

JUNE 2017

# ivt

## INTERNATIONAL INDUSTRIAL VEHICLE TECHNOLOGY

### INNOVATION FOCUS

- | Solar-powered off-highway vehicles
- | Tough hydraulic design problems, solved
- | John Deere's backhoe loader concept

### WORLD EXCLUSIVE INTERVIEW

JCB CHAIRMAN

# LORD BAMFORD

'Autonomy, hybrids and Brexit' – how will they shape the future of industrial vehicles?

### PLUS

- Hyundai HL975 wheel loader
- JCB AgriPro telehandler
- Top 5 vehicles from ConExpo



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**KEEPING IT IN THE FAMILY**

Lord Bamford, chairman of JCB and son of its founder, has a clear vision for the company and a passion for innovation in vehicles



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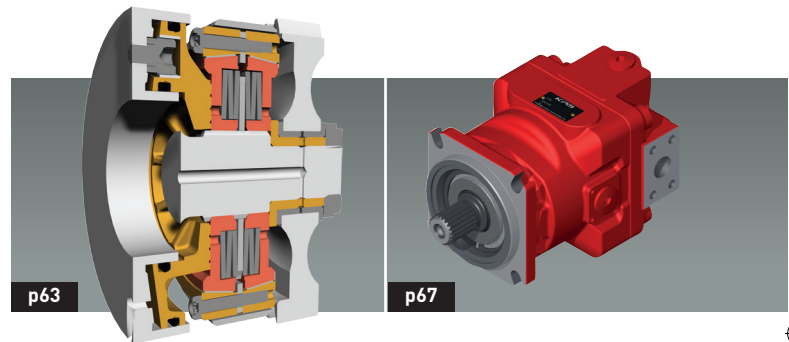
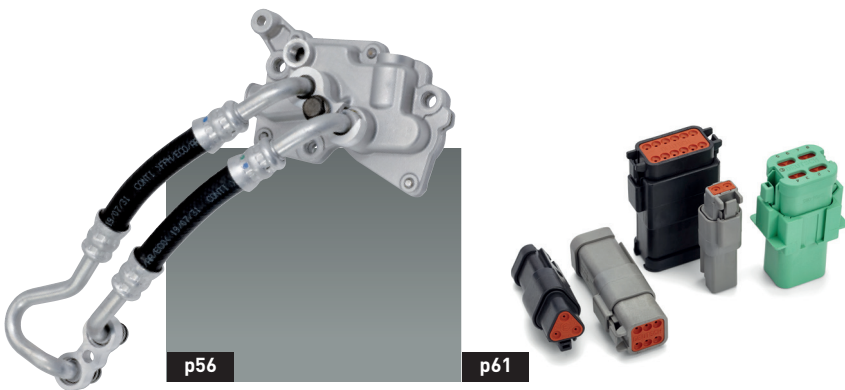
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# FOREWORD

What has driven the great men of industry through history? Money? Certainly some of the world's greatest industrialists have also been some of the wealthiest people on Earth. But it's hard to make your fortune without also having a passion for your chosen field. For Lord Bamford, that passion was absorbed literally from the day of his birth, which was the same day his father sold his first vehicle (a tip-up trailer made from salvaged metal) as a lone business operative under the name J C Bamford. Of course, 71 years later, the company is better known as JCB.

When I met Lord Anthony Bamford last week, one of the details that struck me about his office (but which I didn't have space to mention in the interview on p10) was that he had a coffee table, literally every inch of which was covered with scale, die-cast models of off-highway vehicles. The table wasn't close by, but I guess most of them were JCBs. Lined up. Row upon row. So crammed in that one or two backhoe loaders looked about to topple off the edge. It's the type of coffee table that only someone with a true passion for off-highway vehicles could ever have been responsible for – a passion that became increasingly evident as our conversation unfurled.

As luck would have it, many of the subjects Bamford touched on during our chat, we'd already planned to address in more detail elsewhere in this issue. Automation, unsurprisingly, was high on the agenda in Bamford's answers about the future. On page 18 we take a look at how some autonomous prototypes are already able to replace manned tractors on farms. Not only that,

the RIPPA (Robot for Intelligent Perception and Precision Application) is solar-powered, which leads neatly on to another hot topic of the moment – electromobility. John Deere has built a 100% electrically powered tractor and, in May, Volvo unveiled the world's first fully electric excavator. Neither of the prototypes is anywhere near market-ready, but they seem increasingly likely to be a sign of things to come.

In the same breath as hybrid engines, Bamford mentioned electrohydraulics, such as those that feature on JCB's Hydradig excavator. Perfecting hydraulic systems is an ongoing challenge for industrial vehicle OEMs, which is why, on page 28, we take a look at some of the toughest problems engineers are faced with and focus on the latest products that will help to solve them.

JCB is famous the world over for its backhoe loaders. Indeed, Joseph Cyril Bamford invented the machine in 1952, when he was the first to combine a tractor with backhoe, with one that had a front loader fitted. It's appropriate, then, that on page 36 we have a detailed look at a completely new backhoe loader concept. This one was first presented by John Deere at ConExpo, in Las Vegas back in March, as a vision for what its machines might look like in 10 years' time. It will be interesting to see how much this influences real-world design in the future.

Elsewhere in the issue you'll find plenty more coverage of new vehicles presented at ConExpo, including, of course, one or two further innovations from the irrepressible Bamford family. Ignore them if you dare.

*Tom Stone, editor, iVT International*

Coming up in the September issue of *iVT*

- AGRICULTURE SPECIAL! • OEM interview: inside John Deere's European innovation center •
- Full Agritechnica preview • Also look out for the *iVT Lift-truck Annual 2017* in August!

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# Top 5

## vehicle launches at ConExpo 2017

THE HUGE CONSTRUCTION TRADE SHOW, WHICH TAKES PLACE EVERY THREE YEARS IN LAS VEGAS, NEVADA, SAW A WEALTH OF NEW VEHICLES BEING INTRODUCED TO THE MARKET. HERE ARE FIVE OF THE LEADING MACHINES



Largest and most powerful Case D-series excavator available

### 1 CASE CX750D EXCAVATOR

Following ConExpo 2017, Case Construction Equipment, which used the event to mark its 175<sup>th</sup> anniversary, reported a record number of vehicle and equipment sales at the show.

Case's impressive booth in the North Hall was constantly surrounded by visitors, but one of its key vehicle launches was too big to fit in the hall and so on display outside: the all-new Tier 4 compliant CX750D excavator – a successor to the CX700B and CX800B.

Operating at 512hp, the CX750D is the largest and most powerful model in the company's new D series excavator line. It is available in two configurations: standard and mass excavation (ME).

The CX750D standard configuration weighs 158,300 lb (71 metric tons) and can achieve a digging force of over 75,000 lb. The CX750D ME weighs 159,600 lb (72 metric tons) and can achieve the same digging force as is with the standard configuration.

The ME configuration has a shorter boom and arm for greater breakout forces and faster cycle times. Compared with the standard configuration, it can also handle larger buckets for added capacity.

Both CX750D configurations have an electronically controlled hydraulic pump and solenoid valves to boost breakout forces, increase lifting strength and improve responsiveness in comparison with their predecessors.

New design, hydraulics and operator environment



## VOLVO CONSTRUCTION EQUIPMENT L350H WHEEL LOADER

Visitors were delighted to see Volvo's new range of wheel loaders up close for the first time at its North American launch. Engineered for efficiency, key features of the range include a robust design and improved fuel use compared with its predecessors.

For many, the largest model, the L350H, stole the show with its next-generation hydraulics, powered by a Tier 4 Final D16J engine for high torque at low RPM. It also comes with a rock bucket measuring 7.3m<sup>3</sup>

(9.5 cubic yards) for maximum performance and to expand its uses to quarry production.

To boost the L350H's reliability, it has increased clearance between the rear fenders and tires, allowing greater access when fitting tire chains and reducing the risk of damage to the body of the vehicle.

The L350 has an operating weight of 50-54 metric tons (110,250-119,000 lb) and a static tipping load of 35 metric tons (76,680 lb).

3

Can achieve **8%** higher lift height than other skid steers

## JCB TELESKID

JCB used ConExpo to launch its revolutionary Teleskid – the world's first and only skid steer and compact track loader fitted with a telescopic boom.

The Teleskid boasts impressive features. It can reach 2.4m (8ft) – 60% further forward than other skid steers on the market, and is also the only skid steer in the world that can dig 1m (3ft) below its chassis.

The machine can achieve a lift height of 4m (13ft), which is 8% higher than other skid steers.

Another attractive feature of the Teleskid is that it can carry out the work functions of four machines – forklift, telescopic handler, compact loader and skid steer – making it both versatile and productive.



## CONEXPO REVIEW

# 4

### LIEBHERR LRT 1090-2.1 CRANE

Liebherr launched two rough-terrain cranes, designed especially for high capacity and safety, at its huge outdoor plot at ConExpo.

The LRT 1090-2.1 and LRT 1100-2.1, which can be maneuvered easily in off-road applications, are powered by a Cummins diesel engine that delivers 194kW (264hp) and supplies a maximum torque of 990Nm (730 lb-ft).

A key selling point of the new cranes is that they can be assembled easily at worksites and feature two lift capability modes – long and strong.

The LRT 1090-2.1 (pictured) features a 47m (154ft) telescopic boom comprised of a two-stage hydraulic cylinder with a rope extension mechanism for smooth extension.



The VarioBase support increases the vehicle's safety and flexibility on-site

### MORE FROM CONEXPO

Don't miss our case studies of the **JCB AgriPro** (launched at ConExpo as the Industrial DTVT telehandler) on [page 42](#), and the all new **Hyundai HL975** wheel loader, on [page 50](#). There's also insight into John Deere's **Fixstern Backhoe** concept, which was launched at the show, on [page 36](#)

### PETTIBONE ARTICULATING MULTIPURPOSE TRUCK

Pettibone, part of the Ardco Group, released its articulating multipurpose truck (AMT) at the show.

The truck can be transformed into a multipurpose vehicle, suitable for use in different environments, with the addition of customized and standardized attachments. The attachments, which can be fixed to the rear of the truck using bolts, include flat beds, drills, personnel carriers, water tanks and dump beds.

"You could purchase one machine – the bare chassis unit – buy five or six attachments and then carry out a number of functions with that one machine," said Tim Niedzwiecki, a senior sales engineer at Ardco, at the company's ConExpo press conference.

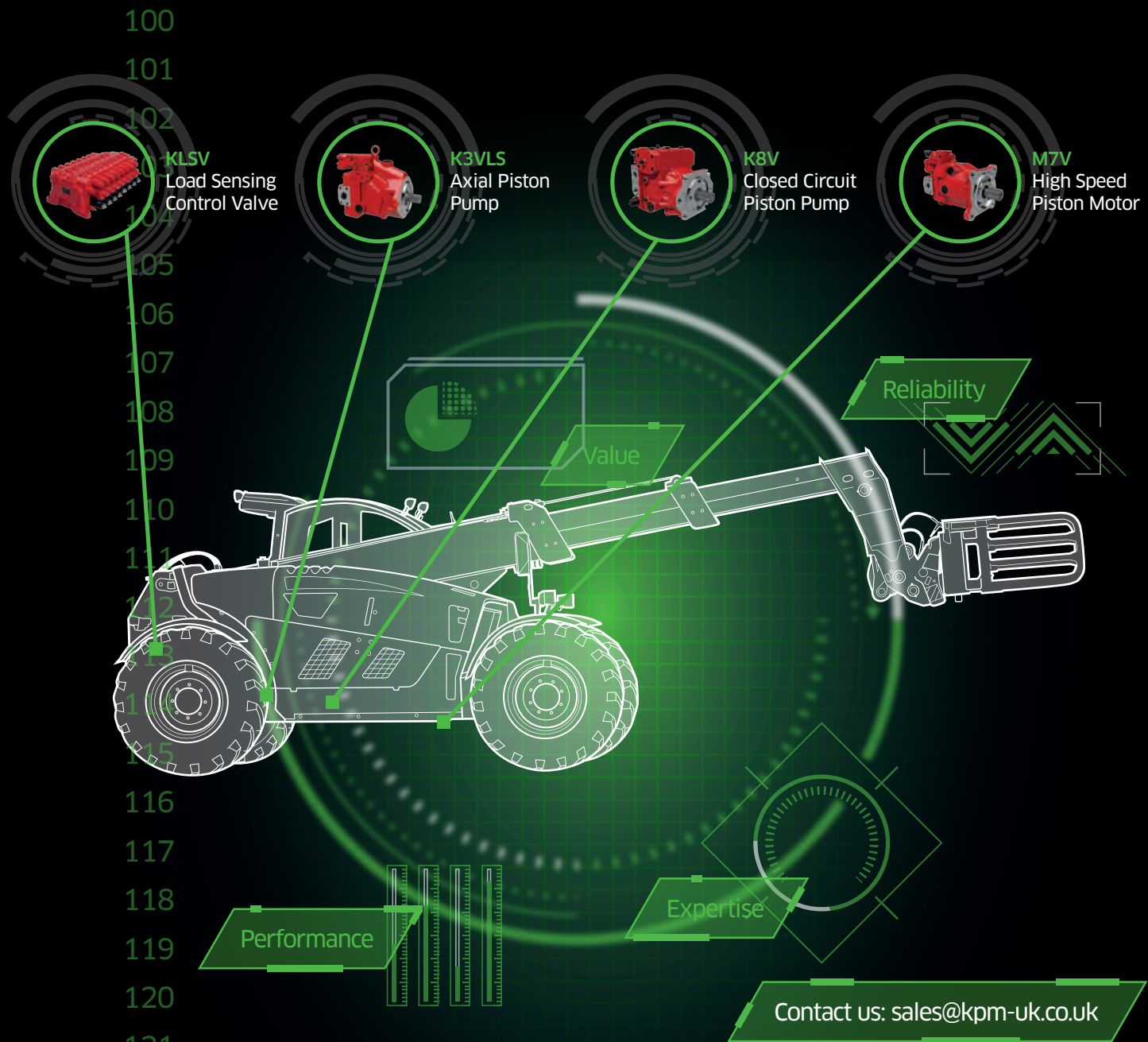
Ardco, which initially made a name for itself by producing custom-made machines for specific applications, created the Tier 4 engine-compliant AMT 400 and 600 models to suit a wider range of customers' needs.

Easy-to-add attachments transform the truck's function





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## WHAT'S NEW

### FORESTRY FOCUS

# Log details

## FLEXIBLE FRIEND

### Sennebogen develops operator-friendly mobile material handler

Sennebogen's new mobile material handlers have been put to work at the Pfeifer Group sawmill in Germany.

The company's 730 E has been developed with a number of features to maximize the operator's productivity. Available with a choice of two engines, the machine is equipped with either a 164kW Tier 111a-compliant unit, or a 168kW Tier I4f engine. Both include direct-injection, turbocharged, charge air cooler technology with automatic idle and automatic stop functions to help keep emissions and fuel consumption as low as possible.

Engineers reduced deadweight on the vehicle, thanks to the weight distribution of the rear boom – saving a further 20% in fuel usage in the process.

The elevated cab provides the operator with an unobstructed view on all sides, while the endlessly turnable upper-carriage gives considerable flexibility. A stacking height of up to 10m is possible and the 730 is capable of carrying as much as 4.3 metric tons at a 10m reach.



## FUTURE VISION

### Virtual reality means the operator can stay in the cab

Hiab is moving forestry work to the comfort of the truck cabin with its advanced virtual-reality technology.

The camera-based HiVision control system positions four cameras on top of the forestry crane that provide the operator with a realistic 270° view of the working area when wearing the virtual-reality goggles.

The company, part of Cargotec, delivered its first system to LogLift forestry cranes, based in Sweden, but its potential benefits could reach many other off-highway applications.

"We are very happy that customers have shown an interest and trust in the HiVision control system. We will continue the close cooperation in the future in order to gain the customer's insight for further development," says Martin Klyver, sales and product business manager at Hiab.

## CUSTOM BUILT

### Volvo designs New Zealand-specific excavator

Volvo has developed custom-built excavators for the New Zealand forestry market.

The EC250DL and its heavier relative, the EC300DL, have been specifically modified for the rugged landscape of the country's South Island.

Volvo Construction Equipment's special application solutions team, responsible for bringing the equipment to market, visited a variety of logging operations to better understand the demanding conditions faced in the region.

As a result, the purpose-built forestry carriers are equipped with a high and wide undercarriage, featuring a special heavy-duty underbelly guard and full-length track guards.

A stronger engine hood and side panels, as well as

reinforced fuel and hydraulic tanks, were also fitted, while the cab has three emergency exits and 31mm-thick reinforced glass to enhance safety.

Button Logging, based in Canterbury, New Zealand, works on hundreds of hectares and its operations have benefited considerably from using the EC300DL.

"Forestry is not the kindest industry in New

Zealand. The gear has to be pretty tough for our environment," owner Rory Button explains. "Logging is a lot different here than, say, in Europe. The wood is much bigger, so there is a real demand for tracked machines."

Forestry is a vital part of the nation's economy, accounting for more than NZ\$1.6bn (US\$1.1bn) in revenue per year.





