

September 2016

iVT

INTERNATIONAL
INDUSTRIAL VEHICLE TECHNOLOGY

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Is Ethernet the new CAN?

Case studies

weycor 250e wheeled loader

Rostselmash RSM 161

combine harvester

Materials

3D printing – how far can it go?

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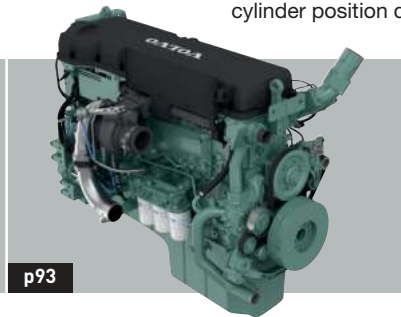
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FOREWORD

Frank Skinner, the 50-something-year-old British comedian, once pointed out how drastically the issue of obesity had changed during his own lifetime. Unlike when he was young, when the few fat people he saw were those with enough money to eat well, obesity is now also a curse on the poor – at least in the developed world, anyway. Consuming calories has become cheaper than ever, and the vast majority of machine operators (while not necessarily poverty stricken, of course) will take in a lot more of them than they expend in what is largely a sedentary occupation. Knowing when to stop stuffing in handfuls of junk food is becoming more and more difficult, it seems...

You'd almost think that we are witnessing the fastest phase of evolution in human history – even though it's generally self-inflicted and avoidable. On the other hand, as Steve Casey points out in our cover story beginning on page 24, the human race has been inexorably growing taller, over the last century or so in particular. Underlying this 'secular trend' are a variety of factors – many of which have also resulted in us living longer than ever before. Gone are the days when retiring in your mid-sixties was the norm – and due to declining birth rates in many developed countries, this situation will only continue. Japan, for instance, is perhaps most notably at risk, with a whopping 61% of its population now being over the age of 65.

All of this has a major impact on the ability of cab manufacturers and OEMs to design equipment that caters for the widest possible range of users. Providing machines traditionally designed for the

95th percentile presumably becomes more awkward when the upper echelons of that range are becoming increasingly populated with what were once considered to be 'unusual' body shapes.

And as for the additional problems that arise from the aging process (worsening eyesight being one key area), those bring into focus a whole host of other design considerations. Just adding sun shades, for example, can make a major difference in combating the older operator's main problem in terms of visibility – an increased susceptibility to glare.

Could all of this lead to greater potential for the customization of industrial vehicles in future? Larger operators could specify a cab with a wider seat and greater distance between that and the steering wheel (or perhaps a bigger cool box?) Or older operators might prefer one that provides warnings and alerts via vibratory features in the steering wheel, joysticks or seat, compensating for their reduced ability to hear audible signals or spot a flashing light.

Whatever the infirmity, there really is no longer any need for an operator's working life to come to an abrupt end once advanced years, rapidly expanding waistlines or unexpected disabilities take hold. New and innovative takes on the area of access and egress in particular form a key element in this issue's Design Challenge (p40) – not all ideally suited for mainstream manufacture perhaps, but a definite possibility for future owner/operator customization. Suddenly my own idea of an operator seat on a folding Stannah Stairlift from ground level into the cab seems a little silly...

Richard Carr, editor, iVT International

Coming up in the November issue of *iVT*

• Minexpo review • OEM interview • DC – extra-terrestrial mining • Engines and emissions
• Case studies • Electric drives • Look out for the Off-Highway Annual in November!

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CNH'S TRACTOR DIVISIONS HAVE UNVEILED TWO VERY DIFFERENT INTERPRETATIONS OF WHAT AN AUTONOMOUS TRACTOR COULD LOOK LIKE

BOONE, IA, USA – Case IH used the Farm Progress Show this August to reveal its stylish concept tractor that is able to operate fully autonomously with a wide range of field implements. Based on an existing Magnum row crop model minus the cab, it features re-imagined styling, with its aggressive headlights, sculpted bonnet and distinctive silhouette being complemented by two-tone black and red wheel rims, carbon-fiber front fenders, and signature LED status running lights.

