device, also called a PMD sensor, is the most important element of the sensor system, based on the time-of-flight function principle. The scene to be detected is illuminated by modulated, invisible infrared light and the reflected light hits the PMD sensor. This sensor is also connected to the source of modulation and each pixel of the PMD sensor determines the distances to the scene due to the phase shift between the transmitted and the received signal. Thanks to the integrated suppression of background illumination, PMD sensors can be reliably operated even at full solar radiation.

Sensor technology, in particular 3D technology, has seen a strong innovation boost over the past couple of years. Due to the close cooperation with manufacturers of industrial vehicles, a product has now been developed that can solve a multitude of applications, while offering an unbeatable price/performance ratio. **iVT**

Daniel Henn is mobile product manager at ifm electronic

BULLETIN BOARD

Versatile sensor

Gill Sensors & Controls has introduced Blade25 inductive position sensors into North America. This non-contacting position-sensing technology provides both linear and rotary position feedback in a single package and can monitor the activator's (target) position in either a straight linear or a curved 'arc' rotary movement as it passes over the sensing element.

The two-piece sensor measures either +/-45° of rotary movement or +/-12.5mm of linear displacement. In both cases there is no contact between the sensing element and the small metal 'target', which acts as the activator and attaches to the moving element. The activator has an air gap between the second part of the sensor, with a solid-state sealed electronics package that is surrounded by the activator.

Inductive technology eliminates the bearing and mechanical wear issues of conventional shaft-driven sensors by separating the position activator from the electronics. This eliminates the need for precise and expensive bearings and the air gap provides an unlimited mechanical life span, as the two pieces never come in contact. This is ideally suited to extremely dirty and contaminated environments, in areas where strong magnetic fields are present, and in complex mechanical assemblies that have tolerance and wear issues over their lifetime.

The standard Blade25 sensor is available with analog, pulse-width modulation (PWM) or serial output (RS232 19.2k 8N) and is specifically designed to meet stringent OEM requirements with an IP67 rating.

It is ideal for use in forklift feedback and control, tractor and implement feedback sensing, industrial vehicle foot brake and throttle control, and cranes and telescopic manipulators.

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Quote Ref: **506**

Dana Rexroth HVT R2 nears production

Engineers have completed final validation testing of the Dana Rexroth R2 hydromechanical variable transmission (HVT), with the start of production expected in Q3 this year.

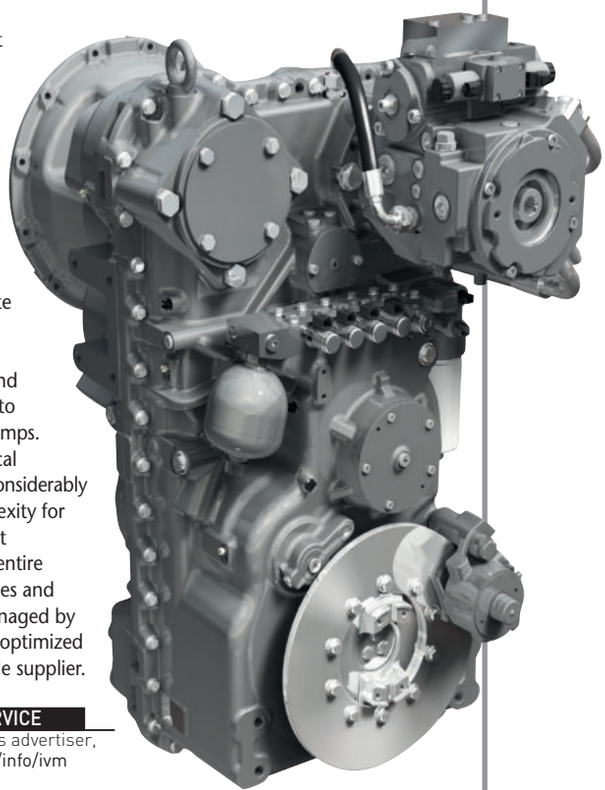
Field tests on working vehicles have shown fuel savings of up to 25% over traditional transmission designs, with additional savings made possible through further optimization with equipment subsystems.