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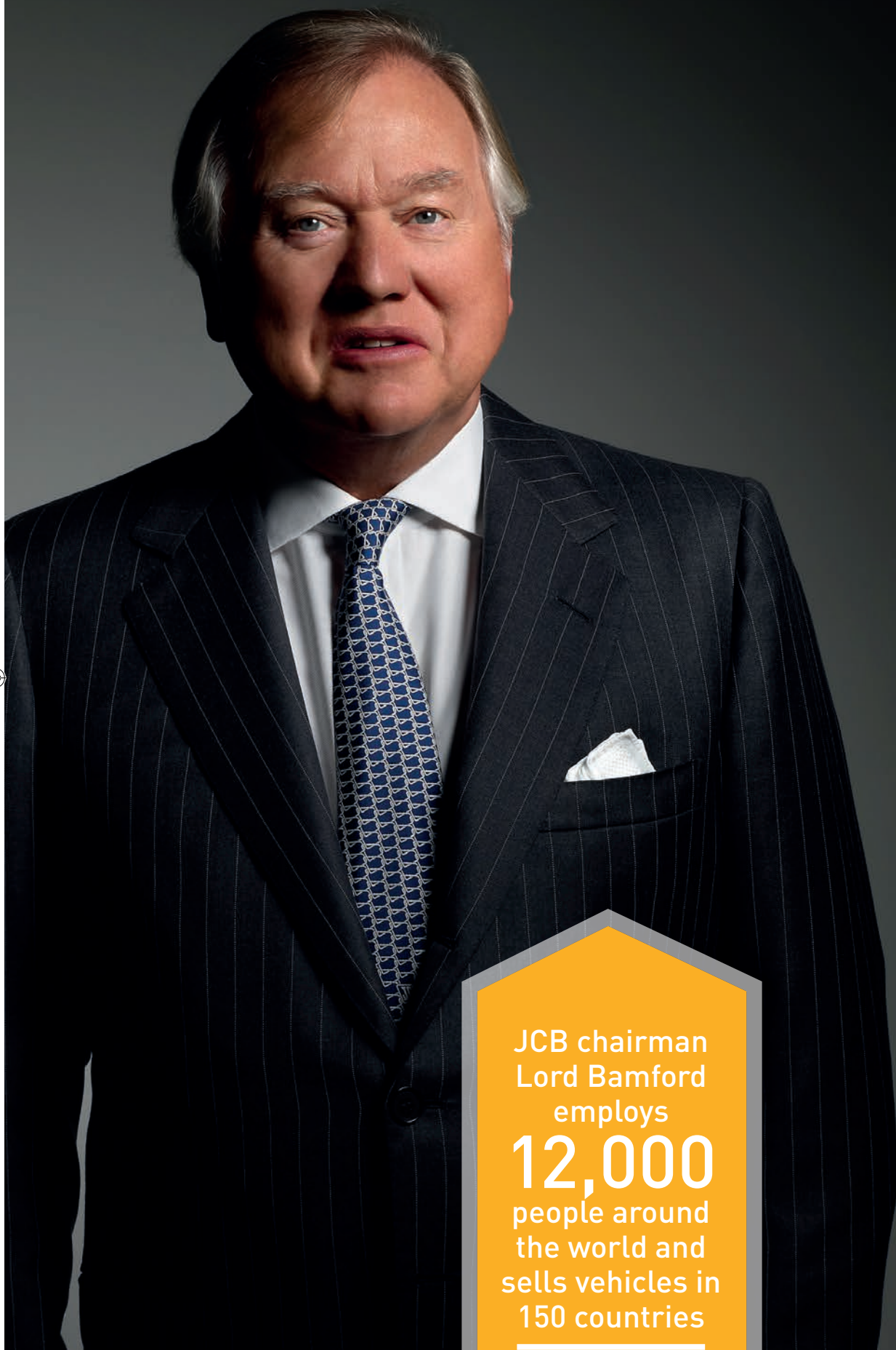
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# Keeping it in the family

OVER THE PAST 70 YEARS, JCB HAS TAKEN ON THE WORLD - AND WON. BUT, FAR FROM RESTING ON HIS LAURELS, CHAIRMAN LORD BAMFORD, SON OF THE FOUNDER, IS DETERMINED THAT THE COMPANY CONTINUES TO GROW AND INNOVATE, WHILE NOT LOSING TOUCH WITH ITS ROOTS



JCB chairman  
Lord Bamford  
employs  
**12,000**  
people around  
the world and  
sells vehicles in  
150 countries

## OEM INTERVIEW

▶ Lord Anthony Bamford is possibly the only company chairman in the world who can say he is exactly the same age as the business he runs. His father, Joseph Cyril Bamford, sold JCB's first machine – a tip-up trailer – on the day he was born, in 1945. Now JCB employs 12,000 people and sells in 150 countries. When it comes to off-highway vehicles, there is no one who can say they have lived them in quite the same way as he has. And there's still so much more to do...

Bamford arrives at JCB World Headquarters in Staffordshire, England, on the morning of our meeting. The day before, he had flown back from business meetings in the Middle East. At 71, many company chairmen would be thinking about starting a comfortable retirement – and for anyone with wealth estimated by *The Sunday Times* at £3bn (US\$3.9bn) 'comfortable' is an understatement – but Bamford shows no signs of slowing down. Industrial vehicles are in his blood and he's still passionate about innovation and predicting the future.

"There will still be a need for machinery – I am sure of that," he says. "Autonomy is already here in some products – tractors for instance. Case and John Deere have developed tractors with no human involved. They may not be commercially viable, but full autonomy can be achieved more readily with tractors than construction vehicles."

At JCB, driver-assist systems are already bringing autonomous functions into the real world. Its Fastrac tractor uses GPS to improve efficiency, and a Proximity Braking System (PBS) is in new wheel loaders. Developed with FCC Environment (UK), it automatically sounds an alarm and applies the brakes if a person enters a preset exclusion zone around the machine.

### World view

Bamford's office looks out over a large lake and landscaped grounds that surround JCB HQ; beyond is the



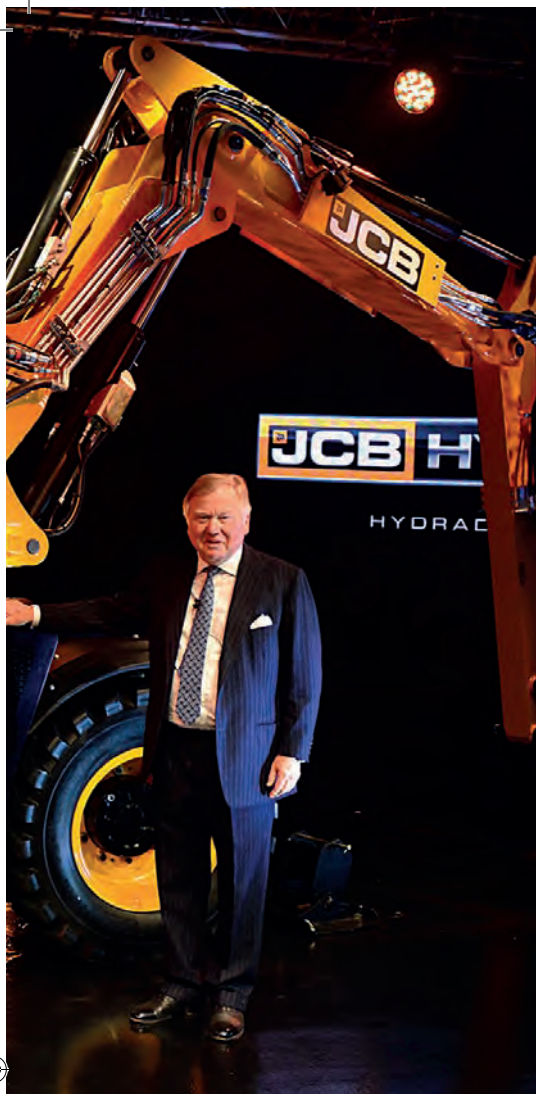
**"THE ENGINE MANUFACTURING I ACTUALLY OFFERED TO CATERPILLAR, SAYING, 'WHY DON'T WE DO THIS AS A JOINT VENTURE?'... BUT THEY WEREN'T INTERESTED"**

lush green countryside where he grew up. It is only five miles down the road to Uttoxeter, where his father rented the single lock-up garage that was the start of the business.

Distant though the dusty plains of Asia seem as the rain lashes the plate-glass windows during our chat, that's where Bamford's attention is often focused. No wonder – JCB is the number-one construction vehicle manufacturer in India, with five factories there and also one in China. It's a fact that is taken into

consideration when developing new machines. For instance, while hybrid electric engines and advanced hydraulics might make sense in the West, they don't translate well to developing nations.

"We have electrohydraulics on some of our machines – including the Hydradig, which is really quite an advanced machine. But one has to temper it with the requirements of the marketplace, as we're selling machines all around the world," says Bamford. "I was in Saudi Arabia and Dubai yesterday. If you are working in very high temperatures, in dust, and many hundreds of miles from a service truck or dealership, it's no good needing a computer to solve a problem, because it doesn't work. So I'm not sure that this headlong rush into more and more sophisticated engines and hydraulics actually works in many parts of the world, so it's a bit of a dichotomy. We have more sophisticated



**A LIFETIME IN THE MAKING**

Bamford has lived every stage of the JCB story. But what would his father, Joseph Cyril Bamford, who passed away in 2001, think of what the company has become now? "Everything he would see now would be things he knew about," says Bamford. "He knew and was involved in the first diesel prototypes, before we went into manufacturing those engines at Ricardo. So I hope he would be pleased with where we are... But what he probably would say is that it wasn't happening quickly enough!"

"He was an engineer and that, more than the financial figures, was what really mattered to him. One of the problems with today's engineers is that they're not good at sketching. They can do it on a computer screen, but it helps enormously to do it rapidly on paper so you can illustrate what you're thinking.

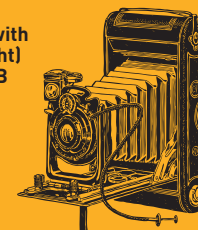
"What he started is continuing. We haven't gone into all sorts of other things; we've stuck to machinery and basically to industry,



ABOVE: Lord Bamford with his mother Marjorie in the early days of JCB, 1948

INSET: Bamford with his father (far right) and the entire JCB workforce, 1947

agriculture and construction, with the last the larger proportion. And we've stuck with diesel engines, hydraulics, gearboxes, axles... that's what we know. I suppose if we were a public company, then people would say we're quite a pedestrian company and should have a foot in different camps, but I don't think it's the right thing for us to do."



excavators in Europe and the same physically being made in India – but with simple hydraulics and engines. We need to do that, and I think our competitors are doing the same."

Perhaps they are, but in Bamford's opinion, competitors are not being quite so savvy about where the real potential for market expansion lies. "We've been in India since 1979 and it will one day be the largest economy in the world. There are 1.4 billion people and it is ignored by lots of companies – particularly in the USA. They see China and think 'Oh, there's 1.5 billion people', but India has an enormous middle class and is moving towards urbanization, while families are getting smaller, meaning they will have more money."

**Betting on Brexit**

Closer to home, there has been a lot of focus on trade deals recently as the UK begins negotiations to leave the European Union. Bamford was a

MAIN IMAGE: Bamford with the Hydradig, a revolutionary new design

vocal supporter of the vote to leave, even writing a letter to his staff to recommend the move. While he's still confident that there will be huge benefits, there is a note of impatience in his tone as he considers the current position.

"I'm more than happy it will be better – and better for Britain," he says. "But we do have to have a better plan for what we do afterwards. It's no good just saying, 'Ah, we've done it'. We have to have a plan. It's rather like Bush in Iraq – he didn't really have a plan for what happened after and we haven't yet got a plan for what happens when we're out of the EU. We won't be out of the single market, though. All this speculation about losing the market won't happen. The USA sells into Europe with no trade agreement whatsoever and does quite satisfactorily – so will we."

JCB is already the number-one manufacturer in the world for

backhoe loaders and telehandlers, "but there are still other machines we only have a small share in, so they'll be the next to go at," he says.

**Ahead of the game**

Taking on US competitors is something Bamford is no stranger to, although sometimes it's unforced errors that give him the upper hand. "The engine manufacturing I actually offered to Caterpillar, saying, 'Why don't we do this as a joint venture?'" Bamford reveals. "We'd developed the engine – with Ricardo and AVL – up to the stage of having many prototypes running and I offered it to Caterpillar, saying, 'You'll need this, it's a four-cylinder – can be three or six', but they weren't interested. We were their largest single customer for diesel engines, buying 100 or so a day, and they didn't even bother to reply, actually. It was more like an NIH syndrome [not invented here] with

### THE STRONGEST LINKS

One of the latest revolutions in the way JCB works is its telematics program – LiveLink. At the end of 2015 the Uptime Centre was created – a huge control room with a giant screen across one wall, which displays the status of every one of the 138,000+ machines worldwide connected to the system. As it is brand new, it is still being refined and improved.

“There are four areas we’re perfecting,” says Tim Burnhope, JCB’s chief innovation and growth officer. “Servicing: We monitor all machines and help our dealers to proactively plan servicing.

“Operational health: What is a machine doing? How’s it performing? If it’s down, we can respond very quickly or do remote diagnostics.

“Geography: This is very valuable. We know exactly where the product is and our rental companies absolutely love that.

Farmers can also use it to geofence acreage.

“Fuel: If one operator is using a machine harder, then that’s the one that will have greater wear and tear. Fuel tells us a lot.”

“In my view, this is the future,” adds Bamford. “Yesterday in Riyadh I was opening a new dealership. I went to look at their LiveLink center. A man had stolen a 457 [wheel loader] and LiveLink tracked it down, and it was working. The police were told where it was and they returned the machine. It was all within a two-day period. We’ve had many machines stolen [in the UK] that end up in Poland or the Czech Republic, or wherever, and we know that the next day we can track them. But that’s not the only reason for LiveLink. It is also immensely valuable to our customers, to our dealers and to us as well.”



ABOVE: Operatives at work in JCB’s Uptime Centre, located close to World Headquarters in Rocester, UK

**“OUR STRENGTH IS THAT WE REINVEST IN OUR BUSINESS EVERY DAY, AND SO THE LONG-TERM FUTURE OF IT IS THOUGHT OF”**

them, and all they did was carry on with their old engines and gradually modify them. But they’re not as fuel efficient, as tight, or as tolerant as our engine, which has been a great success. It’s got low down torque, which we need for our machines.”

It is revealing that Bamford’s delight in this anecdote comes not only from the financial success of JCB’s engine business, but also from the technical achievement. With such skill on-side, business growth will inevitably continue to follow. Nevertheless it is as a family business that he sees the future unfolding. “I’d love it to continue to be a family business,” he says. “Family businesses have their strengths. I know they also have weaknesses, but our strength is that we reinvest in our business every day, and so the long-term future of it is thought of.

“All our development costs are expensed the very day they’re created,” he continues. “A lot of public companies write those costs off over many years to artificially increase profits. We wouldn’t do that.”

And R&D spending is increasing, with separate budgets for different vehicle teams. “So our tractor design team does nothing but tractors,” says Bamford. “But we have a lot of liaison to create standardized components, which has enabled us to grow the business with more products – we have at least 300 basic products in our offering, costing from £1,500 up to £250,000.”

#### People power

Of course, investing in the future isn’t just about technology, it’s also important to invest in the right people. And investing in people and the engineers of the future is another thing Bamford is passionate about. With that in mind, JCB

sponsors a part state-funded free school for 14 to 18-year-olds to encourage the next generation of engineers – the JCB Academy.

“The academy has been going for seven years, with over 600 students and we’re oversubscribed,” he says. “We’re actively involved in helping the development of young people. They spend half their day in overalls, doing engineering. They do the main core subjects, but the bent is toward STEM subjects.” After they leave, students can do what they like, but the trend is to take up management apprenticeships at JCB or another of the sponsor companies: Rolls-Royce, Toyota, Bentley and train manufacturer Bombardier.

“Some students have learning difficulties and yet at 18 they pass the STEM subjects with high grades,” says Bamford. “We feel it’s because they have to put into writing what they’re doing with their hands and we set them programs that are real: What size of fuel pump do we need? Where are we going to buy the components from? They get in touch with suppliers. It’s serious stuff, but fun as well.

“We also have a few hundred apprentices who part of their time are trained at the Academy, part of the time practically with us, and part of the time with Sheffield Hallam University. It’s mainly mechanical engineering, but there are some doing more specialist engineering as well. They come to work at JCB afterwards.”

For his employees it must be reassuring to know that Lord B – as he is affectionately referred to by many of them – is planning so comprehensively to keep JCB ahead of the pack. But it’s also a warning shot to competitors. Thought JCB was at full stretch? The Bamfords are only just getting started. **ivT**



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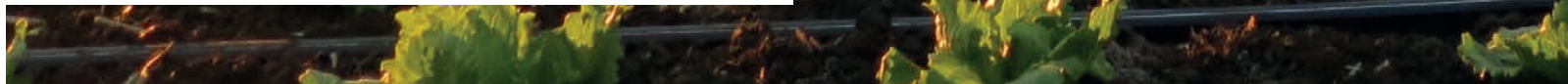
WITH EVER-TIGHTENING EMISSIONS REGULATIONS AND THE ONGOING DRIVE FOR GREATER EFFICIENCY, COULD THE FAR-FUTURE SEE INDUSTRIAL VEHICLES RUNNING PURELY OFF SUNLIGHT? THE REALITY IS, SOME AUTONOMOUS PROTOTYPES ALREADY CAN...

# Solar future

▶ Winds of change now blowing across the smog-darkened skies of the transportation sector may soon be rattling the windows and doors of less forward-thinking industrial vehicle OEMs – at least if the buzz at July’s World Conference on The Future of Transportation in Cologne, Germany, is to be believed. With the rapid proliferation of low-emission zones (LEZ) excluding more polluting road vehicles from European cities as a crisis in urban air quality mounts, radical talk of energy-independent vehicles (EIV) and the questionable viability of the internal combustion engine (ICE) is set to fill the air. But is prophetic thinking about automotive innovation a

weathervane pointing to future imperatives in the industrial vehicle market?

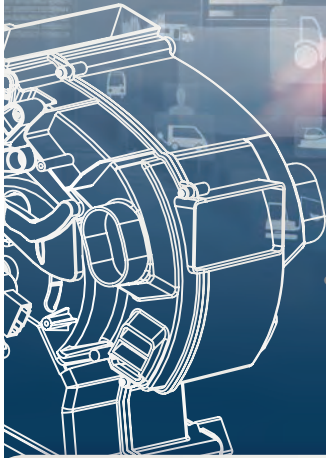
The days of off-highway vehicles enjoying exemption from LEZ regimes look numbered. In Greater London, non-road movable machinery (NRMM) on major construction sites has been required to meet Euro Stage IIIA standards since 2015 and, in a recent *IVT* poll, 52% of voters believed that OEMs should be preparing now for increasingly stringent and widespread limits on industrial diesels in cities. The work of Dr Marc Stettler, lecturer in transport and the environment at Imperial College London, seems to back their opinion. Using proprietary data from more than 1,400



The University of Sydney has developed this robot – the RIPPÀ – which can autonomously spray and weed fields, using only solar power. Is this the beginning of the end for traditional tractors?



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vehicles, Stettler will speak in Cologne about whether the ICE can meet the demands of ever-increasing emissions standards. He is quick to underline the particular public health hazard of diesel emissions. "Diesel engines are more efficient and give lower emissions of CO<sub>2</sub>, which contributes to climate change," he explains. "But we now understand that NO<sub>x</sub> emissions from diesel are considerably higher."

For Stettler, there are two distinct challenges. "We've got to move people and goods in and out of our



**"SOLAR-POWERED AUTONOMOUS VEHICLES COULD FIT WELL INTO LOW-ENERGY-CONSUMPTION OPERATIONS, OR WHERE THERE IS A NEED FOR CONTINUOUS OPERATION WITHOUT HUMAN INTERVENTION"**

Salah Sukkarieh, professor of robotics and intelligent systems, University of Sydney, Australia



cities – and then move them around. For long-distance transport, I think the ICE will probably survive."

However, in cities the picture may be different. "Where we have lots of people exposed to pollution, we might supplement the ICE with a battery or hybrid system so as not to produce emissions in a certain area."

OEMs who have led the way in embracing hybrid or all-electric vehicles would already be well-placed, were such restrictions to encompass urban construction sites.

**Follow the sun**

Dr Peter Harrop, chairman of high-tech market-research firm IDTechEx, imagines a bold future where electric vehicles never plug in, instead picking up electricity through coil-to-coil contactless charging, like electric toothbrushes. "But that's not the end game," Harrop says. "Beyond that, we're talking about energy-independent vehicles."

Through multimode energy-harvesting, the clean, silent vehicles of the future will generate their own electricity. "On land, it's going to be

**THE FUTURE OF FARMING?**

Automated agricultural EIVs are already becoming a reality in Australia. The RIPPA (Robot for Intelligent Perception and Precision Application), a prototype wheeled robot that can detect and spray weeds in crop rows, relies on its own solar panels for electric power.