A collaboration with long-standing technology provider Autonomous Solutions Inc (ASI), the concept has been designed to validate the technology and collect customer feedback regarding their interest and the need for future products of this type. Offering a fully active interface to allow for remote monitoring of pre-programmed operations, the system

automatically accounts for implement widths and plots the most efficient paths according to the terrain and any obstructions in the field.

A remote operator can supervise and adjust the route via a computer or tablet – typically when the vehicle's radar, lidar and onboard video cameras detect moving or stationary objects in its path and bring it to a halt before sending audio or visual notifications. Any drop-out in GPS signal or position data will also cause an immediate stop.

"A farm manager can supervise the activities of multiple machines via a mobile tablet interface while he tends to other tasks or even operates another vehicle," said global product marketing manager of Case IH Advanced Farming Systems, Rob Zemenchik. "Multiple autonomous tractors can work as one fleet or

simultaneously in multiple sub-fleets assigned to separate fields, each assigned with pre-programmed maps and prescriptions. So you could have one tractor pulling a chisel plow followed closely by another one operating a planter. The opportunities for [higher] efficiency are substantial."

Zemenchik added that the technology could function just as well in a cabbed tractor where real-time weather and satellite data could be used to optimally apply crop inputs such as nitrogen, herbicides, or fungicides.

"These enhancements really become interesting for our customers when weather comes into play. Because if it starts to rain in one field, the tractor will automatically stop what it's doing and head over to [a dry] field, provided it can access that field via private roads."





By maintaining the cab, New Holland's take on the autonomous tractor offers the flexibility to carry out operations that cannot currently be performed without an operator



New Holland took a less radical approach, integrating ASI's automation technology into one of its T8 Blue Power tractors. Its retention of the standard cab enables it to be used in operations such as front loader work and high-speed road transport where complete autonomy is not yet possible. The concept tractor is fitted with a seeder that enables it to autonomously seed the next crop straight behind the combine. While fully autonomous, the NH^{Drive} also allows farmers to remotely monitor and control via computer or tablet, enabling them to access data at any time, facilitating right-time decision making. Key parameters including engine speed, fuel levels and implement settings – including seeding rate or coulters downforce – can be controlled easily.

The tractor's progress is shown by a path-plotting screen as well as a live camera feed that provides up to four real-time views (two at the front and two at the rear). The route to the field can also be planned, should this involve private roads or tracks. Once path plotting has finished, the user can choose a job from a pre-programmed menu simply by selecting the vehicle, the field and then sending the tractor out on its task – the whole sequence taking little more than 30 seconds.

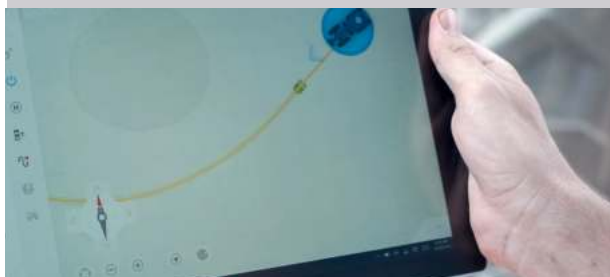
Able to work alongside other autonomous machines or work in tandem with 'occupied' vehicles, the NH^{Drive} follows optimized in-field paths that are automatically generated by the software after taking into account field size and shape, implement width and any pre-existing obstacles. With the potential to be fully compatible with the full suite of PLM (Precision Land Management) solutions, it could also use previously collected yield data for the variable application of inputs to carry out operations with maximum efficiency. It will also be able to use 'big data' such as real-time weather satellite information to automatically make the best use of ideal conditions, independent of human input, and regardless of the time of day. For example, the tractor would stop automatically should it become apparent changeable weather would cause a problem – potentially heading to a dry field in the meantime – then recommence work when conditions have improved.