A product of the joint venture between Dana Holding Corporation and Bosch Rexroth, the HVT R2 features a modular design that can be adapted for a variety of off-highway applications with net input power from 135-195kW (180-260hp), including front-end loaders, motor graders, industrial lift-trucks, reach stackers, forestry skidders, and other select off-highway applications.

HVTs from Dana Rexroth can greatly reduce fuel consumption by decreasing engine speeds throughout the duty cycle and at idle, where speeds can be dropped to as little as 600rpm. Application analysis demonstrates the possibility of further savings without compromising any performance through engine downsizing.

The Dana Rexroth HVT R2 is a modular platform that delivers an extensive suite of configuration options and software controls, such as direct or remote mounting, flexibility in shift control and drive strategy parameters, and the deployment of up to three power take-off pumps.

This hydromechanical variable transmission considerably helps to reduce complexity for off-highway equipment manufacturers, as the entire system of gears, clutches and hydrostatic units is managed by an advanced ECU and optimized for efficiency by a single supplier.



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Quote Ref: **507**

Hydraulic spring chamber completes the range

"Complete system solutions are becoming ever more important," states application manager at Knott, Stephan Raab. "With our new hydraulic spring chamber, which is developed and manufactured by ourselves, we have made an important contribution to the market. Manufacturers of agricultural and construction machinery need to ensure that mechanical parking brakes also function as fail-safe brakes – the spring-type chamber makes this possible."

The advantages speak for themselves. The result is always a constant and maximum braking force – when the handbrake lever is used, factors such as insufficient or poor operation no longer play a role. And because the hydraulic spring chamber can be mounted in close proximity to the mechanical parking brake, efficiency losses along the Bowden cable are eliminated.

"We would not be Knott if we did not offer variants of the hydraulic spring chamber," emphasizes Raab, referring to one of the company's key strengths: individualization. Therefore, stroke lengths, spring force and release pressure are variable within the various size options. "And for special solutions, we always keep an open mind," he adds.

Whether hydraulic/mechanical disc brakes, cam brakes or hydraulic/mechanical drum brakes, the Knott spring-type chamber allows for many combinations to meet any requirements. And if desired, DOT brake fluid can be substituted for traditional mineral oils.

Furthermore, the spring-type chamber promises just what the customer expects: long service life and reliability. Raab points out that: "All spring-type chambers employ an emergency release device and are coated with a zinc flake process. Following more than 480 hours of a tough salt spray test, no functionality degradation through corrosion was reported."

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Quote Ref: **508**

Cast-iron guarantee

Concentric's Ferra line of cast-iron hydraulic gear pumps is designed for robust, high-performance duty cycles. The Ferra F12 is a rugged, compact product that is extremely robust across a wide temperature range and offers increased power density and installation characteristics. As a two-piece design with both housing and flange manufactured in cast iron, this has made it possible to eliminate the rear cover and integrate the bearings into the housing and flange.

The gear profile and shaft are of one-piece construction, providing the drive and driven gear with superior fatigue resistance that allows the use of large-diameter journals, enabling higher load-bearing capacity. The gear profile is optimized for reduced pulsation, lower ripple/noise and higher volumetric efficiency at low speeds.

PTFE-impregnated journal bushings provide optimum alignment as well as a large support area capable of handling most indirect drives and fan loads. Optional outer bearing flange configurations will handle excessive overhung loads. Its two aluminum pressure plates with integrated seals balance themselves as pressure increases, ensuring high volumetric efficiency at low speeds, while maintaining optimum strength and wear characteristics.

Ferra F12 can be used as a single unit or in multi-unit assemblies, giving users an extensive range of additional options for their system solutions.

A full-length version of this article will appear in the *iVT Advanced Lift-truck Technology Annual*, published in late July.