"The RIPPA is powered by lithium iron phosphate (LiFePO<sub>4</sub>) batteries and monocrystalline silicon (mono-Si) solar cells," explains Salah Sukkarieh, professor of robotics and intelligent systems at the University of Sydney.

"The main reason is that it is a highly sustainable technology and opens the door for completely independent operation. We use very high efficiency and lightweight solar panels. Total energy depends on seasonal and geographical circumstances, which dictate the robot's work duty cycle, and we have a large battery buffer in case of cloudy days."

Sukkarieh sees a range of potential future applications for EIVs: "Solar-powered autonomous

vehicles could fit well into low-energy-consumption operations or where there is a need for continuous operation without human intervention.

"In farming, this will include robots that can undertake 24/7 pest surveillance or selectively harvest high-value crops.

"In construction, it may include security and safety monitoring systems. In industry, it may include robots that inspect and maintain roads, train lines, power lines and infrastructure, or that provide transport where applications involve low duty cycles."

So, what are the current obstacles to making heavy-duty electric vehicles viable?

"The first is finding a partner to invest the capital for research and development," Sukkarieh explains. "We have the technology now for large-scale, battery-powered machinery such as tractors and trucks, but there is a large cost involved in advancing the specific energy of the battery systems.

Another key is finding an application where the cost and specific energy advantages of traditional energy sources such as diesel are outweighed by the persistence, emissions and sustainability of state-of-the-art electric vehicles where solar power is used."



**Also introducing VIIPA...**

Mounted on the RIPPA is another piece of autonomous technology, the VIIPA (Variable Injection Intelligent Precision Applicator), which identifies and sprays weeds and crops.

**On the Web**

See the RIPPA and VIIPA in action at [www.iVTinternational.com/field](http://www.iVTinternational.com/field) and [www.iVTinternational.com/orchard](http://www.iVTinternational.com/orchard)

## FUTURE FOCUS

mainly solar power," says Harrop. "Hanergy in China has demonstrated four types of car that run on gallium arsenide (GaAs) solar cells developed by Boeing Spectralab for its satellites. It's structural electronics – the solar cells form part of the body of the car. It is almost vanishingly lightweight. When they park, some open like a petal, giving three layers of solar cells."

In farming, entirely autonomous solar EIVs such as the RIPPA autonomous weed-killing robot (see sidebar, *The Future of Farming?*) for lighter duties are already being developed, while the idea of 'swarms' of smaller vehicles performing roles traditionally fulfilled by heavy tractors gains credence.

Such is the vision that Harrop will present in Cologne – but he acknowledges that there is no immediate prospect of heavy industrial EIVs. "With backhoe loaders and bulldozers there's no way, any time soon, they're going to dig ditches using sunshine for energy." Instead, he envisages a journey in which the gradual progress of the market toward an all-electric future is facilitated by an increasingly sophisticated range of electrical components. Supercapacitors will handle "great lightning-bolts of

energy", regenerating electricity from braking and reverse swing.

More rugged, switched-reluctance electric motors may be deployed, vehicles will have separate motors on each wheel, and silicon carbide (SiC) and gallium nitride (GaN) semiconductors will control these motors while alleviating the need for water-cooling. "These components are expensive," says Harrop, "but you get your money back double-quick. And the big story is, because an army of people are working on reducing the cost of lithium-ion batteries for electric cars, prices are tumbling."

### Silent partners

Electric promises other benefits, too. "Digging up the road in central London, contractors are typically only allowed to work for four hours in 24, otherwise they upset residents with all the stink and pollution from the diesel engines, all the vibration

and noise." Harrop's colorful solution involves unfolding solar roads and airborne wind energy (AWE), whereby a kite or drone is flown, driving a motor on the ground. "You take to that site in central London an unfolding solar road and you fly a kite or put up a wind turbine. It isn't energy-independent, but it makes it silent and pure electric," Harrop explains. "You get permission to work 24 hours, day and night. That gives customers a much faster payback on equipment and a more positive image."

Stettler also sees optimization of use as key to a viable electric future. "By utilizing vehicles, you could spread the higher capital cost of the electric powertrain," he says, in reference to public transport deployment and lift-sharing initiatives on roads. But regarding contractors hoisting kites and unfolding solar roads, Stettler is tentative. "The solar power available

**Dr Peter Harrop will deliver his presentation 'Energy-independent vehicles: a bigger market than autonomous vehicles' at The Future of Transportation World Conference, at 1:00pm on Wednesday, July 5**



**"BECAUSE AN ARMY OF PEOPLE ARE WORKING ON REDUCING THE COST OF LITHIUM-ION BATTERIES FOR ELECTRIC CARS, PRICES ARE TUMBLING"**

Dr Peter Harrop, chairman, IDTechEx

## HIGH-VOLTAGE POWER

John Deere is hailing its SESAM (sustainable energy supply for agricultural machinery) prototype as the world's first battery-powered, high-performance tractor. The SESAM works on two 150kW electric motors and a 670V lithium-ion battery system fills the space traditionally occupied by the engine, providing a maximum output of 400hp and a top speed of 50km/h. Low on noise and emission-free, it forms part of John Deere's vision of an electrified agricultural future.

Braking energy is recovered with over 90% efficiency. The concept gives scope for farms to provide their own power from renewable energy – which could also see farms providing grid power during tractor downtime.

Operational periods without recharging are presently insufficient to make commercial production of the SESAM prototype viable; battery charge lasts up to four hours, but three hours of charging is then required. Nonetheless, John Deere believes advances in battery capacity could soon bring carbon-neutral tractor drivetrains to market.

"If electromobility comes, farmers would not only use energy, but also produce it," says Prof. Dr Peter Pickel, deputy director of John Deere's European Technology Innovation Center. "They could use electric vehicles to increase their consumption or buffer loads of solar plants."

• Don't miss the next issue of iVT for more on the SESAM tractor



### On the Web

Watch a video of the SESAM in action at [www.iVTinternational.com/sesam](http://www.iVTinternational.com/sesam)



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**CAN YOU DIG IT?**

Many thought that the world's first fully electric excavator was still some years off. But this May Volvo Construction Equipment surprised the industry by unveiling just that, at its first Innovation Summit of the year, held at the Queen Elizabeth Olympic Park in London.

The machine – the EX2 prototype – impressed gathered representatives from business and government with its near-silent operation, completely hydraulic-free lifting arm, full remote control across a wide variety of connectivity options, advanced driver assistance, and, of course, zero emissions.

Able to run for eight hours on a single charge, the EX2 is the first step along the road to achieving completely emission-free construction sites. While

John Deere's SESAM tractor [see previous page] could one day lead to marketable machines that will save farmers money in fuel costs, the EX2 is potentially even more significant as not only could it potentially save money, but it could, in fact, be required by law in city centers that are subject to increasingly strict emissions requirements.

But Thomas Bitter, senior vice president for Volvo's product portfolio, admitted to *iVT* at the launch that running such a machine off renewables will have to rely on external power generation for the foreseeable future. "For our power needs it's completely unthinkable an excavator covered with solar panels all over the place! That is not the way," he said. "So the charging technology is key."

in London is limited because you've got street canyons which don't always get the sun," he says.

Stettler explains the part autonomy might play in emissions-reduction. "We're looking at the effects of driving style – which we can control in autonomous vehicles. With smoother driving and less harsh acceleration, you can reduce NO<sub>x</sub> emissions by around 25%." For Harrop, autonomy and electric are part of the same story. "Autonomy works well with pure electric drive because it's electric talking to electric. As totally autonomous vehicles come in, it's not going to be elegant or efficient to use a diesel engine that takes two seconds to get going or change its mind. You want instant control. If it's all-electric, there's a response time of 0.1 seconds, which is much more precise. There's no contention – autonomy works best with electric."

**Autonomous future?**

Harrop remains circumspect about autonomous cars. "Faced with anything puzzling, the thing stops. There are scientific papers on the increase in congestion, ironically, which may be caused by

autonomous vehicles. In terms of industrial machines, it's dead easy in an opencast mine in Chile. But in terms of digging up electricity lines in central London – forget about it. That's the last thing that'll go fully autonomous."

But are the days of off-highway diesels in urban areas really numbered? Construction NRMMS were responsible for 12% of NO<sub>2</sub> and 15% of PM<sub>10</sub> emissions in Greater London in 2010, prior to the new controls. "It's certainly on the radar of people like TfL when they look at city-wide emissions," ventures Stettler. "It's been considered quite small but, as we're reducing other vehicle emissions, it becomes a larger piece of the pie."

Harrop concurs, but in more phlegmatic terms: "Diesel is turning out to be more damaging than anyone dreamt and governments have to respond. Many are responding by tightening regulations for buses and cars, but industrial vehicles are next in line and OEMs know it. It suddenly hits you in the teeth because government says, 'Your vehicles are going to be banned and the enemy's vehicles aren't.'" Readers, take note. **iVT**



LEFT: The idea behind the EX2 is it gets charged up and then can run cable-free. However, it is possible to run it directly from a power source, too



**"INDUSTRIAL VEHICLE EMISSIONS HAVE BEEN QUITE SMALL BUT, AS WE'RE REDUCING OTHER VEHICLE EMISSIONS, THEY BECOME A LARGER PIECE OF THE PIE"**

Dr Marc Stettler, lecturer in transport and the environment, Imperial College London

Dr Marc Stettler delivers his presentation 'Does the IC engine have a viable future?' at The Future of Transportation World Conference, at 12:10pm on Wednesday, July 5

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# The 4 toughest hydraulic design problems, solved

**IN THE DRIVE FOR GREATER EFFICIENCY IN INDUSTRIAL VEHICLES, HYDRAULICS ARE OFTEN OVERLOOKED, EVEN THOUGH IMPROVEMENTS IN THESE SYSTEMS CAN BRING HUGE BENEFITS. WHAT ARE THE BIGGEST CHALLENGES ENGINEERS ARE UP AGAINST? AND WHICH NEW COMPONENTS CAN HELP TO SOLVE THEM?**

## HYDRAULIC INNOVATIONS

▶ It is hard to pick up any technical article these days without hearing about hybrids or electric drives, and although due respect has to be given to the advances that are being made in vehicle concepts, others are pushing the envelope in other disciplines, making refinements in finished vehicles that may be more subtle, but potentially have a much bigger impact on today's machines.

One of the unsung heroes of the component world is the hydraulics industry. Although our focus tends to fall on machines rather than the components, many companies are spending increasing amounts of time tweaking their products to iron out those seemingly insignificant factors that move a finished product from being an excellent product to an exceptional one.



### Problem

1

## Hydraulics are noisy

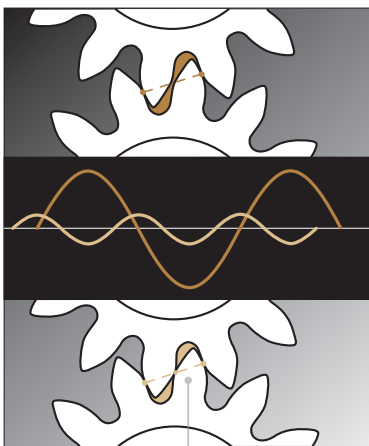
Concentric is one component manufacturer that has been working to reduce noise in hydraulic systems. Its Calma series of pumps has now reached an advanced level of refinement. Although the principle of the flow that is generated by two counter-meshing gears rotating within a fluid has long been recognized, fine-tuning has been a long time coming.

In their basic form, such pumps can generate considerable noise for a variety of reasons. The gears used in the Calma pumps employ a double flank engagement. Conventionally, a gear engages on a single leading flank, but by redesigning the gears within the pump so that each tooth is engaged on both sides of the

opposing gear as the gear enters its compression cycle, load on the individual flank faces is halved. While maintaining efficiency, this reduces the amplitude of the pressure pulsation normally associated with gear pumps by around 75%, thus reducing the vibration, which would otherwise translate into noise, resulting in a smoother action and higher relative torque at low speed.

Another pump producer, Marzocchi of Italy, has pursued the same goal with a different approach. "The new Elika range of pumps was created to face increasing demands of noise reduction," says Tiziana Ferioli, product manager for Marzocchi Pompe. "In recent years,

**Concentric Calma pumps:** Double flank engagement reduces vibration and noise



ABOVE: Calma series double flank engagement





**Marzocchi Pompe Elika pumps:**  
Developed with conjugated profiles to reduce noise

these requirements have increased considerably, because of strict environmental regulations.”

Obviously there will be teeth in any gear pump and we have seen that the effect of the compression stroke in setting up vibration is paramount. Marzocchi Pompe decided to change some major factors for the design of the Elika pumps range.

“After studying different low-noise solutions, such as single contact gear pumps, dual flank pumps and internal gear pumps, Marzocchi Pompe decided to develop helical gears with conjugated profile,” says Ferioli.

This reduced the number of teeth on each gear by moving the design to a helical or spiral gear, thus distributing load more uniformly, ensuring smoother contact throughout the cycle and fewer transitional impacts per revolution.

The company also developed a gear profile that removed

‘encapsulation’ – the phenomenon that, until now, has affected all gear pumps in that, during any given stroke of a pair of conventional gears, a small amount of fluid gets trapped between gear ‘lands’ (the base of one tooth and the top of another) as rotation takes place. The incompressible fluid causes a ‘hump’ as the gears rotate, thus a vibration. After extensive development and a university-based testing program, Marzocchi says the Elika gears are so precise in their fit and profile that they eliminate encapsulation.

It is worth noting that whatever pump is used, hose length, method of hose retention, choice of fittings and internal dimension inconsistency can also all amplify or emit noise in a hydraulic system. Therefore the advantages of advanced products must always be mitigated against good design practice.

## Hydraulics are inefficient

Problem 2

Concentric is also designing electrohydraulic steering (EHS) units. The company had hoped to create a substantially reduced energy consumption compared with conventional integrated circuit (IC) driven systems, where the engine-driven pump runs even when there is no demand. Although the system offers an energy saving of up to 50% in certain applications, in developing this on-demand electrically driven steering pump, Concentric has also gone a long way to addressing demand for a power steering pump from OEMs who are either in the hybrid market or are considering designs that incorporate hybrid technology. It’s the sort of thing that is often overlooked, but because a hybrid machine cannot rely on the IC prime mover being available at all times to provide hydraulic input for power steering, there must be an alternative system to keep things under control. Once again, these very small improvements could become vital as design moves forward.

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**Problem  
3**

**Hydraulics are imprecise**

**Optoi OIS22:**  
Precision achieved  
with barcode  
recognition

As the industry moves toward fully or semi-autonomous hydraulic control systems, accuracy becomes ever more important as there is reduced human intervention to correct errors. The system must be able to recognize any given position of cylinders, whether they are steering- or function-related.

Italian control manufacturer Optoi has achieved improved accuracy in hydraulic control by

employing an optical sensor to recognize a marked reference point on the piston rod of cylinders, thus enabling the system to lock to a specific position; for example, the central position for steering, or the optimum attack angle of a crowd cylinder.

The OIS22 system by Optoi relies on a barcode etched into the piston rod. This is read by an advanced optical sensor set into the cylinder outer body. By recognizing the barcode, it can establish the precise position of the rod within its stroke to an accuracy of 0.05mm. The barcode is etched around the entire rod diameter, so rod rotation does not affect the reading.



**Liebherr  
LiView:**  
Precision achieved  
using optical  
sensor  
technology

**Micro power**

Recognizing that any system must be wear-proof, Liebherr has taken the stance with LiView that the internal dimensions of any cylinder will not be affected by wear. LiView uses a radio signal generated by transducers mounted into the walls of cylinders to locate the position of the cylinder piston. These microwave emitters operate in the space between the lower face of the piston and the end plate, bouncing the signal off the piston lower face.

The LiView controller interprets the changes in frequency to generate a signal, depicting the relative changes in the position and speed of the cylinder. Feeding the signal into a preconfigured processor or

CANbus allows vehicle systems to communicate these in such a way that the driver or autonomous controller can react accordingly.

Mathias Engel, of Liebherr Components, sees great potential in hydraulic/electronic interface. "We believe hydraulic components and systems will remain among the most important parts of the drivetrain of off-highway vehicles for many years – there is so much potential. We focus on three key points: integrating hydraulic components into electronic and electric systems;

reducing fuel consumption and emissions; and extending the functionality of components.

"Hydraulic components will not only enable us to enhance the integration into our machine control systems and improve drive behavior, but also lead to better efficiency, which is the key to reducing fuel consumption."

Although both this and the Liebherr system have a similar aim, neither has enough long-term test data to evaluate durability. Generally, off-highway vehicles are subjected to abuse (both accidental and deliberate) and it will only be the adoption of these systems by OEMs that will indicate how robust these products are in practice.

# PLUG & PLAY

Problem  
4

**Hydraforce  
G3 valve:**  
Can be supplied  
to OEMs for  
installation in their  
custom blocks

## Hydraulic valves are hard to install

HUSCO (Hydraulic Unit Specialty Company) and Hydraforce both have a long history in creating solenoid-operated hydraulic control valves. Both companies are concentrating on the production of a cartridge valve core. This development differs from the traditional valve (which is built in to a purpose-made body) in that these are a self-contained core/solenoid/valve pack with a standardized core profile. Conceptually, these can be supplied with a generic body or supplied to OEMs for installation into their own custom valve blocks.

Hydraforce released its G3 valve in 2016 and HUSCO is expected to see mass production in 2018. Both



manufacturers cite flexibility and more effective control through higher on/off forces as reasons to adopt this concept, but for many manufacturers, ease of installation and the fact that they can effectively design their own valve layout might tip the scales. Additionally, Hydraforce claims a proportional current draw reduction of 30% due to more efficient electromagnetic forces, and in these times of almost obsessive hybridization, current draw and its

optimization might also be reason to consider these.