The further development of the NH^{Drive} will be a key element of the future PLM strategy – one of the pillars of New Holland's Clean Energy Leader strategy – and represents the ultimate expression of its 'doing more with less' concept. "The NH^{Drive} autonomous tractor offers us the opportunity to open up completely new horizons for future farming," claimed brand president Carlo Lambro. "An autonomous tractor that is able to work day and night helps solve the problem of a lack of specialized labor during the most intense seasons, makes 100% use of the periods of favorable weather for various farming activities, and maximizes the rational use of resources."

New Holland says that its entire tractor range, as well as other agricultural equipment, could conceivably be fitted with the same technology in future.



ABOVE: Case's Industrial Design Team re-imagined a Magnum tractor for a future autonomous era, eliminating the traditional operator station and crafting its sleek and dynamic lines



Path plotting and access to tractor and implement data will enhance operational productivity and efficiency

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*Eleanor Smith
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WHAT'S NEW

CONSTRUCTION FOCUS



JIM MANFREDI, MACHINERY OUTLOOK

BUNDLE OF JOY

Komatsu is to acquire Joy Global for just under US\$3bn, making it its wholly owned subsidiary after the deal closes in mid-2017. The Joy product lines fit nicely with Komatsu's surface mining offering, giving it a full-line presence. Joy has an estimated 60% to 70% share of the rope-shovel market with its P&H-branded models; matching Komatsu's mining trucks to that fleet will enable the Japanese OEM to offer its customers one-stop shopping.

Joy had recent annual sales of US\$1.4bn. In 2015, revenue was evenly split between surface and underground mining. The former is now declining, and represented approximately 45% of Joy's total revenues for the first six months of its fiscal year.

Several improvements were made to the engineering facility to promote a more collaborative work environment. It has now been designed to create more 'chance encounters' among employees who might not otherwise work together, with the key aim of

Komatsu to acquire Joy Global for just under US\$3bn

sparkling additional collaboration and greater innovation.

At its production facility, expansion and redesign of the north assembly and compact excavator production areas will improve the factory flow and increase accessibility for employees. Mechanical improvements include a shot blast system to prep major weldments before painting occurs, and a ColorMax booth to help evenly spread a weather-resistant, orange finish on the tailgates.

Bobcat's West Fargo HQ is currently undergoing a US\$9.5m expansion, which is set for completion imminently.

CAT'S SIX-YEAR ITCH

Caterpillar is to phase out its successful, six-year strategic alliance with Wacker Neuson, and shift design and production of its mini excavators to its own facilities from 2018. Cat will focus on growing its global mini excavator business as it leverages existing facilities and design teams to deliver new machines weighing less than three tons.

Five of the current models manufactured by Wacker Neuson will phase out in mid-2018, and the 302.7D CR will phase out at the end of 2019. The 300.9D will also phase out at the end of 2019, or later if mutually agreed by both parties.

SCHAEFF HAVEN

Yanmar is to acquire Terex's German compact construction equipment business for approx. US\$60m, taking over sale and production of wheeled loaders, midi/mini excavators, wheeled excavators, and other

Yanmar paying US\$60m for Terex compact business

products in Europe.

Included in the acquisition is the Crailsheim manufacturing facility, and the parts distribution center in Rothenberg.

Takehito Yamaoka, Yanmar Holdings president, said, "We are very happy to have concluded an agreement for the acquisition of Terex Corp's small- and medium-sized construction machinery business, which possesses a strong Europe-based sales network and excellent products, including the distinguished German Schaeff series [to] expand [our] machinery business."

EASY ON THE GAS

MOLINE, IL, USA – Combining a 536hp PowerTech PSX 6135 13.5L Tier 4i engine with brushless AC generators and motors, water-cooled brake resistors and solid-state power electronics, John Deere's 944K hybrid wheeled loader can offer considerable fuel savings over competing 9yd³ (6.88m³) models with conventional drivetrains. Its hybrid-electric drive recaptures energy from slowing the machine when the operator lifts off the accelerator, lessening the load on the engine and further reducing fuel consumption. For maximum fuel efficiency, the engine can run in a limited speed range of 1,200-1,800rpm in Normal mode, or at a constant speed in Performance mode so that boom and bucket functions are powerful, quick and responsive.