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Quote Ref: **509**

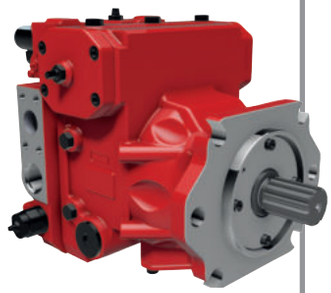
Pump efficiency means fuel savings

Kawasaki Precision Machinery has launched the K8V axial piston pump series for closed-circuit applications in industrial and construction machinery. The optimized design contributes to reducing fuel consumption due to high pump efficiency, while ensuring a comfortable operator environment as a result of the low noise level.

The new K8V series is claimed to offer the best pump efficiency on the market. This is the result of Kawasaki's world-class R&D in high-efficiency technology, combined with its many years of experience in designing and manufacturing cutting-edge hydraulic components.

The K8V pumps feature a mechanical position feedback, enabling flow rate to be precisely controlled for optimum performance.

Necessary functions for closed circuits – such as charge pump, relief valves and cut-off valve – can also be integrated. The company also offers a high-response option, for the K8V125 only, for use in applications such as concrete pumps.



Kawasaki currently offers the K8V pump in two sizes: K8V90 (90cc/rev) and K8V125 (130cc/rev), while a third size, K8V71, is already being developed. The operating pressure range for these pumps is 400/450 bar (rated/peak).

This new Kawasaki offering demonstrates the company's huge commitment to developing new products that deliver solutions to customers, while maintaining the key themes of reliability and controllability.

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Quote Ref: **510**

One size fits all (well, four couplers)

Faster's R&D department has launched a quick-release cartridge style couplings series– the 'universal concept'. These products, designed for agricultural tractor applications and for assembly inside specific cast iron manifolds with a lever, are fully compliant with ISO standard 7241-1 part A. The aim of this new technical concept is to use only one cast iron manifold, due to the ability to use the same cartridge housing for four different coupler styles:

- Cartridge coupler according to ISO 7241-1 Standard 'A' series 12.5 size (½in);
- Cartridge coupler according to ISO 7241-1 Standard 'A' series 20 size (¾in);
- Flat-face coupler according to ISO 16028 and ISO 15567 12.5 size (½in);
- Flat-face coupler according to ISO 16028 and ISO 15567 10 size (5/8in).

The current market trend is for improving the power, attachment reaction time and hydraulic system flow rate of tractors, which creates a real need for a higher-performing coupler. In addition, this provides the possibility of a flat-face coupling that gives performance levels very similar to those of high-specification agricultural couplings, but with the added benefits of no spillage during the connection and disconnection phases.

In addition to the very compact dimensions, these cartridge couplings are also interchangeable inside the most popular cast iron blocks which represent the current standard on the agricultural market. Moreover, these cartridges are very easy to connect and to disconnect.

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Quote Ref: **511**

Compact and efficient traction control

HydraForce has released the HTD10-40 torque divider, a valve that enables more efficient, compact and effective control of motor speeds. When operating on slippery or uneven terrain, drive motors have a tendency to spin-out, which causes ruts in the ground and excessive tire wear. Traditional solutions adopt an inefficient and oversized flow-divider solution or costly electronics to solve this problem.

Rather than using oversized flow controls, the HTD10-40 achieves efficient torque control of the motors, regardless of differing motor speeds, by balancing the pressure drop across each motor.

A simple and elegant HTD10-40 solution has been demonstrated to reduce the motor control horsepower requirements by up to 6%. In addition, the reduction of manifold complexity reduces the footprint of the manifold and can simplify the machine build by eliminating the need for the sensors, compensatory valving and controllers that are typically required to effectively control motor speeds and tractive efforts.

The HTD10-40 torque divider is ideal for traction control in order to prevent spinning wheels and wheel scuffing; ideal for applications where series motors require there to be some limited variation in speed, such as auger, conveyor/spinner, sweepers/brooms and drill motors; and can accommodate systems with multiple traction control modes.

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Quote Ref: **512**

Sunlight-readable high-tech displays

A high level of clear readability – especially in the case of strong sunlight – is an important requirement for displays in many industrial vehicle applications. Operators are often dependent on the performance of their displays so as not to endanger safety or the project being carried out. How is it possible to create displays that offer the required resistance to strong sunlight?