### Picking the right component

Incorporating new components into a design is always a question of cost and suitability. In their environments, all innovations will provide specific advantages and enable the designer to bring the final product to a new level. These products are, without a doubt, at the cutting edge of component design. However, with the hugely differing demands, in particular between traditional and developing markets, engineers need to have a clear goal. Simply because an application in the rice fields of Asia, for example, might not have the same demand for low-noise electronic system management or indeed, even precise control, as would a machine aimed at urban construction sites in the West. Nor would the customers be willing to pay for it. **ivT**



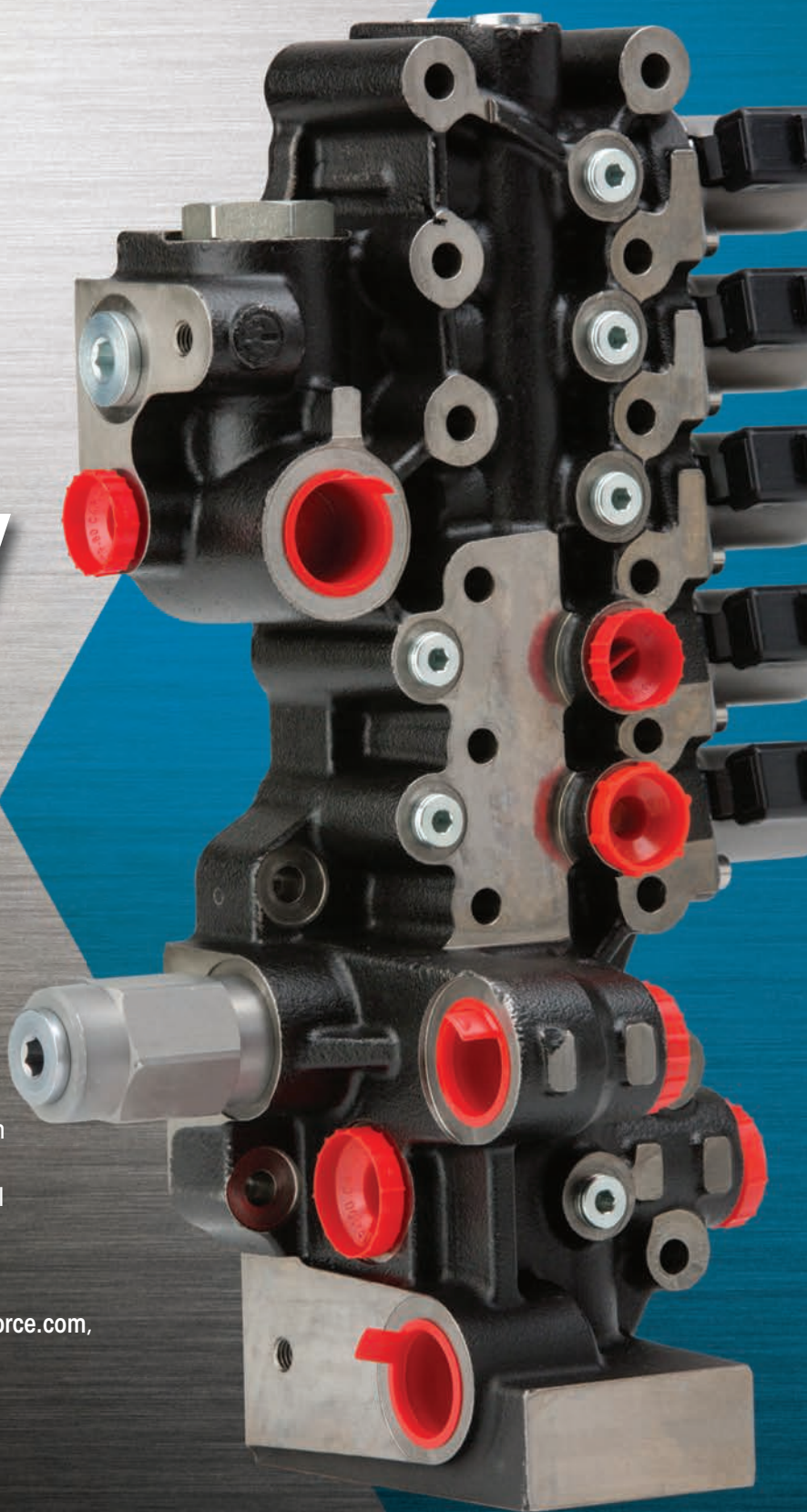
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# Guiding star

ONE OF THE MOST STRIKING MACHINES UNVEILED AT CONEXPO 2017 WAS, IN FACT, A CONCEPT VEHICLE, WHICH VISITORS COULD EXPERIENCE VIA VIRTUAL REALITY HEADSETS. NOW WE'VE GOT THE INSIDE STORY ON THE DEVELOPMENT OF JOHN DEERE'S FIXSTERN BACKHOE



**iVT CONCEPT**

LEFT: One of John Deere's currently available backhoes, the 310L



MAIN IMAGE: John Deere is calling the Fixstern a "next-decade vision for what a backhoe could be"

## iVT CONCEPT

▷ What is the most commonly requested improvement John Deere customers want made to a backhoe loader? More power? Better fuel economy? Smarter controls? No, it's much simpler – more comfort. But sometimes the simplest requests can be the hardest to achieve.

“Customers say, ‘I spend all day in these things. How can I be more comfortable?’” confirms Robert Moore, global manager of product verification and validation for John Deere. “It’s a simple request, but it’s tough to do on a tractor. So we had to start with a clean slate.” And so the Fixstern backhoe concept was born – a vision of what a backhoe could look like in 10 years’ time.

### Technical challenges

One reason it’s challenging to make a backhoe cab more comfortable is

To make the Fixstern cabin bigger, engineers had to reduce the size of the rear wheel

Designworks on the Fixstern Backhoe,” says Moore, who is an experienced backhoe engineer. “We want to get this vision out there and share some of the innovations with our customers to see which of the ideas we are presenting ring most truly with them. Then we’ll try to pull those forward and see if we can implement them sooner.”

### Revolutionary design

Reducing the size of the rear wheels on the Fixstern while still maintaining stability was no easy feat. Ultimately it was another technical innovation – the hybrid electric powertrain – that had indirect effects that made this design viable. “The hybrid drive lowers the center of gravity,” explains Moore. “It decouples the drivetrain in such a way that we

could push the wheelbase out and move the rear wheel further back. That enabled us to reconfigure some other things, giving the mainframe a modular nature. It opened up some spaces for storage and gives options for frames we might mount to the machine in the future.”

Another way in which John Deere has managed to increase cabin space is with a lightweight matrixed metal exoskeleton concept. This uses emerging materials to reconfigure the traditional backhoe form.

The Fixstern design was launched at ConExpo in Las Vegas in March, with virtual reality headsets giving attendees the chance to experience what it would feel like to sit in the cab. Extra space in the cabin freed up by the new design enhances sight lines, as well as creating space for storage bins. “There are large

**“CUSTOMERS SAY TO US, ‘HOW CAN I BE MORE COMFORTABLE?’ IT’S A REALLY SIMPLE REQUEST, BUT IT’S TOUGH TO DO ON A TRACTOR”**

Robert Moore, global manager of product verification and validation, John Deere

that it’s difficult to increase the space available to the operator on account of the large rear wheel housing, which cuts into the cabin.

“The rear wheels define how long the door sill can be,” says Moore. “They intrude into the space for the operator and make it hard to turn the seat around. Operators want additional room and more comfort when they rotate from forward facing to rearward facing. They also want much better front and rear visibility. We’ve known for decades that we’d like to make these things better, but it’s a real challenge.”

That’s why John Deere decided to go back to the drawing board. “We asked ourselves, if we could do anything we want with a backhoe, what would we do? So we collaborated with BMW







Major elements of the real-life machine would be 3D printed, allowing for new innovations

LEFT: The finished concept design  
 BOTTOM: The scale model on display at ConExpo 2017, 3D printed by Dinsmore Inc, www.dinsmoreinc.com

**BACKHOE IN DEMAND**

John Deere’s wasn’t the only concept backhoe loader on display at ConExpo 2017. Over on the Danfoss stand was a scale model of another boundary-pushing design. The component manufacturer had commissioned designer Jon Pope to refine a design that he first developed for the cover of *iVT’s Off-Highway Annual Review 2014*.

“They really liked a backhoe concept I had done for *iVT*,” says Pope. “So we decided to do an updated version of that for the future.”

A model on the stand was 3D printed, but additive manufacturing wasn’t just an effective way to display the concept – a key idea behind the real-life manufacturing of the machine is that parts of it would be 3D printed.

“The backhoe has 3D-printed loader arms, backhoe assembly and ROPS/FOPS,” says Pope. “The loader arms, boom and dipstick are designed with a honeycomb structure on the inside, which makes for very ridged structure that can take a lot of side load. The hydraulic lines are printed inside the

loader arms. This protects them from getting damaged and shields them from the elements.”

The concept proved to be prescient, because in yet another corner of the huge ConExpo site, the world’s first prototype, fully working 3D-printed excavator was unveiled – Project AME (Additive Manufactured Excavator). It shared some elements of Pope’s design, notably the housing of hydraulic systems within the loader arms, made possible by 3D-printing techniques.

“The backhoe and operator station are mounted on a rotating platform, similar to an excavator,” continues Pope. “This provides much greater backhoe swing compared with a traditional assembly. The operator station and counterweight rotate inside the rotating platform. When the machine is being used as a front-end loader, the cab faces forward. When used as a backhoe, the operator station and counterweight rotates 180° to face the backhoe. This ensures a counterweight always opposes the backhoe assembly, eliminating the need for stabilizer arms.

The articulating chassis has a pivot point that allows the front chassis to oscillate. A hydraulic ram locks up the frame oscillation when the backhoe is used on unstable ground. Otherwise the hydraulic ram is set to float, allowing the front chassis to freely oscillate.”

**On the Web**  
 Watch the unveiling of Project AME at [www.iVTinternational.com/3dex](http://www.iVTinternational.com/3dex)

BELOW: The cover of *iVT’s Off-Highway Annual Review 2014* was the inspiration for the new backhoe design



## IVT CONCEPT

A head-up display on a hard-hat visor could give servicing and real-time operation advice



storage pods that rotate with the seat,” says Moore. “The operator can rotate them and access them from the operator seat from the front or back position. There’s also a table.” This feature was particularly popular with customers who experienced the simulations in Vegas. “But there’s no reason why that space couldn’t contain an auxiliary fuel tank,” says Moore. “Or a hydraulic power unit to run hammers or saws or whatever else you might want.”

Changing the wheel base brought with it an additional challenge in terms of where to locate stabilizers, because there was no longer room in the traditional position at the rear. Now they fold away on each side in front of the rear wheels.

“They still hit the ground in the same way as they do today. But they pivot from a completely different point,” says Moore. “The goal was to maintain the same footprint and the same stability, and we accomplished that just by moving the pivot.”

### Intelligence and connectivity

Of course, as a machine of the future, the Fixstern is designed to harness the latest in artificial intelligence and connectivity, drawing from the most recent telematics ideas from John Deere. “Telematics today is

becoming wi-fi,” says Moore. “In the past couple of months we released a wi-fi device that enables communication between machines and operators, and machines and bystanders. And you can get diagnostic information on your smart device about what might need attention at the next service.”

For the Fixstern this concept is taken a stage further with a head-up display on a visor connected to a hard hat, which not only helps with machine servicing but also real-time operation. “It’s an augmented reality view that can ‘paint’ a track to show the operator the digging target depth as he changes view.”

Designing the Fixstern was a two-year project, but only the latest in what is now a 20-year relationship between John Deere and BMW Designworks. It is a relationship of which Moore is proud: “As our models have progressed, they have started to abide by a more stringent industrial design language, which is a major achievement.”

Now all that remains to be seen is how many Fixstern features are incorporated into market-ready machines by the time the June 2017 issue of *iVT* is published. We’ll do our best to remember to take a look back and inform you. **iVT**

**“AS OUR MODELS HAVE PROGRESSED, THEY HAVE STARTED TO ABIDE BY A MUCH MORE STRINGENT INDUSTRIAL DESIGN LANGUAGE, WHICH IS A MAJOR ACHIEVEMENT”**

Robert Moore, global manager of product verification and validation, John Deere

### Fixstern

*noun*

1. Astronomie: ein scheinbar die absolute Position am Himmel nicht verändernder Stern  
Fixstern = fixed star;

John Deere chose this German name for its backhoe concept as some of the ideas it has developed will be the ‘star’ they navigate by over the next decade



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# Best of

JCB'S INNOVATIVE DUALTECH VARIABLE TRANSMISSION MEANS ITS AGRI PRO TELEHANDLERS ENJOY BOTH ACCURACY AND SPEED... AND NOW THE SAME TECHNOLOGY IS BEING ROLLED OUT IN THE OEM'S CONSTRUCTION VEHICLES



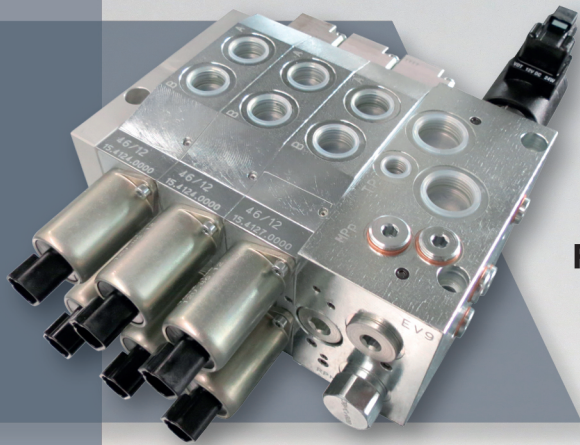
# both worlds

LEFT: The Agri Pro is as effective on the road as it is in the farmyard

BELOW: The DualTech VT Loadall brings similar innovation to the construction industry



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▷ The JCB Agri Pro range of telescopic handlers, comprising the 531-70, 536-70 and 541-70 models, was conceived to give farmers, long-accustomed to a compromise between low-speed precision and control, and high speed power and performance, the best of both worlds. And the revolutionary DualTech Variable Transmission (VT) system behind the success of these vehicles is now being rolled out across JCB's other telehandler ranges aimed at the construction industry.

With its earliest roots in agricultural machinery development, JCB prides itself on having continuously improved its telescopic handlers in response to the evolving needs of farmers since making its first telehandler, the JCB 520, in 1977. According to Tim Burnhope, JCB's chief innovation and growth officer, consolidation in the face of rising costs has seen the average farm size grow rapidly in recent years creating demand for a product that is fast on the road and productive at moving bales in the yard. As Burnhope explains, "There was a compromise because of the technologies that were offered. On one hand you could have a powershift transmission that was great for acceleration, high speed, roading and towing. But if you were handling bales in the yard or a field, a hydrostatic transmission would be precise in terms of its



ABOVE: Inside the DualTech Variable Transmission gearbox, which is able to automatically switch from hydrostatic to powershift drive

control and inching, and perfect for rehandling.

"Farmers were saying, 'Should I buy a hydrostat or should I buy a powershift?' But we realized that what the customers were really saying was, 'I need something different.' So we decided that farmers shouldn't have to compromise any more." The DualTech VT was born.

**New technology**

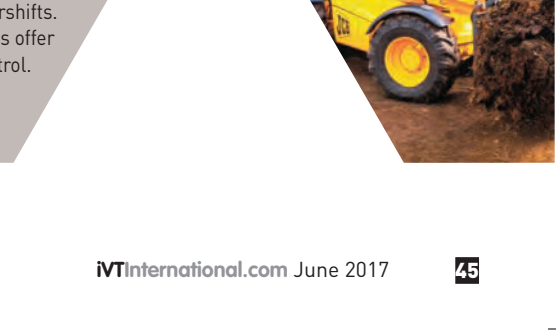
How could a have-your-cake-and-eat-it, compromise-free material-handling solution be achieved? The answer lies in the DualTech VT's industry-first two-in-one combination of separate and interchangeable hydrostatic and

**1989**  
Loadall 525-58 and 525-67 telehandlers feature improved rear visibility thanks to mid-engine installation and lower boom pivot, together with improved traction and maneuverability thanks to multimode steering and equal wheel sizes.

**THE BOOM YEARS**  
The JCB telehandling timeline – a farmyard force for 40 years...

**1980-1981**  
The heavy-lifting JCB 525 is launched, followed by lighter 520-2 and 520-4 models with 4WD and larger rear wheels for improved traction and flotation in fields and mucky farmyards.

**1986-1987**  
JCB Synchro Shuttle transmission gives improved road speeds and smoother gearshifts. Light-touch servo joysticks offer improved operator control.



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## CASE STUDY JCB AGRI PRO

### 1996-1997

The Loadall 526S features a 106hp turbo engine and larger 24in tires. The first side-engine Loadall appears a year later.

### 2001

Loadall Farm Super Special models with 120hp engines and five-speed powershift offer greater power and a 40km/h top speed. JCB's Smooth Ride System (SRS) reduces bounce and spillage on uneven ground.

### 2005

JCB-manufactured engines are installed in Loadalls for the first time, with the 526/526S and 528/528S models boasting rear-positioned 4.4-liter Dieselmax engines.

### 2006

Agri Plus, Super and Xtra models introduce six-speed powershift transmission and a new torque lock-up system. Meanwhile JCB sets a new diesel-power land-speed record at Bonneville Salt Flats, Utah, with a modified Dieselmax 444 engine and produces its 100,000<sup>th</sup> telehandler.



powershift drives in a single transmission system.

When working in first gear, from 0-19km/h (12mph), hydrostatic drive provides the Agri Pro Loadall with stepless speed control, using an electronically controlled hydraulic pump and motor to allow fine speed adjustment, responsiveness and optimum maneuverability at low speed. This makes it ideal for precise farmyard operations such as stacking bales. Whereas handlers with solely hydrostatic transmissions need to deliver power across the full range of speeds, the DualTech VT's hydrostatic module is designed to offer smoother, quieter performance at the exclusively lower speed range at which it operates.

However, as soon as the Agri Pro exceeds 19km/h, the DualTech VT system automatically switches from hydrostatic drive to powershift transmission, moving through three gears up to the vehicle's top speed of 40km/h, with no need for manual gear-changing at any stage.

Switching to powershift enables the Agri Pro to maintain the reputation of previous JCB Loadalls for vigorous performance in field work, towing and road travel, and make the most of available torque to provide brisk acceleration, powerful hauling and a workmanlike ability to maintain impetus when uphill.

### More for less

Burnhope says the Agri Pros are 13% more productive than the previous JCB Agri Super and as much as 25% more productive than models from

competitors. "Most machines in our industry have a maximum speed of 40km/h," says Burnhope, "but the clever bit, if I'm moving between Farm A and Farm B, is to average 40km/h, or as close to it as you possibly can. Direct drive in three gears makes it efficient on the road. The acceleration is incredible and it has excellent hill-climbing ability, enabling it to maintain a fantastic average speed over distance."

The 4.8 liter JCB EcoMax diesel engine in all three Agri Pro Loadall models – the JCB 531-70, 536-70 and 541-70 – produces 145hp (108kW) at 2,200rpm. Meanwhile the selective catalytic reduction (SCR) system, originally introduced by JCB in 2015, removes the need for a particulate filter.

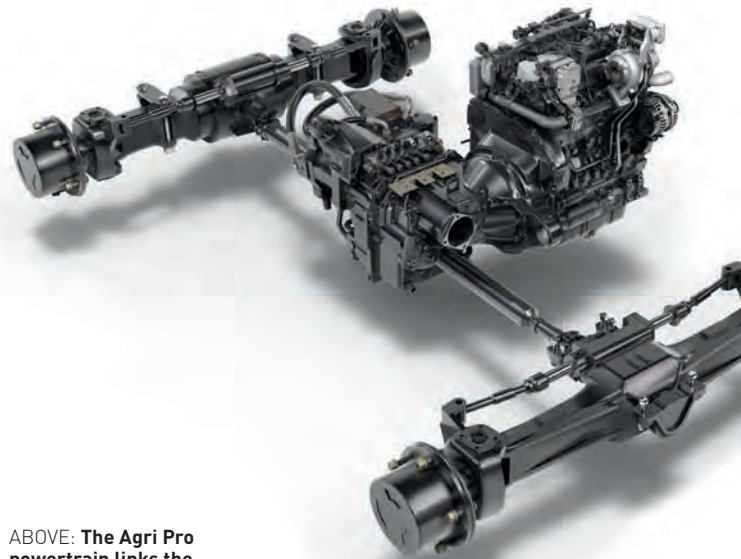
### On the up

The models differ in their lift capacity, ranging from a maximum of 3,100kg in the 531-70 to 4,100kg in the 541-70 model, with all three sharing similar physical dimensions. While the 531-70 is lighter and therefore more efficient over distance, the 541-70 caters for customers valuing load capacity over travel efficiency.