With no transmission shifting or clutches to engage, smooth directional changes and reduced spillage can be assured. In combination with the 12ft-wide bucket and breakout force of 103,388 lb, operators can therefore efficiently maintain stockpiles and heap hoppers in quarry operations, aided by the 944K's strong pushing power and quick ramp-climbing ability. Four settings can be incrementally selected through the sealed-switch module to optimize traction when crowding against a load. In difficult terrain, the standard electronic traction control facility can automatically limit torque to any required wheel when slippage occurs, and with enhanced rimpull control, tire spin and slicing can be prevented.

The coast control feature functions like the dynamic braking of a hydrostatic transmission, slowing the loader without touching the pedal and helping to reduce component wear.

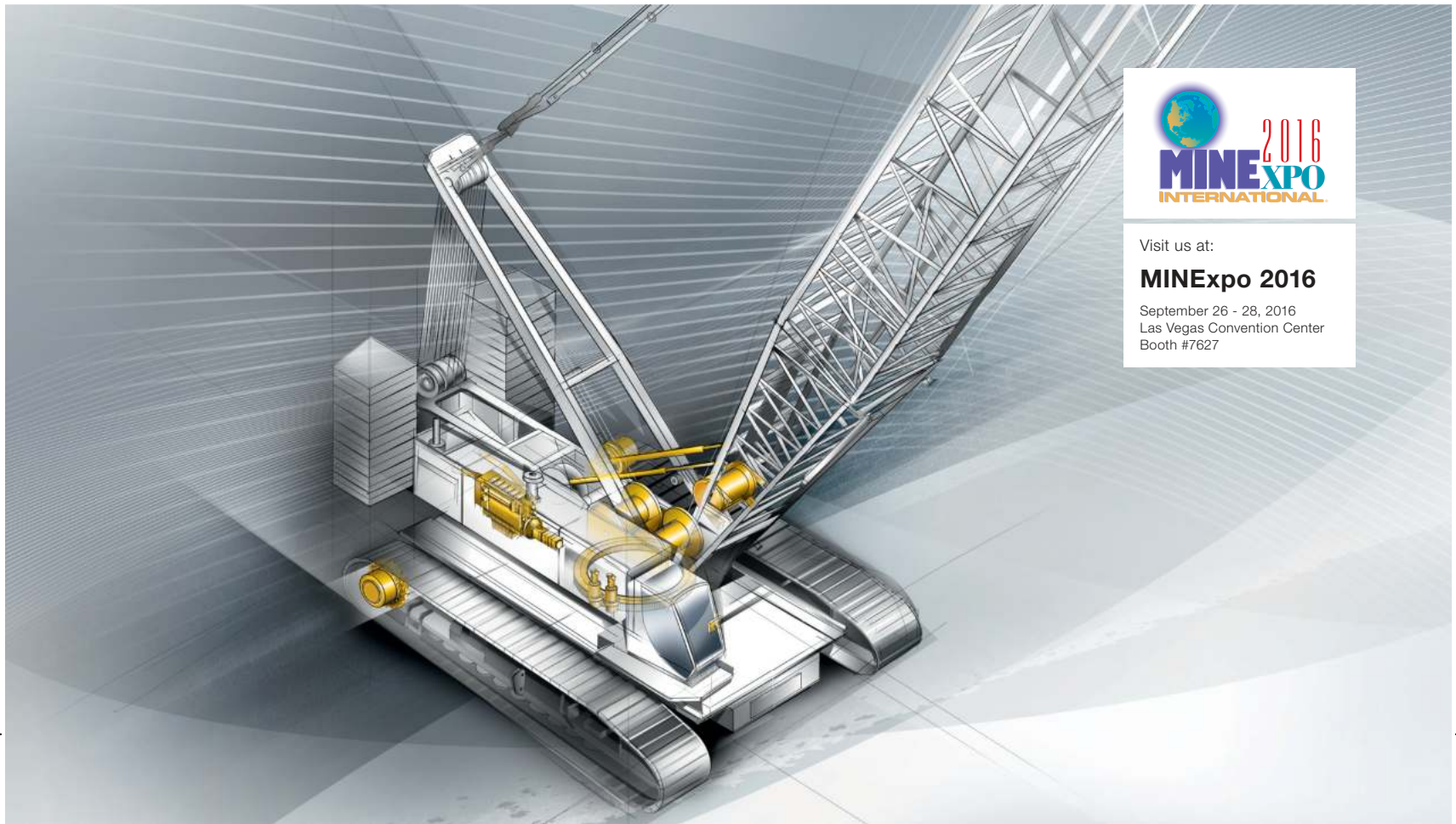
As Deere's largest wheeled loader, the 944K features a cab that is 10in wider than that of the 844K, making it the largest in its class. With floor-to-ceiling front glass, and a reduction in front fender length, this offers a commanding view of the bucket and tires. In-cab noise is just 72dB(A), and 108dB(A) for bystanders.