SemsoTec, a high-tech company based in Munich, Germany, which specializes in display technology including complete customized hardware solutions for industries such as automotive and off-highway, has developed a special process using optical bonding.

"With this innovative new process, individual elements of the display are bonded together using an optical material, which in the case of a touchscreen includes the operating element, the display and the sensor. The result is suppression of the disrupting reflection of sunlight and enhancement of contrast level," says Jochen Semmelbauer, SemsoTec CEO.

LC-Displays from SemsoTec can achieve a high brightness level of up to 1,000cd/m². This value defines the amount of light that is produced on the outside surface of the display, describing exactly the light intensity characteristic on this surface. Using this technology, special displays are also very readable even in the case of strong sunlight under the most difficult of conditions.

For many industrial applications, this combination of reliability and toughness (rugged design) will be indispensable under the influence of extreme environmental conditions.

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Quote Ref: **513**

Wire-actuated encoders enhance safety

In addition to global efforts on the part of manufacturers, associations, organizations, and ultimately the machine users themselves, the new version of European Standard EN 13000 focuses on new and enhanced security requirements, for example for all-terrain cranes, hydraulic lifts, MEWPs, and vehicle-mounted cranes. But in the construction and agricultural equipment markets, the requirement for intelligent safety systems has also increased.

Hand-in-hand with its customers, Siko has developed new wire cable sensors that, in combination with safe control systems, enable the overall system to be certified pursuant to SIL2 PL d. With MTBF values of >100 years, these sensors are therefore ideal for use in certified complete systems.

The Siko wire-actuated encoders SG32, SG42 and SG62 provide this enhanced security using a specialized and fully redundant sensor system, which is used to precisely determine the position. Their two completely separate sensor systems detect the exact position and display them separately as analog signals.

With measuring lengths from 3-6m, these sensors are therefore ideally suited for accurate position determination of the outriggers on cranes and working platforms, as well as for determining the position of booms.

Furthermore, the highly durable structure of the sensors is even more impressive, as the spring assembly is protected against the ingress of dirt and water and invariably works perfectly – even in a temperature range of -40° to +85°C.

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Quote Ref: **514**

Setting new standards in comfort

The standard HVAC and heaters of the Kalori range are the ideal solution for OEMs equipping the cabin of their construction or agricultural vehicles, saving them considerable time and effort in developing a specific item that won't give any better comfort.

From 2-14kW, the Kalori range of evaporators and heaters comprises a variety of shapes, enabling them to be installed under the seat, in the roof, beneath the cab or in the dashboard. Adaptations can be carried out easily – sometimes only by developing a bracket or a specific air duct part.

To this end, the company's engineers develop plastic-injection or vacuum plastic parts, according to the investment/quantity ratio.

The Kalori Trim Line (which is now one of the most diverse lines of air diffusers, grills and accessories on the market) offers all the accessories required to produce the desired air diffusion and the controls. With its global solutions, its technicians can send OEMs a proposal in several days, ensuring they won't lose time and money through involvement in an expensive development for which the manufacturer may not always receive the desired return on investment.

Choosing standard and 'design-proven' products also results in choosing quality because of the large experience already achieved with these standard products and the improvements they deliver.

Of course, some projects will always require a dedicated HVAC, and this is also a large part of the activity in the Kalori design office.

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Quote Ref: **515**

Take control of your productivity

J R Merritt Control's ultra-compact CS3 joystick series has been designed specifically for both off- and on-highway industrial vehicles, including excavators, forklifts, truck-mounted cranes, bucket trucks, construction, agricultural, mining and forestry equipment, scissor lifts, boom lifts and aerial work platforms. Its durable housing, center-pivot design, and ultra-tough proprietary boot ensure this joystick is able to withstand a lot of abuse.

Ideally suited for high duty-cycle applications, the fully customizable CS3 maximizes the performance and efficiency of operations through a variety of handle styles and grips with an assortment of push-button and lever options.

With corrosion-resistant components and conformal coated electronics, this rugged controller provides an environmentally sealed and safe mounting for any application that is exposed to the elements. Offered in single- and multi-axis models, it is engineered for smooth, non-biasing handle action and supports a variety of deadman functions.