Hydraulics are provided to the boom by JCB's 140 l/min flow-on-demand piston pump together with a cutting-edge hydraulic circuit that regenerates oil pressure for the lift and extend cylinders, allowing the boom to be lowered quickly. As Burnhope explains, "Everything is timed to perfection, so as I go into

**"DIRECT DRIVE IN THREE GEARS MAKES IT VERY EFFICIENT ON THE ROAD. THE ACCELERATION AND HILL-CLIMBING ABILITY ENABLE IT TO MAINTAIN A FANTASTIC AVERAGE SPEED OVER DISTANCE"**

Tim Burnhope, chief innovation and growth officer, JCB



ABOVE: The Agri Pro powertrain links the DualTech VT gearbox to a 4.8-liter JCB EcoMax diesel engine, conforming to Euro Stage IV/US Tier 4 Final

## CASE STUDY JCB AGRI PRO



ABOVE: The Agri Pro is able to maintain consistently high speeds on-road

BELOW: Like the Agri Pro, the Industrial DTVT model has excellent boom handling accuracy at low speeds



a heap and dig some corn and come back, the hydraulics are perfectly timed for that Y-cycle. You've got enough power to lift the boom as you're going back, so it's already lifted ready to tip in." This helps reduce loading cycle times by up to 20%.

Switching from Drive mode to Flexi mode enables engine speed and ground speed to be controlled separately when the hydrostatic transmission is engaged (i.e. at speeds up to 19km/h). This allows ideal combinations of engine and ground speed to be selected for specific functions such as stacking bales or operating a yard sweeper – ground speed is regulated using the right foot pedal, while engine speed is adjusted using an electronic hand throttle. A memory feature allows setting combinations for specific boom operations to be restored.

### Personal profile

Agri Pro operators can also choose between the performance profiles of Power and Economy modes. Power mode allows the engine to run at maximum revs, exploiting the machine's full capability for

operations such as heavy lifting and towing, where strength and power are paramount. Switching to Economy mode puts a 1,700rpm ceiling on revs, alters power delivery characteristics and initiates earlier upshifts, giving a more relaxed driving experience and, according to JCB, reducing fuel consumption by 5% across an agricultural duty cycle.

All Agri Pros feature a seat-mounted servo joystick with proportional roller switches for boom control, high-intensity LED lamps providing 360° 'daylight' illumination for late-night or early-morning work, and the power brakes first seen in JCB's 550-80 Loadall model. Meanwhile, a forward and reverse shuttle trigger minimizes the need to use the brakes when changing direction, making it possible to work for long periods without braking at all.

### Industrial revolution

Having successfully pioneered the DualTech VT system as a response to changes in the demands of modern agriculture, JCB has now extended its benefits to other sectors. Three new industrial telehandlers with DualTech VT were launched in February 2017, followed by the unveiling of the first Industrial DTVT construction vehicles at ConExpo in Las Vegas, Nevada, in March. Burnhope cites green waste contractors, roofing firms and the fracking industry among those likely to reap the benefits and it is not hard to see how a range of customers contending with similar repeat handling cycles, as well as the need to traverse around or between sites, will soon also begin counting the gains in productivity, efficiency and driveability that the Agri Pro delivers. **ivT**

### 2016

JCB launches the Agri Pro range with industry-first DualTech VT transmission in the same year as historic Loadall production reaches 200,000 units, with JCB manufacturing a total of 90 Loadall models.

### 2014

Automated boom suspension and generative lift cylinder hydraulics form part of a smart technology package offering quicker loading and reduced fuel consumption.

### 2015

The compact 525-60 features new separate control of ground speed and engine speed. The JCB T4F EcoMAX engine enables Loadalls to meet new emissions standards without recourse to a diesel particulate filter.

### 2017

Following the success of the Agri Pros, telehandlers for industrial and construction markets – Industrial DTVTs – are unveiled.



### On the Web

Watch a video of the Agri Pro in action at [www.ivTinternational.com/agripro](http://www.ivTinternational.com/agripro)

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BELOW: The HL975 bucket is built with curved side plates to prevent material spilling and to protect the vehicle body



Wheel loaders have been the subject of a lot of attention at Hyundai recently. Within the past 12 months, the Korean firm successfully launched the HL900 range of vehicles.

With eight variants available, the HL900 family is already a sizeable one, but Hyundai is not finished and has found space for at least one more. The latest addition is the HL975.

“The new HL975 wheel loader takes an important place in our wheel loader line-up,” says Juston Thompson, product specialist at Hyundai Construction Equipment Americas. “It gives customers a more affordable alternative to larger loaders like the Hyundai HL980, and provides higher horsepower, larger bucket capacity and improved tipping load than the Hyundai HL970 model.”

Bridging the gap between the HL970, with its 7.3 cubic yard bucket, and the HL980, with its 5.75 cubic yard bucket, the company is expecting the new model to be the Goldilocks wheel loader for many customers – not too big, not too

small, but just right with its 6.3 cubic yard bucket.

Following extensive research among operators across the globe as to their expectations for the next generation of wheel loaders, the HL975 has been developed to include a number of features and technologies that set it apart even from some other members of the HL900 family.

Even the bucket itself incorporates the latest engineering know-how, with curved side plates preventing material spilling. Made out of high-grade anti-wear steel, the bucket also has an enhanced spill guard at the back that protects the wheel loader’s joints from potential damage.

#### **New power generation**

It is in the powertrain, though, where the HL975 distinguishes itself from other wheel loaders in the Hyundai range.

All of the vehicles in the HL900 series have Tier 4 Final-compliant engines, but while its closest relatives (the HL970 and HL980) are powered by Scania engines, underneath the



ENGINE

**250kW**

max. gross power

**1,765Nm**

peak gross torque

**24.9mph**

top speed

## CASE STUDY HYUNDAI HL975

hood of the HL975 there is a Cummins QSG12 unit instead.

The decision to introduce a different engine was an intentional one and was not taken lightly, explains Thompson.

“We had some requests from customers who said they would like a Cummins engine,” he says. “They had previously shown a lot of loyalty to the Cummins engine, and here in North America they were very familiar with it as it is used in the majority of our products, so they wanted a machine with the Cummins engine.”

Providing maximum gross power of 250kW at 2,100rpm and gross torque peaking at 1,765Nm, the engine gives the vehicle considerable power to handle the inevitably tough tasks of digging and loading in quarries, gravel pits and surface coal mine environments.

**BELOW: The HL975 comes with an eco-pedal as standard, which allows the operator to distinguish between economical operation and power operation**

### Running cleaner

Boasting such performance figures is all well and good, but the modern wheel loader is also expected to

meet increasingly stringent emissions legislation.

Along with selective catalytic reduction technology and a diesel particulate filter, there is a suite of engine technologies to ensure that the HL975 satisfies the fuel efficiency requirements placed on it as well.

Equipped with an eco-pedal, the operator is able to maximize fuel savings when using anything between 0% and 85% of the engine throttle. When circumstances require more, additional pressure on the pedal provides the necessary extra power to make sure the job gets done.

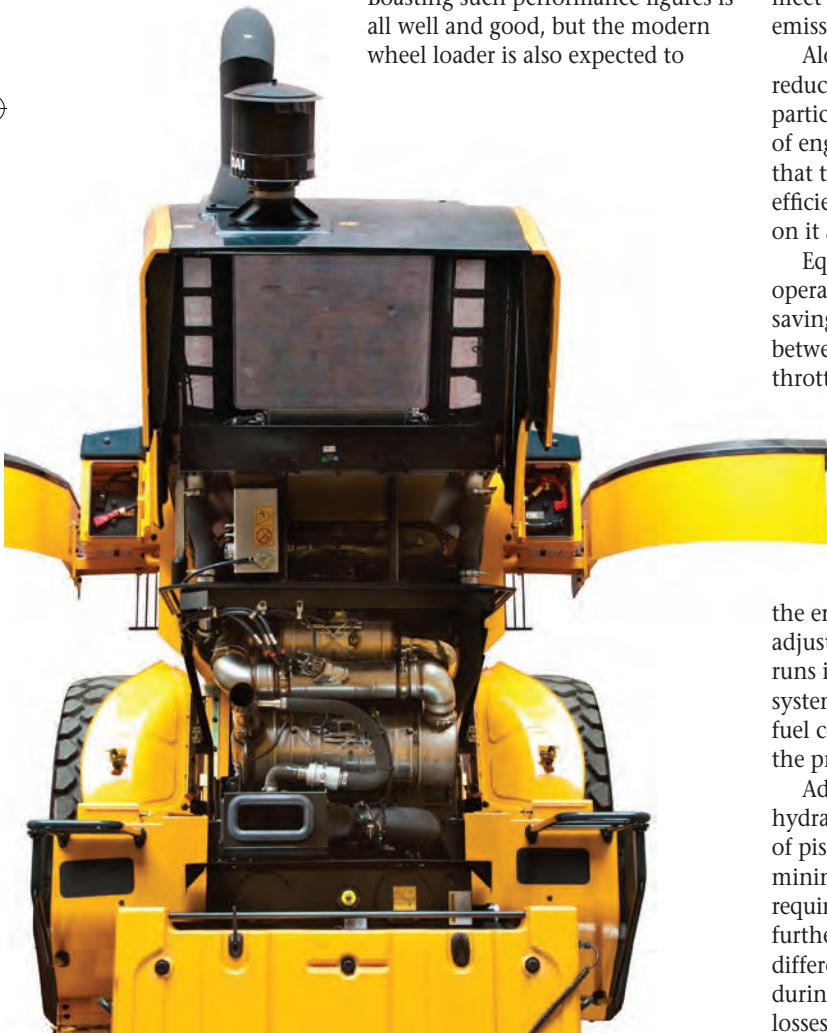
An automatic shut-down functionality on the engine enables the operator to adjust the settings for how long it runs in an idle state before the system stops – reducing unnecessary fuel consumption and emissions in the process.

Additionally, load-sensing hydraulics provide precise control of piston pumps and discharge the minimum oil pressure and flow required to enhance engine efficiency further, while a hydraulic lock differential prevents tires slipping during operation to also limit fuel losses and improve productivity.



**“THERE IS AN INTEGRATED AUTO-WEIGH SYSTEM THAT ALLOWS THE OPERATOR TO TRACK INDIVIDUAL MATERIALS”**

Justin Thompson, product specialist,  
Hyundai Construction Equipment Americas





## HAIL THE CAB

The cab of the HL975 is laid out with ease of operation in mind. Larger than previous models, the LED monitor is intentionally laid out in a way not too dissimilar from a modern smartphone and by connecting their phone's wi-fi to the vehicle's Miracast system, the operator is even able to view their gadget's screen on the monitor.

Elsewhere in the cabin, operators benefit from an

electrohydraulic implement control lever that allows for both typical joystick control, as well as fingertip control, and helps minimize fatigue by requiring less exertion from the individual.

The controller, along with the armrest, is mounted on the fully adjustable seat to provide high levels of comfort, while the cabin includes innovative noise reduction technologies to leave in-cab sound as low as 73dB.

### Worth its weight

The HL975's technologies, however, extend much further than the engine.

"There is an integrated auto-weigh system that allows the operator to track individual materials," says Thompson. "It increases productivity by making sure materials are weighed out properly. It weighs the amount collected in the bucket before it is dumped and can then also show the cumulative total dumped, so it can show the total number of loads put into the truck and has the ability to track three different materials."

"At the end of the day, it'll all be put through the Hi-Mate system, which is our telematics tool, and you can then go online and see what was the exact output by that machine."

Of all the vehicle's features, it is the auto-weigh system that Thompson believes sets the HL975 apart from its wheel loader competitors.

Accurate to  $\pm 1\%$ , the system is considerably more accurate than typical onboard scales. The

measurement results produced, as well as various other informative facts and figures, are displayed on a new 7in color touchscreen monitor.

Thompson concludes, "The HL975 wheel loader provides features that combine to give our customers what we call 'the Hyundai edge' – performance, convenience, serviceability and safety."

When the technologies and features are all combined, with the HL975, Hyundai seems to have covered all bases for the needs of today's wheel loader operators. **iVT**

**LEFT: The HL975 allows the operator to measure the load collected in the bucket and track the weights of up to three materials**

### LOADING

**23,435kg**  
breakout force

**20,000kg**  
max. tipping load

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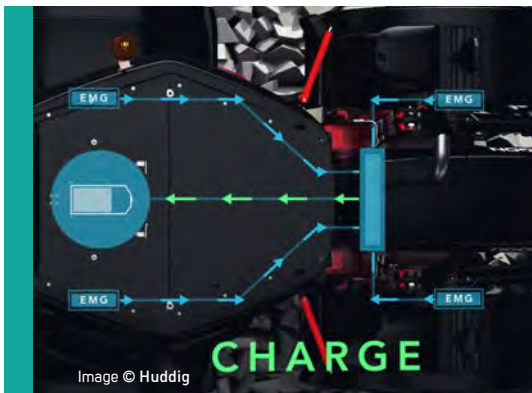
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# Safe and sound

ADVANCES IN FUEL HOSE DEVELOPMENTS MEAN THEY CAN BE PRESSURE-RESISTANT, CAPABLE OF PERFORMING IN HIGH TEMPERATURES AND ELECTRICALLY CONDUCTIVE

Construction and agricultural machines and other industrial vehicles place special demands on materials and engineering. That's because the throughflow volumes encountered here require correspondingly larger line cross-sections, as a result of which the materials used are subjected to even greater stresses than in the automotive sector. Hoses and lines installed in the engine compartment have to withstand ever higher pressures and temperatures here.

The latest fuel hoses from ContiTech can withstand temperatures of up to 35 bar. Such pressures occur, for example, in intake lines for high-pressure pumps in combination with an upstream particulate filter. Feed lines for large engines also have to withstand high pressures to ensure a reliable supply to the fuel injection pumps. The rising temperatures in the vicinity of engines where the fuel lines are used are another factor. The outer lining of ContiTech's fuel lines can therefore withstand a radiant heat of up to 180°C briefly and a continuous temperature of up to 160°C. The enhanced pressure and temperature resistance is achieved by means of improved strength members plus new and further improved rubber compounds.

## Flashover prevention

Another requirement from the market is the demand for electrical conductivity, as specified, for instance, in SAE standard J1645. The reason for this is to prevent the risk of ignition and the danger of a flashover caused by an electrical charge generated by a material flowing through the line. The specified resistance of less than 106Ω is achieved by using especially conductive compounds for the interior. However, it's not enough just for the hose to be conductive. Rather, the continuous conductivity of the entire line system, including the connectors, has to be ensured by using suitable materials. Both conventional metal connectors and the latest generation of conductive polyamide connectors are used here.

The high flame retardance of the fuel lines also contributes to greater safety. Tests have shown that ContiTech fuel lines withstand a flame temperature of 800°C for more than two minutes – enough time, therefore, for the driver to escape from the vehicle in the event of a fire.



ABOVE: Comprising of a hose and stainless steel pipe, the fuel line handles pressures up to 10 bar

LEFT: The flexible high-temperature hose can withstand heat of 250°C

## New kid on the block

The latest development from ContiTech in the field of fuel lines for mobile machinery is a thin-walled, extremely flexible hose with external reinforcement that is used for high temperatures. Because of its properties, the hose is fitted in especially tight, complex and hot environments – for example, near a turbocharger, in the exhaust system, or on the diesel particulate filter. Depending on the particular finish, the hose can withstand temperatures of up to 250°C. The special braid newly developed for this purpose consists of a synthetic fabric that is resistant

to high temperatures and chemicals, enclosing the inner lining made of a rubber adapted to the application. This is therefore especially flexible.

As a result of its lightweight design, this solution also offers a considerable weight advantage over the PTFE pipes enclosed in a stainless steel braid used hitherto for these tasks, contributing to reduced fuel consumption and CO<sub>2</sub> emissions.

The hose withstands operating pressures of up to 15 bar and can also be manufactured as a molded hose or for sale by the meter. In addition, a kink-resistant version is possible.

Various hydraulic hoses were often used in the past as fuel lines, but many of these proved unsuitable, particularly in light of the increased demands and the now required resistance to

biodiesel. In this regard, manufacturers can benefit from ContiTech's experience, extensive product portfolio and material, process and consultancy expertise. Thanks to their FKM or thermoplastic linings, ContiTech's fuel hoses are suitable for use with all fuels, including biodiesel (RME or PME), E10 to E85, and LPG and CNG.

In addition to the flexible heavy-duty rubber hoses, the portfolio also includes affordable NBR hoses for temperature ranges up to 80°C, plus inexpensive, lightweight pipe solutions. The connector systems used range from classic metal fittings right up to all the commercially available metal or plastic quick connectors. The lines can therefore be tailored precisely to the respective requirement and application.

**Sound strengths**

ContiTech's noise-optimized fuel lines represent a special solution. Extra strong members permit more volume at the lowest pressures. These strength members damp pressure and soundwaves, meaning that no additional damping elements have to be fitted. The complete line systems made of flexible hose elements with stainless steel pipes for diesel particulate filters, which ContiTech offers inclusive of the necessary sensors, are another highlight. Here, too, the thin-walled hoses with external reinforcement for tight package spaces are used. The hoses withstand the aggressive exhaust gases that flow through them and are compatible with all the sensors on the market.

When it comes to efficiently cutting nitrogen oxides in diesel vehicles to meet the applicable exhaust emissions standards, ContiTech took a leading role at an early stage and contributed to the introduction of the important selective catalytic reduction (SCR) technology by developing heatable lines for the urea solution used in the process. The SCR lines have seen constant further development since then.

The performance capability of engines in modern construction and agricultural machines and other industrial vehicles is based on the reliable and precise use of different media, such as fuel, water, gas, air and oil. ContiTech is at the machine manufacturers' side as a development partner with pioneering



**MAIN IMAGE: The fuel hoses are suitable for various applications**

**INSET: The heavy-duty rubber hose can cope with all fuel types**

solutions. The company manufactures all types of line system for supplying air to the engine and for providing the pneumatic pressure to operate compressors.

ContiTech develops components and complex modules for engine cooling that meet the most stringent requirements in terms of flexibility, pressure and temperature resistance. In addition, ContiTech manufactures charge-air lines and solutions for lubricating and cooling turbochargers. **ivT**

*Harald Koch is head of product development at ContiTech Mobile Fluid Systems*

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# Functional display

## HOW TRENDS IN THE INDUSTRIAL VEHICLE SECTOR ARE BEING LEVERAGED TO OPTIMIZE HUMAN-MACHINE INTERFACES

The Internet of Things (IoT) and the availability of powerful hardware have greatly affected the industrial vehicles industry. On the operators' side, consumer electronics such as smartphones are used on a daily basis within work environments – for example, to stay connected with other drivers, to pair devices to play audio, or to use QR codes as failure codes to request detailed failure reports that are displayed on the phone.

On the hardware side, the price per component has reduced dramatically and this access to cheaper yet more powerful hardware means that more can be done with less.