Brushless AC motors combine with a 536hp PowerTech engine to power John Deere's largest loader at minimum cost



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AGRICULTURAL FOCUS



JIM MANFREDI, MACHINERY OUTLOOK

MAINLY ON THE PLAINS

Kubota is set to purchase Great Plains Manufacturing, based in Salina, Kansas. The deal will include all five of its divisions with multiple facilities in Kansas and a manufacturing plant in Sleaford, UK.

Since 2007, Kubota has worked with Land Pride to provide quality, performance-matched implements to dealers and customers in North America.

GPM encompasses five divisions: Great Plains Ag, which makes seedbed preparation, nutrient application, and seed placement equipment; Land Pride, which produces grounds maintenance tools such as mowers, rototillers, rotary cutters and dirt-working equipment; Great Plains International, which sells the above products worldwide; Great Plains Trucking, which operates a nationwide fleet of flatbed trucks; and Great Plains Acceptance Corporation, which finances these products.

For the foreseeable future, all five divisions will operate with their infrastructure intact, respecting the distinctiveness of the brands, trademarks and operational strengths.

OUT ON BALE

New Holland has signed a European agreement with Mascar, an Italian producer of a complete range of round balers, bale wrappers, precision pneumatic planters and mechanical planters.

The contract provides for the exclusive supply of a range of fixed-chamber round balers designed for baling any type of crop, from hay to straw.

New Holland Agriculture brand president, Carlo Lambro said, "[We] have pledged to cooperate in the development of customizations able to bring additional pluses to our

comprehensive range of round balers in terms of productivity, efficiency and the satisfaction of customers with distinct and highly specific requirements."

The range is perfectly integrated with the existing NH range so customers will enjoy an even broader choice when selecting the machine that best fits their needs.

AGAINST THE TIDE

A near-13% increase in domestic market share helped Argo Group weather an industry-wide downturn last year. The sales boost, which strengthened its number two position in the Italian tractor market, follows

a €75m, three-year R&D investment plan that has rejuvenated its McCormick and Landini ranges.

Revenues amounted to €461m compared with €465m in 2014. The net operating result came in at €12.1m.

In Italy, Europe's third-largest tractor market, the Landini brand advanced its market share from 9.2% to 10.4% overall, strengthening its second-place behind New Holland and ahead of Same, Deere and Antonio Carraro.

GRIMMES' TALES

The Grimme Group, as well as Grimme Landmaschinenfabrik, now has a new management structure. As of July 1, the group is run by MDs Franz Grimme, Franz-Bernd Kruthaup and Jens Walter, and Grimme Landmaschinenfabrik by MDs Sebastian Talg (sales), Richard Weiß (purchase and production), Carsten Seelke (engineering) and authorized officer, Henk Gövert (commercial department).

Christoph Grimme, the son of Franz Grimme, completes the management team as an authorized officer. Responsible for international production, he holds the project management for its new factory in China.