These devices also feature long-life Hall-effect technology for a contactless proportional signal.

The CS3 line of joysticks can also be configured to a range of output configurations, including CANopen, J1939, and basic CAN protocols, for seamless equipment integration.

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Quote Ref: **516**

Turning the wheels of industry

Products from Curtiss-Wright's Industrial division are suitable for numerous industrial vehicle applications. The Arens Controls portfolio includes by-wire shift selectors for automatic/automated manual transmissions for trucks, buses, etc; and mechatronic controls including multiple-function operator consoles and hydrostatic lever controls. Power management systems including traction inverters, DC/DC converters, DC/AC inverters and power distribution modules for hybrid vehicles are also available.

Penny & Giles joysticks come in single- and multi-axis configurations and can be specified with multiple handle options to offer proportional control and an HMI for numerous on-/off-highway applications. Linear, tilt and rotary sensors are suitable for numerous applications, and its solenoids and solenoid valves include standard and configurable designs in a selection of styles.

Ideal for electric vehicles such as aerial work platforms and pallet/stacker trucks, the PG Drives Technology motor controllers include AC, AC/DC, permanent magnet DC and separately excited versions. Integrated control systems featuring joystick, interface, traction and ground modules are also available to manage the entire functionality of AWPs.

Williams Controls products include floor-, narrow-, suspended-, LCV, EM and rocker electronic throttle controls, with complementary systems including lever-operated and rotary electronic hand controls, standard and customizable heavy-duty industrial joysticks, and contact and non-contact rotary position sensors.

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Quote Ref: **517**

818 state of the art

The Type 818 instrument cluster is Bauser's widest-ranging solution, offering maximum overview and control for most large forklift trucks, agricultural equipment and construction and compaction machinery. It is equipped with a CAN interface for CANopen, SAE J1939 and Tier 4 emission control, offering up to 21 warning lamps – but has the potential to downsize according to customer demands. Whenever this is required, a different front foil can be implemented.

Type 818's warning lamps can indicate conditions such as engine preheat, a blocked engine intake air filter, engine oil pressure, engine oil temperature, and engine coolant temperature.

In addition, it is also possible to present machine status indications such as handbrake, AdBlue (diesel exhaust fluid) fault, master error, lever position, hydraulic filter blocked, dipped beam lights and direction indicators.

Type 818 offers TN-display bar graphs on either side, presenting, for example, fuel level on the left-hand side, and engine and hydraulic oil temperatures on the right-hand side. With its viewing angle also at six o'clock, the central display is a 3.5in TFT color display that comprises transmissive technology and contains 320x240 dots.

As with Bauser's other solutions, this technology is fully operational in ambient temperatures ranging from -30° to +85°C.

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Quote Ref: **518**

Wear-free measurement in the tank

Ultrasonic fuel level sensors operate on the principle of continuous measurement and enable precise detection of the fluid levels in tanks with complex geometry. elobau's new 2UF ultrasonic fuel level sensor was specially developed for use in diesel and biodiesel, and is the ideal choice for agricultural and construction machinery due to the high reliability and long service life enabled by the wear-free and contactless technology.

The contactless measurement principle prevents continuous contact with the medium to be measured. Nevertheless, the sensor has still been designed for long-lasting resistance to diesel fuels, especially biodiesel.

The sensor measures the surface of the fuel with a resolution of up to 1mm over a measurement range of up to 1.2m. It has been designed to operate in harsh environmental conditions and has an operating temperature range of -40° to +105°C. The corresponding temperature drift is removed and adjusted via the electronics integrated in the sensor. Because, in mobile applications, the medium in the tank is constantly in motion, wave movements or sloshing caused by reflections at the tank wall are eliminated through damping and do not directly affect measurement results. For special application cases, the individual parameters can be specifically adapted by elobau sensor technology.

An optional focus tube, made of diesel-resistant material, focuses the ultrasonic waves and stabilizes the measurement range if positioned at an incline or when there is sloshing around in the fuel tank. The focus tube also increases the maximum achievable measurement length.