### Working with displays

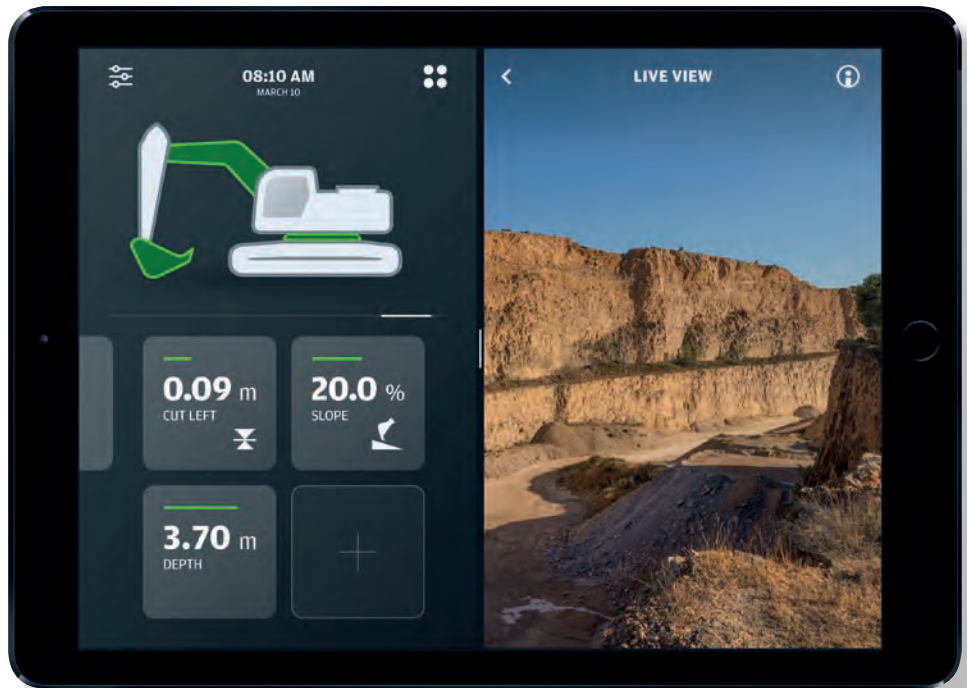
Human-machine interfaces (HMIs) now feature complex user interfaces with access to state-of-the-art graphics, 3D content and the possibility to integrate technologies such as voice recognition. In the past multiple systems on a chip (SoCs) were required to run multiple functions on displays. Today, with the increasing number of displays in a vehicle, a single SoC is more than capable of powering multiple functions on multiple displays using software that allows users to synchronize content on these displays.

Consequently, there are three HMI trends in industrial vehicle technology: personalization; multidevice displays and touch; and speech.

Elektrobit's Graphical User Interface Development Environment (EB GUIDE 6) serves the needs of these trends. The EB GUIDE 6 is an all-in-one software tool for creating executable specifications, modeling, rapid prototyping, simulation and target deployment of multimodal HMI applications. EB GUIDE enables the development of graphical user interfaces and voice user interfaces as well as touch- and gesture-operated procedures. EB GUIDE makes it easy to manage versions and variants by sharing common HMI components in between. It is multiuser capable, so large and globally distributed teams can work on the same HMI model – saving manufacturers development time and money. Elektrobit works with leading chip and hardware vendors to provide EB GUIDE target frameworks on a variety of platforms. Clean software abstraction layers ensure portability to a wide range of platforms and operating systems.

### Personalization

With EB GUIDE, a number of HMI features can be personalized – for example, to give language



support in either text or speech. Depending on the customer's requirements, EB GUIDE offers the possibility to display text or issue voice commands in the user's preferred language.

Another feature that can be personalized is the configuration of shortcuts on hard keys. As systems grow increasingly complex, the number of functions that operators can access is also increasing. The configuration of shortcuts on hard keys offers operators the freedom to set up hard keys in a manner that suits their working style.

EB GUIDE also supports the configuration of features via a service technician or at the end of line – the manufacturer can have one basic machine with hundreds of feature configurations for the end customer to order. The HMI can be built to support all features at the manufacturer's end of line; the manufacturer can configure features based on availability of functions and their end customers' requirements.

### Touchscreens and multidevice displays

Today's touchscreens come with robust surfaces that match the harsh environments of the industrial

ABOVE: Elektrobit's EB GUIDE 6 aids in the development of multimodal HMIs

vehicle domain. They can be used in hazardous environments where operators often wear gloves and protective clothing, or in environments with extreme temperatures. Not only do HMIs save time during operation, but they can also be used to provide timely information and offer direct access to functionalities.

The transition in hardware architecture to a single electronic control unit (ECU) allows operators to swipe content from one display screen to another. Having additional displays just for rear and side cameras, as special add-ons, is also a common feature of industrial vehicles. Operators can simply swipe the content of the camera they want to access onto a central display, control functions of complicated machines, or even have displays dedicated to different functions and situations. iVT

Martin Riedl is product manager for EB GUIDE at Elektrobit Automotive GmbH



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# All-weather friend

HEAVY-DUTY CONNECTORS ARE PROTECTING THE NEXT-GENERATION OF OFF-HIGHWAY VEHICLES IN HARSH ENVIRONMENTS AND UNDER EXTREME PRESSURES

Tomorrow's construction equipment, farm machinery, and mining vehicles will operate autonomously, 24 hours a day, seven days a week. TE Connectivity's sensors and connectivity solutions are at the heart of the technological breakthroughs that will make it possible. The equipment currently operating in fields and worksites is loaded with technology. Global positioning systems (GPS), camera systems, efficient engines, large touchscreen monitors and advanced diagnostics are commonplace in heavy machines. Many of these things are helping operators control vehicles semi-autonomously. The advances reduce operator fatigue and have made working long days easier. The new technology has also helped increase safety and saved operating costs.

## Onward and upward

Taking things to the next level, fully autonomous heavy vehicles are just around the corner. The thought of having huge combines and mining trucks driving around without an operator at the controls raises concerns in the minds of many. Questions about safety, standards and regulations are front and center for most people. However, for the engineers that are tirelessly working to design the equipment of the future, questions about how to transform their ideas into creations are top of the mind.

For autonomous operation, the sensing and decision-making activities normally assigned to the operator are assigned to the vehicle itself. Decision making involves complex software analytics to process inputs and assign tasks to the vehicle. All these inputs must be provided by devices that communicate with subsystems and ultimately the vehicle master control. To integrate all these new systems, industrial and commercial engineers ask themselves, "What type of connectivity products will support the breakthrough technology needed to automate the next generation of equipment?"

TE's portfolio of industrial and commercial transportation products are specifically designed to meet the extreme demands and challenges of non-stop, all-weather use. TE connectors are offered in several shapes, latching mechanisms, mounting styles and materials in order to meet diverse application requirements.

TE's Deutsch DT connectors have been making connections in harsh industrial and commercial transportation environments for over 30 years.

Multiple size 16 Deutsch contacts can be used with the DT connectors, while silicone rear wire and interface seals help enable a high resistance to extreme temperatures and moisture levels



Manufactured in 2-, 3-, 4-, 6-, 8- and 12-cavity arrangements and for cable-to-cable, cable-to-board, and cable-to-device applications, design flexibility is at the heart of the DT connector product line.

Deutsch DT connector design strengths include optional flange mounting, multi-pin arrangements and design flexibility. DT connectors offer the ability to use multiple size 16 Deutsch contacts, each with 13A continuous capacity.

Wedglocks are used to secure the contacts in position within the connector shell. Thermoplastic housings offer a wide operating temperature range and silicone rear wire and interface seals enable the connectors to withstand conditions of extreme temperature and moisture. DT connectors can be configured for printed circuit board mounting. DT connectors for electronic modules are available in straight or 90° pins and offer sealed flanges or flangeless header mounting. DT products have options for specialized headers and offer full enclosure solutions. They are also available with internal components including resistors, diodes, busbars and LEDs.

## Future requirements

Engineers designing the equipment of tomorrow need connectivity products that offer field proven reliability and rugged quality. Knowing that the

connections on autonomous construction equipment, farm machinery and mining vehicles are protected by decades of engineering knowledge and confirmed by being put to the test in the real-world gives priceless peace of mind.

Collaborative relationships between TE and innovative equipment companies will make future heavy machinery more connected. When autonomous equipment takes over the fields and worksites, products like Deutsch DT connectors will be making it all possible.

DT connectors feature several accessory items that complement the connectors, including boots, backshells, gaskets, dust caps and mounting clips. They cover a wide array of design requirements such as assisting with mounting, providing additional protection and offering enhanced aesthetics.

The DT connector product line's design flexibility empowers engineers; there's no need to compromise. Because DT connectors have been around for 30 years, the product line has evolved and strengthened by offering innovative modifications to meet engineering requirements, while remaining true to the original DT connector design as a rugged solution for harsh environments. **ivT**

Clark Woodruff is global product manager at TE Connectivity



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# Reducing time-to-market

## HIGH-PERFORMING AND EFFICIENT NEXT-GENERATION ORBITAL MOTORS ARE HELPING OEMs GET THEIR PRODUCTS TO END USERS MORE QUICKLY

Regardless of the sector in the mobile machine industry, time-to-market is always a hot topic of conversation. Hiccups, lengthy processes in developing machines and slow time-to-market, reduce opportunities for innovation, not to mention the chance to be the first to reach your customers with the newest, most reliable products.

In an era where performance expectations have a major effect on mobile machine development, companies are working to develop efficient solutions to improve time-to-market. This can include anything from streamlining the supply chain to simplifying system design. Consider Danfoss, which is taking on the challenge of helping OEM customers get their machines to market faster by innovating orbital motors.

When compared with existing models, the new Orbital X motors from Danfoss have up to 15% higher torque capability than current OMP and OMR motors, and up to 45% higher than current DH and DS motors. Shaft seal lifetime is improved by 50% and the motor also has a finish that meets the corrosion class C3 standard, making it suitable for conditions with high levels of humidity and/or industrial pollution.

### Improved design

Not only does the Orbital X motor portfolio offer high performance and efficiency for the end user, integrating one into a new or existing machine design also reduces time to market for OEM customers.

Machine design and installation time can often extend the development process. Because of this, reworking and refining an existing system to accommodate new innovations may not always be possible.

With that in mind, Danfoss designed Orbital X motors to reduce time spent early in product implementation. This flexibility is achieved through a new modular motor platform design. The Orbital X motor portfolio offers two modular platforms – one platform has offset/end ports and the other has aligned ports. The platform also offers adaptability within housing, displacement and shaft modules, meeting the requirements of a wide variety of application needs.

The simpler design leads to better availability and shorter lead times. This allows OEM customers to get what they need, when they need it, giving them a leg up on the competition.

Even when a new product or solution can easily be incorporated into an existing application, sorting



The Orbital X motors have 15% higher torque capacity than existing motors

through different configurations and design options could take additional time up front. Spot-on product selection further simplifies the integration process.

### Supporting cast

Along with the physical product launch, Danfoss also debuted a line of Orbital X tools to improve the user experience. OEMs now have direct access to the new product conversion tool, which is available in the app store. The app provides a simple overview of what product to convert to, new material numbers, differences between an existing motor and a new one, as well as links to technical information.

Other tools offered include the new product configurator, an updated product selection tool, and a product lifetime estimation tool. When working in conjunction with a Danfoss engineer, these tools provide OEMs with extensive application system support and precise product information.

For further assistance on the best way to integrate an orbital motor – and to learn how it

works with other system components to form a total machine solution – work with engineers at a Danfoss Application Development Center. The customer benefits of adding an Orbital X motor can be proved in real time, while the value to OEMs continues to grow with the partnership.

Developing ways to improve time-to-market is crucial to improving profitability and productivity for OEMs. Companies that look ahead to provide these solutions, whether in the form of a shorter supply chain, an improved machine design or a new product, ensure OEMs are equipped to best serve their customers. **ivT**

*Mette Munk is work function division product marketing manager at Danfoss*



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# A spatial relationship

WITH GREAT POWER COMES GREAT RESPONSIBILITY – TO PACKAGE ALL THAT POTENTIAL INTO A TIGHT, COMPACT INSTALLATION ENVELOPE. WITH A 20-30% SMALLER SPACE CLAIM, FERRA PUMPS DO JUST THAT

Greater power density typically enables a reduction in the size of components – which makes Concentric's Ferra hydraulic gear pump ideally suited for use in today's material handling, agriculture and construction vehicles.

The Ferra series pumps offer increased power density and deliver higher durability within a 20-30% smaller space claim. Their two-piece cast-iron design is extremely robust across a broad temperature range and offers greater installation flexibility due to the compact design.

The expanded pressure ranges up to 300 bar available with the Ferra series pumps offer industrial vehicle designers a variety of options when selecting products.

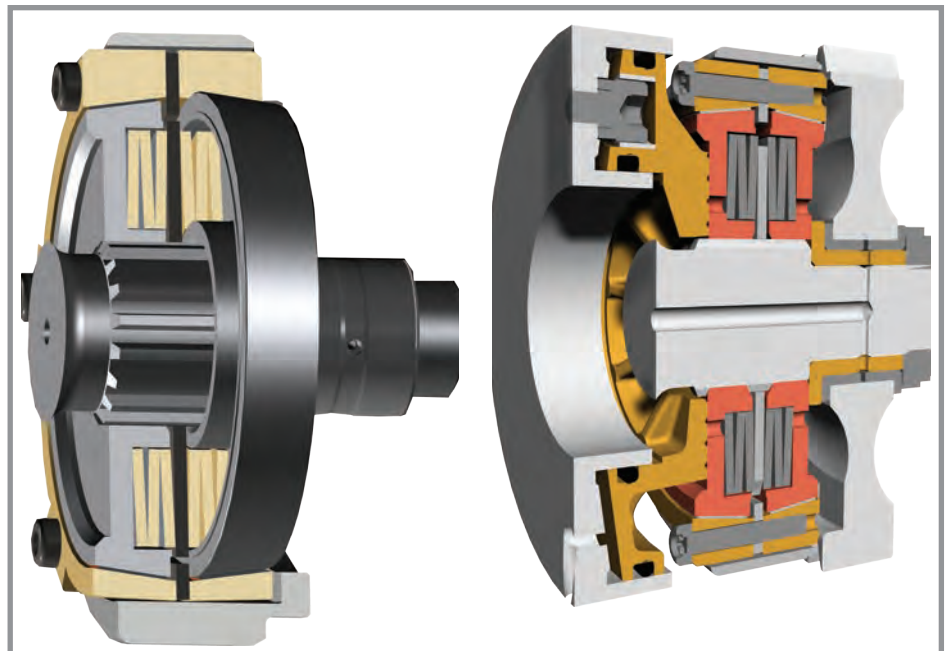
Extensive testing has demonstrated that the Ferra pump matches or exceeds competitors' products in a smaller package with better power density, while offering much improved performance at lower speeds. Both bench tests and in-vehicle tests have shown that the design is highly suitable for high-flow implement and steering circuits and fan-drive applications.

The Ferra F12 is a rugged, compact unit that is extremely robust across a broad temperature range, while also offering increased power density and greater installation characteristics compared with conventional pumps. It is a two-piece design with both housing and flange made of cast iron, which has made it possible to eliminate the rear cover and integrate the bearings into the housing and the flange.

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

The PTFE-impregnated bushings help to ensure optimum alignment and a large support area capable of handling most indirect drives and fan loads.

There are two pressure plates to ensure high volumetric efficiency at low speeds while integrated seals reduce clearance that offset axial loading and balance themselves as pressure increases.



ABOVE: Concentric's patented dual cone clutch technology

ABOVE RIGHT: Integrated actuation for ease of packaging

Concentric offers F12 pumps with a range of port and mounting options, splined, keyed or tapered drive shafts, with displacements from 16-41cc/rev, pressures up to 300 bar (4,351psi) and maximum speed of 3,000rpm.

## Smaller, quieter and more reliable

Concentric continues to develop and expand its product offering by pushing the power density envelope even higher. The ability to deliver the same power output within a smaller pump body offers designers greater flexibility when space allocation is limited. In addition, the cast-iron body is more durable and performs better under a wide range of environmental conditions.

Reliability can also be improved through better integration of components into a more contained system that reduces maintenance requirements.

Reducing vehicles' noise output is an important issue when considering how to improve the working environment. There are a number of ways that the level of noise can be reduced. Power-on-demand options using Concentric DCC (dual cone clutch) technology is one method the Calma series offers. Additionally, novel designs in the components used in the system can impact the overall noise emission levels. Pump designs can be optimized, including through the careful selection of materials, to reduce any obstructions to the flow and pressure pulsations, thereby lowering the resulting noise that is emitted.

The Ferra Series also includes uni- and bi-rotational motors. **ivt**

*William Pizzo is vice president of global engineering/hydraulics at Concentric, USA*



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# Sensor technology

THE SENSOR AND CONTROL INDUSTRIES CONTINUE TO DEVELOP TECHNOLOGIES THAT IMPROVE THE WORKING EXPERIENCE OF OFF-HIGHWAY VEHICLE OPERATORS

▶ Curtiss-Wright's Industrial Group is a recognized leader in the research, design and manufacture of critical controls and assemblies – including sensors, electronic throttle controls and joysticks – for on- and off-highway specialty vehicles. In recent years there have been a number of trends and customer requirements that have affected the company's approach to design and manufacturing.

In order to meet the need for improved productivity, off-highway vehicles have moved away from discrete hydraulic controls to fully electronic operator controls, such as those offered by Curtiss-Wright's brands: Arens Controls, Penny & Giles, PG Drives Technology and Williams Controls. These controls can improve vehicles' reliability and maximize comfort for the operator, helping to increase productivity, reduce operator fatigue, improve safety and reduce manufacturing costs.

Rapid-design techniques, such as computer modeling, have played a major role in reducing design costs, with much less time – and therefore money – having to be devoted to prototyping. In manufacturing, component counts are reduced thanks to improved technology and CANbus wiring systems. This use of less materials has contributed to cost-effective designs, as well as having a positive impact on reliability.

## Robust design

Curtiss-Wright's latest innovation, designed by Penny & Giles, is the non-contact NRH27C rotary position sensor, which is suitable for use on specialty on- and off-highway vehicles using CANbus communications.

The NRH27C extends, and shares similar features with, the company's recently introduced NRH271 and NRH272 family. These features include a low-profile sensor body, small footprint, CANbus J1939 communication and a fully encapsulated IP69K-rated design that offers protection against water, dust, shock, vibration and temperature. This makes the range ideal for use by OEMs of on- and off-highway vehicles that are used in challenging environments. The range is also a cost-effective solution for medium-volume applications where a degree of customization may be required.

Within the CAN messaging structure of the vehicle, the NRH27C's two independent Hall-effect



ABOVE: The JC040 rocker joystick controller

ABOVE RIGHT: The non-contact NRH27C rotary position sensor

sensing signals enable error checking of the positional data, which addresses the needs of safety-critical applications. Additionally, an onboard diagnostic function means predefined error messages can be sent to indicate the present state of the sensor. The versatile, factory-programmable electronics can also be set to different baud rate, node ID and frame rates according to system requirements.