Argo Group increased domestic market share by almost **13%**



PLUS TWO

FABBRICO, ITALY – McCormick has added the X7.650 – a new six-cylinder tractor – to its X7 Pro Drive series, even though an equivalent four-pot model is already available. "We already have a four-cylinder tractor – the X7.450 Pro Drive – with the same peak power and torque outputs as the new model," explained Paul Wade, product specialist at McCormick's distributor in Great Britain, AgriArgo UK. "But many operators like the characteristics of a six-cylinder tractor, including the added stability for operating heavy mounted implements that comes with an extra 410kg in weight and 150mm longer wheelbase."

The new model therefore delivers 152hp at 2,200rpm rated speed from its 6.7-liter BetaPower engine, built to McCormick's specification by FPT Industrial. The power curve then rises as revs are pulled down under increasing load to a peak of 160hp at 1,900rpm, while maximum torque of 676Nm is reached at just 1,500rpm. These characteristics can be exploited by shifting up to load the engine for maximum power, to take advantage of the increased reserves of torque that are available to pull the tractor through tough areas of soil when cultivating or plowing, or when tackling an incline with a trailer, for example.

The X7.650 is available in Premium and Efficient versions, the latter likely to appeal to operators of MTX and XTX models of similar size and power. "It will also be a candidate for operators with the popular MC135 Power6 wanting a more powerful tractor for increased productivity with modern features but limited high-tech electronics," added Wade.

Both versions have a 4-speed PTO with power and economy gearing capability to suit different applications. A 24x24 Pro Drive transmission provides a push button 4-speed powershift and range shifting, with an optional creep gearbox (standard on the Premium) for specialist drilling, etc. Load-sensing hydraulics as standard deliver up to 123 l/min from a piston pump, and 44 l/min from a unit dedicated to steering and ancillaries such as 4WD and PTO clutches.

The same power as the X7.450 from a larger engine – but the six-cylinder arrival is likely to be extremely popular



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WHAT'S NEW

HANDLING FOCUS



MICHAEL LEU, FORKLIFTACTION.COM

BACK TO SQUARE ONE

Manitou is buying back 2.8% of its share capital from Toyota Industries Corporation. The two companies have signed an agreement relating to the purchase by Manitou BF of a block of 1,120,000 of its own shares at a unit-negotiated price of €13.38 (US\$15.09) in an off-market block deal worth €14.9m (US\$16.8m).

The transaction follows the termination of the industrial partnerships between the two companies, dating back to December 2014.

Toyota and Manitou have been winding back relations and, in 2013, decided not to renew their exclusive distribution agreement for Toyota-branded equipment in France, believing that this collaboration no longer fitted market developments.

Manitou regained full control with US\$16.8m buyback

EMIGRATING TO POLAND

Kalmar will shed 160 employees and gradually cease operations in Lidhult, Sweden, as it shifts production of forklift trucks to Poland. In March, it had announced plans to consolidate its assembly operations in Europe – to improve operational efficiency and ensure competitiveness in the global market, it said it would transfer the production of forklifts from Sweden to Stargard, Poland, starting from Q4 of 2016.

Kalmar has just completed its employee cooperation negotiations with the labor unions in Lidhult. As a result, a new, state-of-the-art premises in Sweden will be added and the operations in southern Sweden will be transformed into a Business, Innovation and Technology Centre.

The restructuring costs associated with the transfer are estimated to amount to €18m (US\$19.8m).

Kalmar currently employs 350 people in Lidhult and

Ljungby, Sweden, and about 320 people in Poland.

THE SP ON MANITOU

Manitou has opened a new production facility in Vinhedo, São Paulo, Brazil, as a means of boosting its presence and market share in Latin America. It has sold Manitou products in Brazil since 2008, working with dealers and a regional office. In 2014, the company undertook detailed analysis of the local market and added the Gehl and Mustang brands.

The first plant in Latin America has created more than 300 direct and indirect jobs. "We want to have a sustainable presence in Brazil," says president and CEO Michel Denis. "This current market [is encountering] difficulties, but we are really confident for the future. It will take time, but our group will be present when we [have a] favorable economic situation."