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Index to Advertisers

JUST WHEN TECHNOLOGY AND COLLABORATION WAS STARTING TO IMPROVE THE SITUATION IN THE RUSSIAN OFF-HIGHWAY MARKET, SOMEONE HAD TO GO AND SPOIL THINGS...

Before the Iron Curtain fell, Soviet Bloc countries needed hard currency in the same way Bugs Bunny needs carrots – the result being that, in Western Europe at least, one could buy great Eastern European products at knockdown prices.

At the time I was living in the UK and struggling with the shocking cost of things compared with what I had been used to in my student days. I decided that to save money I would get a motorcycle to reduce traveling costs. An MZ150 made in the East German town of Zschopau came at a stunningly reduced price versus the Yamahas and Triumphs that were my true objects of desire at the time, so I shelled out the cash at a back-street dealer and was ready to ride.

I LOOKED AT SEVERAL MACHINES WHERE THE ENGINEERS HOPED TO WESTERNIZE THEIR PRODUCTS WITH A QUICK LIKE-FOR-LIKE REPLACEMENT

The MZ was interesting – it was practical, cheap to run and actually pretty reliable. I used it for years then sold it to a broke guy with a girlfriend 180km away, and who was convinced that hacking back and forth each weekend on a 150cc motorbike to see the object of his desire was the answer to his dilemma.

If any criticism were to be leveled at the MZ, it was the lack of finesse. For example, whereas the Hondas all used plastic multiplugs to connect the electrics, the MZ had huge brass connectors joining each single wire. Where the MZ's instruments were in rubber housings, Honda dials were in GRP binnacles. The bottom line is, they could make a good motorcycle, but in those times the materials that western companies took for granted just weren't available to engineers in the Soviet countries, so the finesse – and perhaps just a little reliability (the damp got into those connectors big time) – was missing.

Some years later, I did some consulting for companies trying to get into the then-burgeoning Russian construction machine industry by replacing the Russian components with western alternatives. I looked at several machines targeted by the hapless engineers who were hoping to update and westernize their products with a quick like-for-like replacement.

Illustration: Julie Welby

I might just as well have been looking at my MZ! What had seemed to be a simple replacement exercise generally culminated in a complete redesign of the drive systems – not really due to the quality of design, but because it was all so massive! The malady that had bugged the MZ – poor access to materials – stymied the off-highway product too.

It occurred to me at the time that the subcomponents were actually military vehicle drives, but of course what would have been an excellent choice of component if you were designing a battle tank to sweep through the plains of, oh, let's say, Eastern Ukraine, did not sit too well when (following exposure to world market forces) manufactured cost became an issue. Everything was over-dimensioned and clumsy.

Did it work? Yes. Was it reliable? Probably – the gears and splines were so massive it could hardly not have been. Was it efficient and practical in terms of modern competitiveness? Well, I will leave you to speculate.

I have to say, though, that once quality components were available, the Russian companies that I dealt with were quick on the uptake and soon had product rolling off the assembly line that would hold its own in most of the world's markets – even though Russian firms tended to stick to doing business with their traditional partners.

So things were looking good. But guess what? Just as there was a good thing going with these products, the politicians got involved by stirring up the conflict in Ukraine. Sanctions were imposed and the ruble dived, so now no one is doing much at all – partly because of currency and partly because half the population seems hell-bent on killing the other half.

Now, it would be easy to blame this carnage on one particular personality, to turn this into a vendetta for one side or the other; to ask any single person to explain properly the deaths of some and damaged lives of others, the ruined infrastructure, and the waste of time, money and credibility to their causes (no matter how justified they feel they may be) that develops from this sort of situation.

What I cannot understand, though, is that if the off-highway engineering community – some of whom have barely two words of each other's languages in common – can work together, reach agreements, decide a direction and develop top-class products that are a credit to cooperation, then why do we tolerate inept politicians who cannot manage our countries or lead them in an equitable manner?

Surely it is part of a politician's job to negotiate around meaningless disharmony that ruins the work others do and stifles our economies. It is their job, it's what we pay them for! Sadly, as far as I am concerned, it is money wasted... **iVT**

Comments: theinsider@ukipme.com