Contained in a 9.5mm low-profile housing and available with industry-standard AMP Superseal, Deutsch DT04 series connectors, or simple 18AWG flying leads for customer termination, the NRH27C can be powered from a 5V DC regulated or 9-30V DC unregulated supply and provides a full 360° output range.

## Operator control

Another recent introduction is the single-axis JC040 proportional rocker, which is ideal for use in arduous applications and builds on the success of

potentiometric versions available from Penny & Giles.

Using non-contacting, Hall-effect sensing technology for long-life integrity of the output signal, the IP67-rated JC040 provides safety functionality via dual outputs – which can be set to positive or a combination of positive and negative ramps – and also benefits from independent supply voltages for each of the outputs. The JC040 rocker is designed for in-cab and electronic robustness, assured by sealing of the internal PCB to a rating of IP67.

An optional mechanical overpress feel – which operates at 20° of travel from the center position – has also been incorporated into the JC040 design to provide additional operator feedback. The electrical output of this mechanical feature can be used in a system to indicate a new mode of operation such as rapid traverse. **iVT**

*Mike Iles is a marketing manager at Curtiss-Wright Industrial, that includes the Penny & Giles legacy brand*



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# Increasing power

## OFF-HIGHWAY OEMs ARE SET TO BENEFIT FROM EXTENSIVE DRIVETRAIN EXPERIENCE AND BROADER PRODUCT PORTFOLIO

▶ Numerous factors are making the systems integration of off-highway equipment increasingly complex, including electrification and hybridization, onboard vehicle diagnostics, telematics, autonomous vehicle operation and emissions controls.

In today's competitive environment, OEMs may be reluctant to assume all the technological and capital risks alone in developing these innovations and engineering them to work together as a single, integrated system.

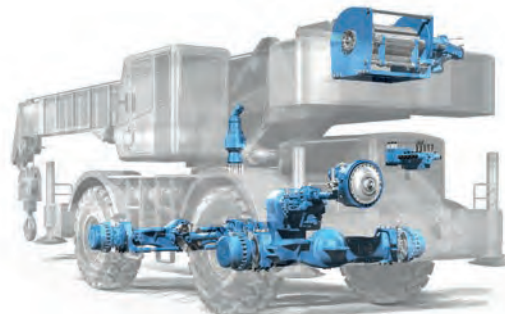
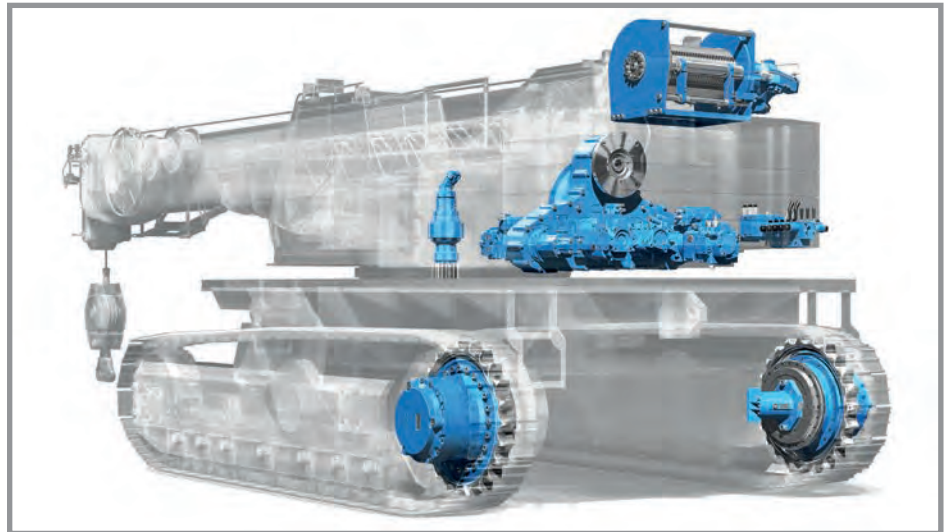
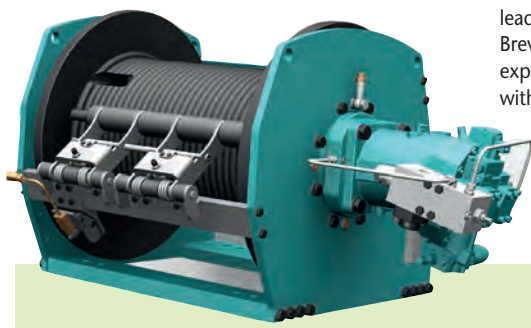
Successfully developing and delivering to market the technologies demanded by off-highway customers can only be accomplished through close collaboration between OEMs and suppliers. Dana engineers are looking to venture far beyond the traditional, simple delivery of individual components and work closely with OEMs to develop a deeper, collective understanding of how products integrate into the vehicle as a whole.

### Combining strengths

This is why Dana recently acquired the power-transmission and fluid power businesses of Brevini Group, SpA. The acquisition immediately expanded Dana's product portfolio and also increases Dana's addressable market for off-highway driveline systems by providing access to new opportunities in the tracked vehicle market, accelerating its hybridization and electrification initiatives.

The Brevini technologies include a wide range of highly engineered mobile planetary hub drives; planetary gearboxes; hydraulic pumps, motors, and valves; and advanced electronic control systems and sensors. Brevini's expertise in cylindrical gearing and planetary hub gears also supplements Dana's long history in spiral bevel and hypoid gear technologies.

By using a single source for technologies that manage power conveyance to move machines and also perform the work functions of the machine, OEMs can now leverage numerous technological and supply-chain benefits. An immediate example



ABOVE: The full system for crawler cranes now integrates Brevini power-transmission and fluid power technologies

LEFT: Dana has been developing rough-terrain crane drivetrain solutions for 50 years

BELOW LEFT: The motor/winch system provides load control for cranes

of this integration is Dana's complete drive and motion system for 50- to 100-metric ton wheeled and crawler cranes. This system includes a Spicer transmission, driveshafts and axles, as well as a Brevini slew drive, motor/winch system, splitter box/pump drive, proportional directional valve, and two mobile planetary travel drive options.

### Fully integrated, connected vehicles

Moving forward, Dana will use its technological leadership to amplify the benefits offered by the Brevini product line. Engineers are currently exploring opportunities to infuse Brevini products with Spicer Smart Suite technology.

This platform of fully integrated, connected-vehicle features converts operating data from drive and motion systems into actionable insights for enhancing productivity, improving operator and machine safety,

reducing maintenance costs, and decreasing total operating costs.

Smart Suite technology has leading-edge, machine-learning algorithms embedded into the software. By recognizing, learning and anticipating vehicle and operator behavior, this system can greatly reduce the need for equipment calibration and allows operational parameters to be customized by taking into account specific machine characteristics, engineering tolerances and operator tendencies.

The diagnostic tools offered by the Spicer Smart Suite package can monitor key mechanical components and deliver predictive maintenance to prevent breakdowns, and can alert both operators and maintenance personnel to potential issues before they cause a bigger problem. **IVT**

*Christophe Dominiak is vice president of engineering for off-highway drive and motion technologies at Dana*



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# Sealed protection

A ROBUST, INNOVATIVE SOLUTION IS KEY TO PROTECTING VEHICLE WIRE CONNECTIONS FROM THE EVER-INCREASING DEMANDS OF THE WORKING ENVIRONMENT

There are many pressures put on the electronic components used in industrial and agricultural vehicles. The causes of these pressures are the rugged conditions facing most automotive and non-automotive transportation systems, the increase in the number of electronic systems built into vehicles, and new environmental regulations.

All vehicles put some form of stress on the components from which they're made, so it is crucial for vehicle manufacturers to use components that can, to some degree, withstand shock, vibration and temperature fluctuations.

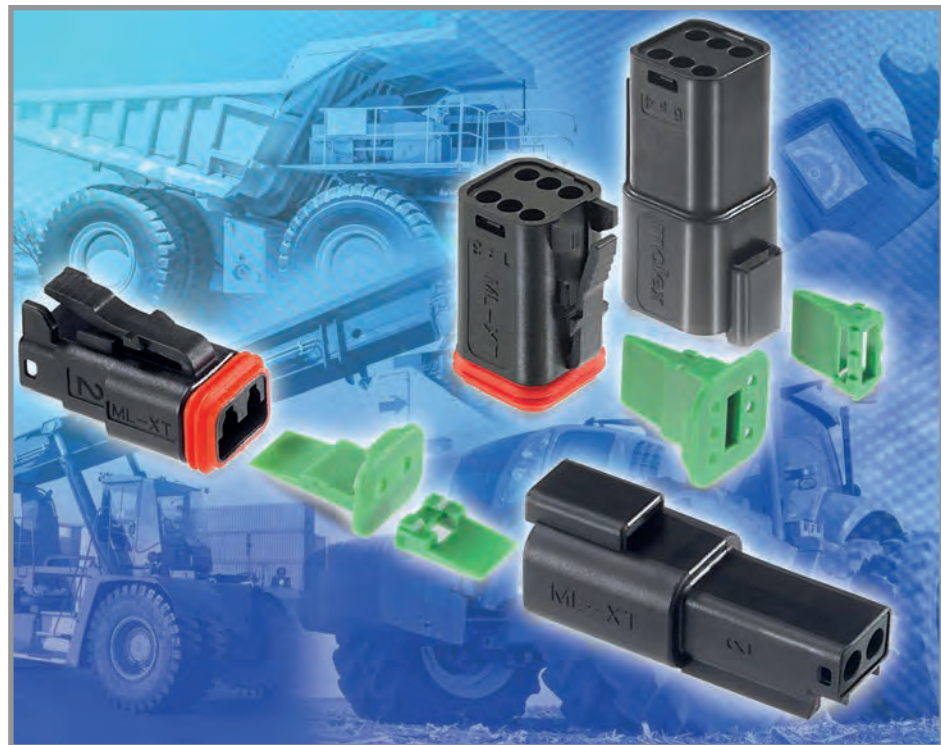
With the introduction of complex engine management systems, driver assistance systems, control systems for specialized functions such as lifting, as well as infotainment systems, the choice for the components used is even more important.

## Sealed connection system

Connector systems are especially vulnerable because they make both physical and electrical connections within a vehicle. Robustness for connector systems is especially important because they may need to be plugged and unplugged repeatedly. One platform that is proving extremely valuable for critical vehicle-wiring applications in rugged environments is Molex's ML-XT sealed connection system.

Featuring market-leading, high-performing seal technology, ML-XT has been proved to prevent the ingress of fluids under extreme conditions. Advanced two-shot LSR (liquid silicone rubber) molding produces a one-piece plug housing and interfacial seal that maintains optimum seal positioning at all times, including during mating and unmating of the header and receptacle. The result is a cost-competitive solution with superior reliability over de facto standard connectors in the industry.

The ML-XT connection system is IP69K-rated and J2030 power-wash test capable. Devices use Molex's proven XRC (extra-rugged circular) terminals with current ratings up to 13A and connectors that feature a high terminal retention force, exceeding 111N. Rear seals are made from HCR (high-consistency rubber) to prevent damage during terminal insertion/extraction, and latched rear covers lock-in rear seals to enable flexible cable exits and movement and prevent leak paths.



ABOVE: The rugged ML-XT connection system with high-performance seal technology offers reliability for critical vehicle-wiring applications in harsh environments

Plug and receptacle housings are supplied pre-assembled with internal HCR rear seals and covers, reducing inventory, assembly time and costs for harness manufacturers. The plug housing features an integral locking latch with a finger grip that enables easy handling and secure mating of the plug and receptacle. Color-coded housings are available to facilitate the easy visual mating of harnesses.

## System use

Applications for the ML-XT connection system to be used in include sensors (electrical, fluid, velocity, magnetic, moisture, navigation, position angle, optical, pressure and proximity), engine control units (ECUs), airbag control units (ACUs), diagnostics, alternators, starters, air-conditioning,

lights, pumps, power-steering modules, hydraulics and more.

TTI Inc., the specialist distributor of electronic components, has invested in new stock, new lines and field applications engineers (FAEs) to support the transportation market. The company offers connectivity solutions from Amphenol, Delphi, JST, Molex, TE Connectivity and others that address these applications, as well as supplying relay solutions from Omron, Panasonic, TE Connectivity and more, in addition to vehicle sensors from franchises including Amphenol, Honeywell, Murata, Omron, Panasonic, TDK and Vishay. **ivT**

*Dermot Byrne is industry marketing director Europe, Transportation and Automotive, at TTI Inc.*



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# Extended motor range

A SERIES OF VARIABLE AND FIXED DISPLACEMENT MOTORS, FOR USE IN BOTH HIGH- AND LOW-SPEED APPLICATIONS

▶ Kawasaki launched the M7V axial piston motor at Bauma 2016. Since then it has successfully been used in various applications, including hydrostatic transmissions, drill rigs and crane winches.

As a result of the success of the M7V, Kawasaki has extended its range to include two new products – the M7X and the M7VC.

The M7X is a fixed displacement axial piston motor and is available in three frame sizes: M7X85 (with a displacement of 85cc), M7X112 (with a displacement of 112cc) and M7X160 (with a displacement of 160cc). This product would be suitable for use in winches and earth drills.

The M7VC is a plug-in style variable displacement motor, currently available with a displacement of 85cc. In contrast to the M7V, the M7VC has a transverse displacement control mechanism, which allows for a more compact installation, making it suitable for track drives and wheel drives. It is suitable for applications where precise low-speed control is required, such as pavers and other road building machinery.

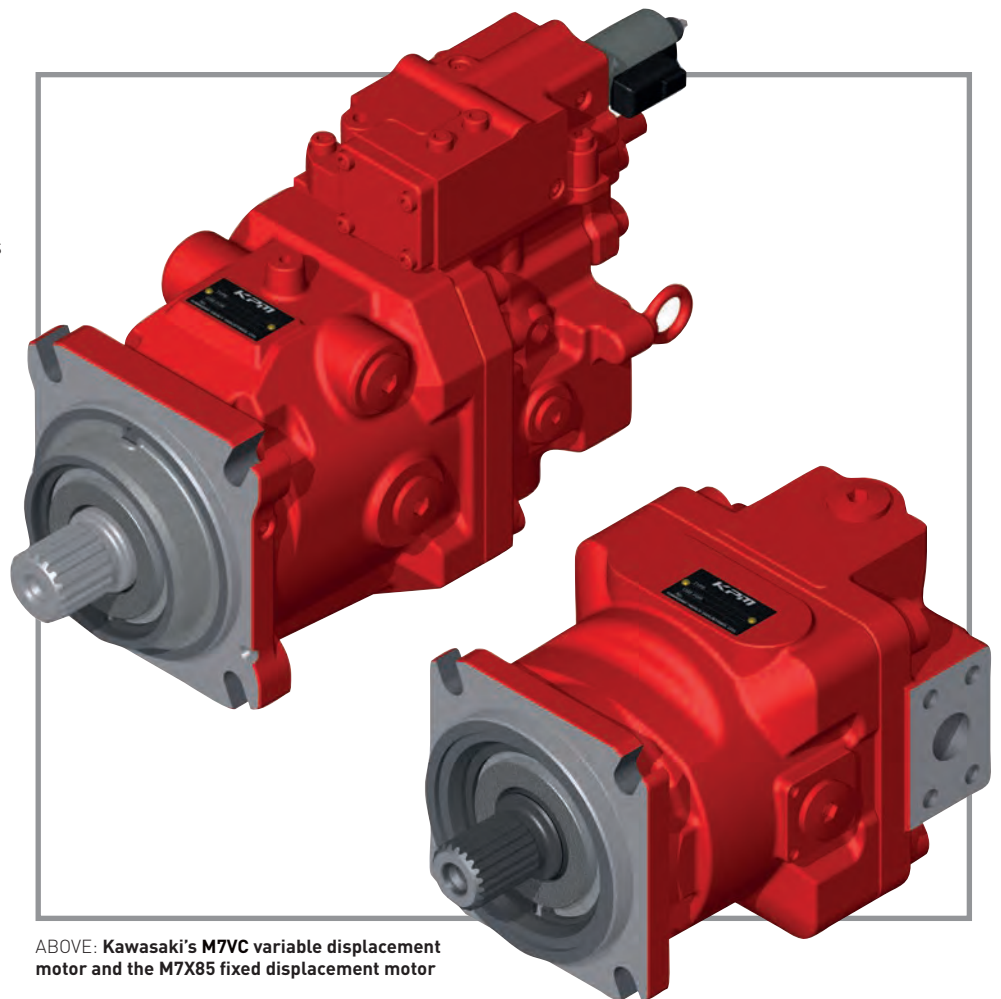
These two new product ranges offer the same smooth performance, low speed and compact design as the M7V range, which has already proved to be a success in the market for a variety of customers.

The M7V axial piston motor range includes the same displacements as the M7X series. It boasts a 400 bar continuous pressure rating and various control options. Electric or hydraulic pilot-operated proportional control and constant pressure control make this series the ideal choice for a wide range of needs.

Both series can be used with general reduction gears or couplings as the installation dimensions (mounting size, output spline) and thread size follow ISO and SAE standards.

## Research and development

When creating the M7V, M7X and M7VC product ranges, Kawasaki leveraged its experience in the field of construction machinery and industrial vehicles, while employing the fluid dynamics technology it cultivated through aircraft and rolling stock research and development, to incorporate



ABOVE: Kawasaki's M7VC variable displacement motor and the M7X85 fixed displacement motor

newly developed rotary components (pistons, cylinders, etc).

In order to achieve the high speed required in hydrostatic transmission vehicles, heat generation was a key technological challenge to overcome. When developing these three products, Kawasaki chose specific materials with greater heat resistance, enhanced the dimensional accuracy of the parts, and increased the surface hardness.

To optimize hydraulic pressure balance, the pistons, cylinder block and other rotary

components were fully redesigned and the shape and other aspects were thoroughly re-examined down to the smallest detail.

The result: compact axial piston motors that are able to deliver excellent performance at both high speed and at low speed with both low noise and smooth operation in a wide range of applications. **IVT**

*John Boote is business development manager at Kawasaki Precision Machinery UK*



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# BULLETIN BOARD

## Air-conditioning without engine power

**Webasto's** unique engine-off cooling technology provides an innovative solution for on-demand cabin cooling by cooling the cabin while the engine is turned off. This reduces the operating hours and therefore considerably reduces costs incurred by the owner of the vehicles.

At the same time, the technology ensures that the operator of the machine can work in the comfort and safety provided by a cabin that always has a pleasant temperature.

The Webasto solution is especially useful for commercial vehicles – operators often work in areas directly exposed to the sun.

Moreover, operators' cabs are often made of glass and heat up quickly when outdoor temperatures are high. The Webasto Polar Cab ES cools the

cabin when the engine is turned off, avoiding idling during breaks and still ensures an ideal working climate with on-demand cabin cooling.

An additional advantage of the Webasto cooling technology is that temperatures are kept at a stable level during downtimes, under hot and humid conditions. The Polar Cab ES has a cooling capacity of 2kW. When the engine is shut off, it is capable of maintaining cool and pleasant cabin temperatures. It is designed for a wide variety of machinery types and sizes, including trucks, agricultural machines and heavy-duty off-road machines. Webasto offers two cabin air-conditioning choices: the Osaka, which is a floor-mounted cabin air-conditioner; and the Oakland, which is a ceiling-mounted device.