Brazil is Manitou's first production location outside Europe and the USA.

THE END FOR OMEGA?

A receiver has been appointed as Omega Lift has slipped into insolvency. The Canadian OEM is being wound up by the Toronto-Dominion Bank, which has called in its loan, leaving the company unable to meet its payroll.

Omega Lift has had a checkered existence, facing claims of fraud, non-payment of suppliers and non-delivery of goods.

Court documents show that the Toronto-Dominion Bank is chasing close to CAD\$11m from Omega Lift and its related companies. The bank was advised that Omega Lift had temporarily shut its business operations for an unknown period of time as a result of liquidity issues and summer holidays, without the bank's knowledge, and had exhausted its credit facilities.



It's amazing what you can see without any A-pillars

ALL THE BETTER TO SEE YOU WITH

ASCHAFFENBURG, GERMANY – Having long used overhead tilt cylinders on many of its trucks as a means of reducing vibrations and forces from the mast, Linde Material Handling has now taken full advantage of this concept to maximize the field-of-view for the operators of its E20-E35 four-wheeled electric trucks. The result is the Linde Roadster E20R to E35R series, available in capacities of 2.0, 3.0 and 3.5 metric tons.

Because the cylinders redirect forces and vibrations backward onto the overhead guard frame, the requirement for A-pillars can now be removed. After a few small structural modifications, the view to the front has been improved by 28%, greatly enhancing passive safety, particularly in logistics and industrial facilities with heavy passenger traffic. People or objects in the driving path, whether nearby or in the distance, can be spotted much earlier, giving the operator more time to react accordingly. With the optional overhead safety glass guard, the overhead view is improved by 50%.

However, ergonomics in terms of access and egress have not suffered as a consequence, as a curved steel tube has been incorporated behind the steering column and dashboard to serve as a boarding aid. This also allows for the easy addition of optional equipment, serving as an attachment point for a terminal, display for the Linde Safety Pilot assistance system, or clipboard.

The concept comes into its own, of course, on vehicles used indoors, which therefore do not require a cab, doors or heating. However, additional equipment options include a frameless windshield that is made of safety glass, and a frameless rear window.

Those aside, the basic technical and performance characteristics are consistent with the standard E20-E35 models. This includes popular features such as the dual-pedal control, Linde Load Control, or the compact front-axle with dual-motor front-wheel drive.

Linde will continue to produce the E20, E25 and E30 models in standard and Roadster versions. The premium for the Roadster is €1,500, with the optional overhead safety glass guard adding another €1,500.

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HEAVY INDUSTRIES

▶ The year 2016 has left many of us with the feeling that we have lost some of the most admired and influential people of our time. One such legend in the world of industrial design is Ray Innes, who died in March this year. Ray wasn't exactly famous, but if he had chosen to step into the media spotlight he could certainly have become very widely known in mainstream design. He preferred, however, to keep his consultancy small, so that he could enjoy doing what he did best:

designing, while living in a place that he loved, together with his family, in rural southwest Scotland.

Those who are acquainted with his work will no doubt agree that he was one of that rare breed of design professionals who are more than just an engineer or stylist. Ray was special because he had the technical skills to back up his creative mind and the artistic skills to enable his technical ideas to come to life at the stroke of a pencil. Not just a stylist, not an engineer, but a true industrial