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## Unshakeably accurate sensor

**ASM Sensors** has introduced the Positilt PTK29 inclination sensor, which compensates dynamic influences to give correct values even when in motion.

The sensor measures inclination between +/-180° with one axis or +/-60° with two axes. Using gyro-compensated MEMS technology, the sensor position signal is instantaneous, with no delays, and can be mounted with selectable axis orientation.

The sensor electronics are completely enclosed and protected by a hermetically sealed stainless steel housing. The compact 10mm flat and maximum 49.5mm-wide sensor housing enables installation

in space-restricted locations. For safety-critical applications, the sensor is also available in a hermetically sealed stainless steel housing with redundant output options and in protection class IP67. The rugged design of the Positilt PTK29 inclination sensor enables it to operate in areas of high shock and vibration in a temperature range of -40°C to +85°C.

The sensor is available with digital (CANopen and CAN SAE J1939) outputs and has a static linearity up to 0.05.

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## Reliable in the harshest conditions



The latest in the M Series off-highway product range from **DSE** is the new compact M840. Its size-to-feature ratio allows the controller to be used in the widest variety of applications and includes a smaller, optically bonded screen with superior clarity suitable for exterior or interior use.

The HMI/programmable color display, using a single Deutsch connector, meets IP67/NEMA 6 to cope with the harshest environments of the off-highway market.

The powerful Cortex M4 + M processor used in the design provides a 200MHz clock speed and

includes 32MB of SDRAM and 16MB of flash storage, making the performance and operation of this controller highly effective.

Features include two fully independent CAN interfaces for J1939, CANopen and Raw CAN, while an Ethernet interface provides options for flexible communication options.

The DSE M840 joins the other controllers in the DSE M Series and represents an expanding range of off-highway control equipment.

Mark Wass, division manager for DSE, says, "We are extremely pleased to see our control modules being successfully trialled and adopted as standard product within many applications across the world. We are looking forward to seeing our market continue to grow with the introduction of the new M840."

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## Adjustable mobile hydraulics solution

**Autec's** new CRD base station, tested for off-highway heavy-duty environments, integrates a bidirectional dual-band radio (both 870MHz and 915MHz bands) approved in all major international markets.

With up to 12 bidirectional proportional axis and 64 digital commands through CAN/CANopen and/or SAE J1939; it comes with four programmable MOSFET outputs.

The STOP and UMFS are safety functions (up to PLe EN ISO13849-1/SIL 3 IEC 62061 for STOP and up to PLd/SIL2 for UMFS) depending on the output configuration.

A new diagnostic display and an interface for wired control stations also come as standard features. Output ports can be adapted by

customizable connectors and cabling interfaces (e.g. M12 connector, multi-pin plug, cable gland). The system is already in compliance with the new RED 2014/53/UE directive that will be mandatory from June 2017.

A new 4.3in sun-readable color display enhances the remote control information and diagnostics from the machine under control to the portable unit. The display is completely programmable by CODESYS V3.5.

Thanks to its 256 colors, 480x272-pixel resolution, six soft-keys for display navigation, shockproof glass and wide viewing angle (up to 130°), this new display allows for comfortable visualization of the machine's operating parameters, statuses or other warnings.



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## Stress reliever for operators

Modern agricultural and processing construction machines are being equipped with increasingly complex functions requiring comfortable, user-friendly and ergonomic operating controls. As a specialist in this field, **Elobau GmbH & Co. KG's** customized systems are being used by leading tractor and off-highway vehicle manufacturers.

Until now, customized armrests were not economically feasible for manufacturers with smaller quantity requirements.

With the innovative design of the MA 225 midi and MA110 mini modular armrests, Elobau is able to offer customers a well designed and individually configurable solution.

The control modules can be equipped with various operator control options, ensuring that nearly all functions of mobile processing construction machines can be ergonomically operated.

The different approaches for reducing complexity and making increased use of haptics in the vehicle cabin are described by Elobau as 'Active Controls'.

These include displaying: only the functions needed for the work task; and variable symbols for operating elements and feedback in the adaptive joystick handle – without interrupting the operator from the actual work task.

The position and type of the operating elements of the MA110 mini modular armrest can be individually configured and ergonomics enable fatigue-free operation of the machine.

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## Semi-autonomous solution

**First Sensor's** Area View application is the latest development in automated driver assistance systems (ADAS), which utilizes long-term automotive camera design know-how. Designed to increase safety and comfort driving using several ADAS functionalities from 360° area view up to object recognition and its derivations, it supports the principle of accident avoidance. The Area View application, with its embedded control unit (ECU), meets all relevant requirements. Although initially developed for the automotive market the provided ECU facilitates up to six 2.0 MPix cameras to support difficult environments as well as large industrial vehicles.

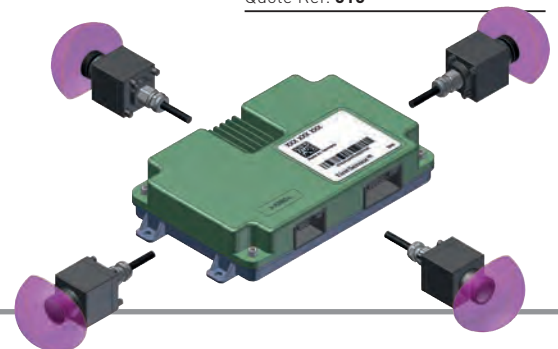
Starting from basic functionality like well-known top view or bird view functions, the Area View application supports any viewer

position and viewing angle from the vehicle to the outside world, i.e. full 360° area view, or the view from outside to the vehicle. In driving mode, the viewing position can be changed by selecting one of several predefined viewing positions on the control panel.

The application architecture on hardware and software side meets embedded requirements, e.g. hard real-time and secure abilities. It is developed under Automotive Spice (ISO/IEC 15504-2) process rules. Additional functionalities like object recognition, distance measurement of objects, tracking, etc. are modular addable. The system is extremely resilient to temperature and shock and benefits from built-in memory and superior processor power.

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## Electrical heaters without the hassle

**Kalori** has been developing specific HVAC heaters, adapted to the needs of OEMs, since 1999.

E.HVAC is an electric version of standard HVACs and the same size, meaning the same air diffusion system can be used.

In terms of the heating elements, Kalori sources the best-quality PTC elements, which guarantees a high level of performance. The safety of these elements is guaranteed by their operating principles.

On every Kalori E.HVAC unit, security is reinforced by an additional sensor, primarily designed to protect the casing, which in turn is manufactured using high-quality injected polyamide or polypropylene, with glass fiber.

In terms of air-conditioning, years of experience in the design

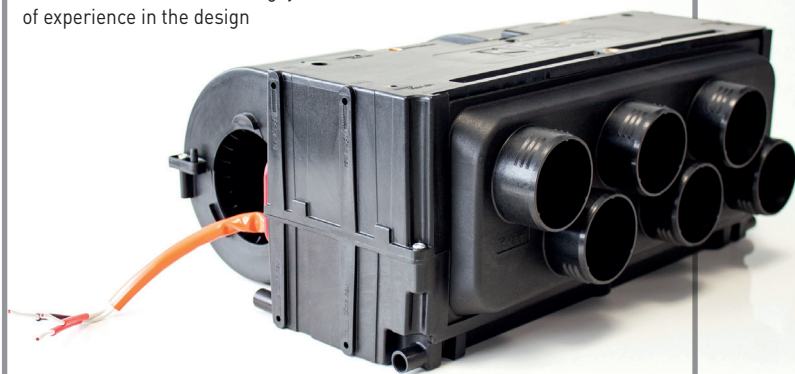
of air duct parts and air diffusion systems, simulation software and test benches enables Kalori to offer the right solution – to preserve both autonomy and comfort levels.

While users may agree to pay for air-conditioning, they do not want to pay for “a little bit fresh air”; comfort must be total without compromise and must be achievable using just electrical power.

The circuits are closed, using one of the best electric compressor ranges on the market: 12V, 24V, 48V, 80V and 600V versions are available as standard.

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## Robust and easily fitted inclinometer

**Tecnord** has expanded its range of single- and dual-axis inclinometers with the introduction of the CANbus interface for J1939 networks.

The EC-SNR series of inclinometers uses up-to-date 3D-MEMS (micro-electromechanical systems) technology to measure the sensor's inclination relative to Earth's gravity (tilt angle), providing a linear variable output that is sent on the CANbus network.

The use of this technology provides distinct advantages in reliability, stability and compactness, and since there is no use of moving parts, these sensors have a virtually infinite life.

Applications include road construction equipment, cranes and booms, scissor lifts, agricultural

vehicles, container handling and hydraulic lift systems.

The dual-axis sensor is mostly indicated for the planarity control of a chassis or any mechanical structure with respect to the Earth's gravitational pull.

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## ML-XT™ Sealed Connection System

The rugged ML-XT™ connection system with market-leading high-performance seal technology is a cost-competitive solution offering superior reliability for critical vehicle-wiring applications in harsh environments

**Features:**

- Covalently interlocked one-piece plug housing and interfacial seal formed by 2-shot LSR (liquid silicone rubber) moulding technology
- Drop in replacement for defacto-standard industry connectors
- Rear seals made from HCR (high consistency rubber)
- Latched rear covers lock-in rear HCR seals without exceeding the perimeter of the housings
- Plug and receptacle housings are supplied pre-assembled with internal HCR rear seals and covers
- Plug housing features integral locking latch with finger grip



For more information on what TTI Europe has to offer, visit [ttieurope.com](http://ttieurope.com) or contact us at [sales@de.ttiinc.com](mailto:sales@de.ttiinc.com)

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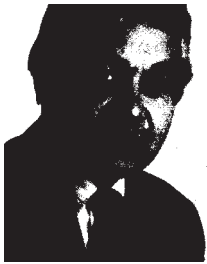
Mobility

We are there when overview is crucial.

Area view systems for commercial vehicles increase the productivity by quicker maneuvering processes and help to prevent accidents.



[www.first-sensor.com](http://www.first-sensor.com)



## THE INSIDER BIDS FAREWELL TO *iVT* WITH A LOOK AT A POSSIBLE FUTURE SOLUTION TO DELIVERING HEAVY VEHICLE COMPONENTS

▷ Regular readers will remember that in our November issue, we covered the speculative NASA projects investigating off-world mining opportunities. We discussed the problems of designing suitable vehicles, actually delivering them, assembling them and servicing them at a site in another part of the solar system.

Even if we managed this, recovering the materials back to Earth where they could be useful posed a dilemma. Of course, this issue is not unique to space and applies in a somewhat lesser way to many of our remote industrial sites, particularly those involved in mining. So Hybrid Air Vehicles' work piqued my interest. Operating out of the UK, the company is currently focused on its Airlander 10 project. This vehicle is, to all intents and purposes an airship, albeit one of a quite advanced design and configuration.

At a presentation given by the company recently, at which I was a shadowy anonymous figure lurking in the back row, engineers explained that the vehicle employs thrust from four ducted fans to provide the initial lift to bring the unit airborne and an aerofoil form on the body to provide lift during transport. Those involved gave a sparkling presentation extolling the virtues of their machine, explaining how this aircraft, which had originally been conceived for military applications as an airborne observation post and control center, had very real applications in the commercial world. Cited among these were passenger transport, specialist surveys and the delivery of specialist equipment to inaccessible locations.

Obviously the problem of accessing most of our planet has been solved by the development of the airplane and the helicopter, so dropping chunks of machinery in remote locations has for some decades been a matter of flying the components to the nearest airport, then transferring them by helicopter to access the nearest landing

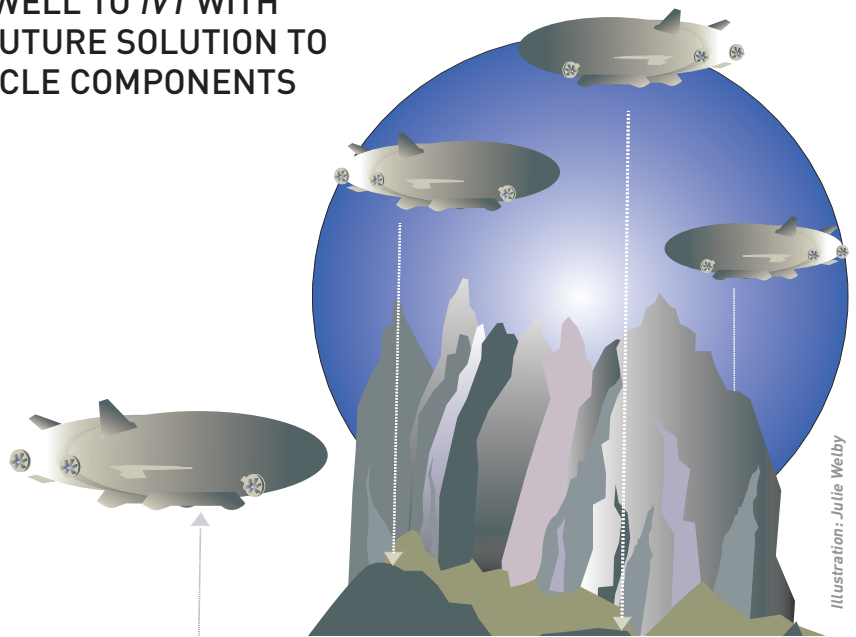


Illustration: Julie Welby

location in the area of operations. However, should these 'hybrid' air vehicles ever be properly developed and commercialized, they could potentially revolutionize remote site operations.

Using specialized air transport is expensive. Even light airplanes need a place to set down, and helicopters burn fuel like it is going out of fashion – more so when in hover – and while capable of vertical take-off, still need a safe landing site and are restricted on payload. So if the urgency is a few boxes of bearings then no big deal, but a replacement engine, axle or driveline might prove problematic.

The Airlander 10 on the other hand has a usable payload of 10 metric tons and there are plans for the larger Airlander 50, which has a payload of, yes, you've guessed it, 50 metric tons!

Unlike other aircraft, this capacity would be usable in all circumstances as the machine does not need mechanical power to stay aloft. So, it could be used as a floating warehouse or overhead crane, and could remain airborne over the site indefinitely. Fuel demand is also low as the fans are driven by four passenger-car-size diesel engines, so for some remote operations it actually solves a lot of problems. However, as in most things, there are some *quid pro quo* items to take into account.

Firstly, I can only speculate as to the initial cost of the machine. And the Airlander 10 is big – 92m long and 44m wide to be exact, which is roughly the size of a soccer field. Also, of course it is still in development, so even if you wanted to obtain one, you might currently be pushed to get a production unit. But, according to those involved with the project, these machines are the future of specialist transport. With the low fuel demand, potential for heavy component and specialist material delivery or key personnel transportation at a very low running cost, they might well be right.

So now, after many years writing this column, the time has come for this old hand to take a well-earned break. It's been informative, it's been emotional, but most of all it's been fun – particularly when I've connected with you, the readers, who have emailed to say how I've succinctly captured the issues of the day – or, just as often, to say how woefully wide of the mark I've been! I don't know when we'll meet again; it could well be in the pages of this magazine at some future date. But if, in the future, you happen to see an Airlander 10 gliding gracefully through the sky, you might just recall where you heard about it first. It's been an honor to have been your industry Insider. **iVT**

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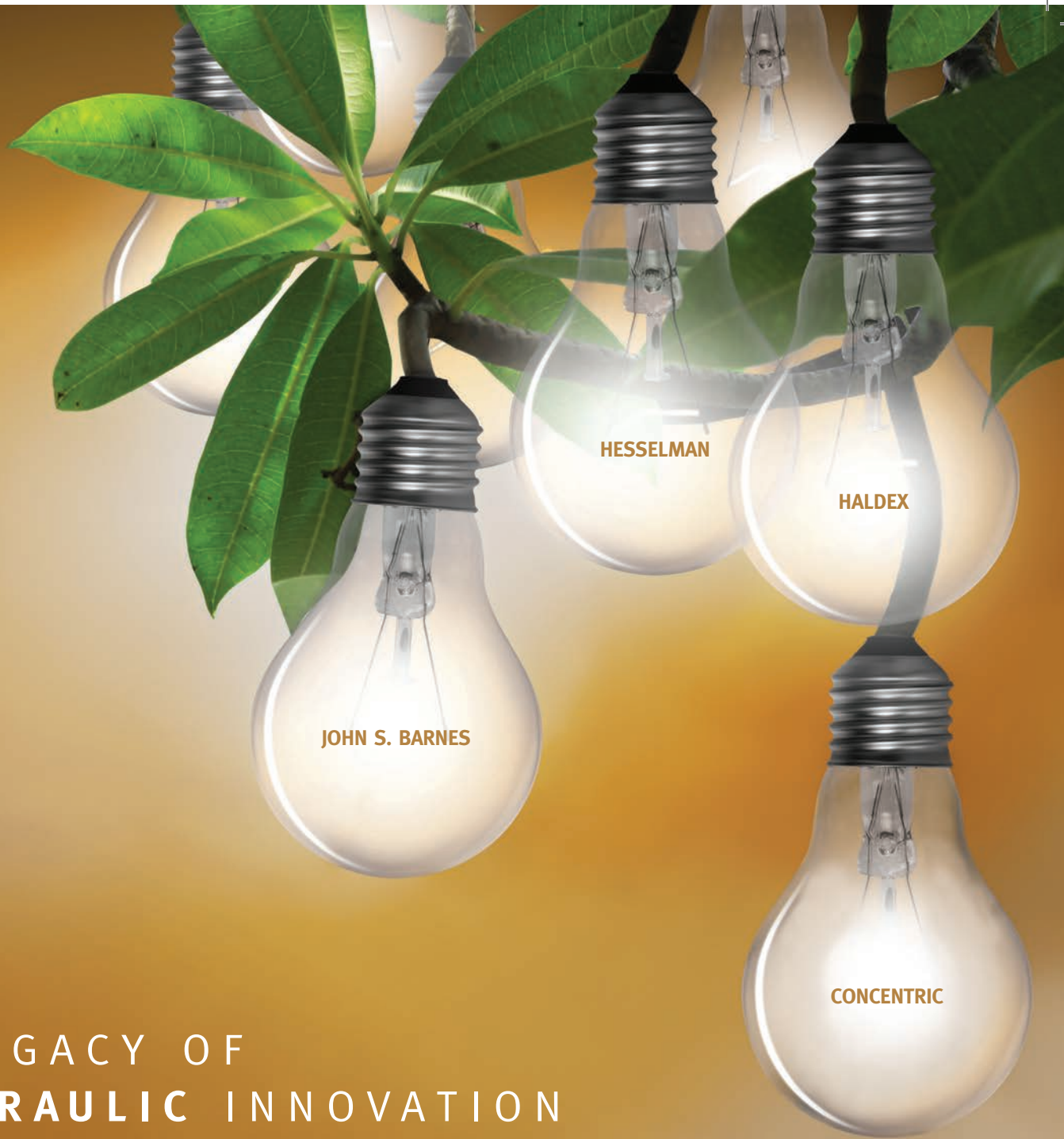


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