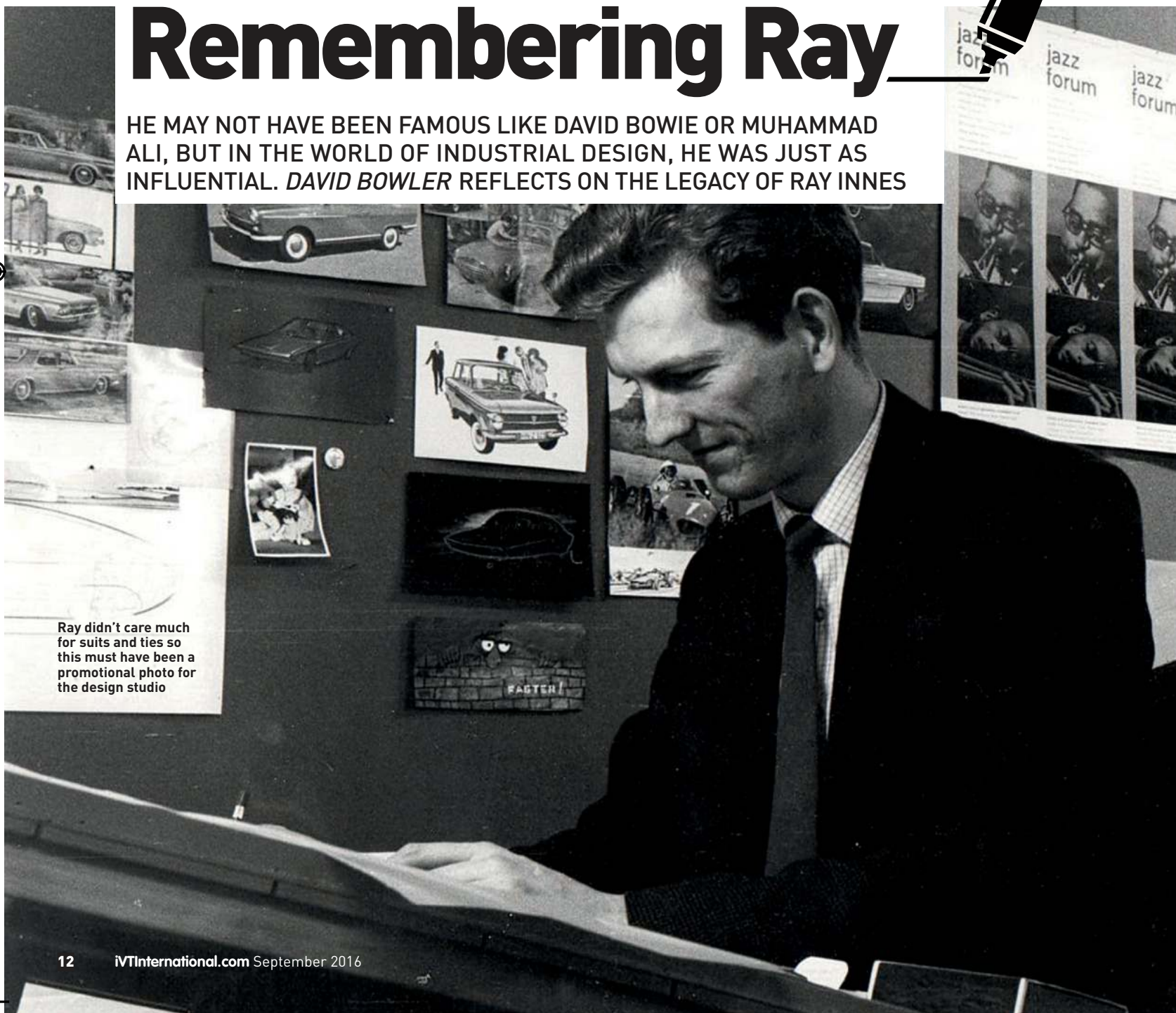
designer. He was, in many ways, one of the pioneers of his generation and his value in the field of design has been felt throughout the industrial vehicle sector for four decades, which, for an independent designer, is a significant achievement.

Early influences

Ray's early career explains how his ability as an industrial designer was formed and perfected at a time when industrial design as we now know it was very much in its infancy.

Remembering Ray

HE MAY NOT HAVE BEEN FAMOUS LIKE DAVID BOWIE OR MUHAMMAD ALI, BUT IN THE WORLD OF INDUSTRIAL DESIGN, HE WAS JUST AS INFLUENTIAL. DAVID BOWLER REFLECTS ON THE LEGACY OF RAY INNES



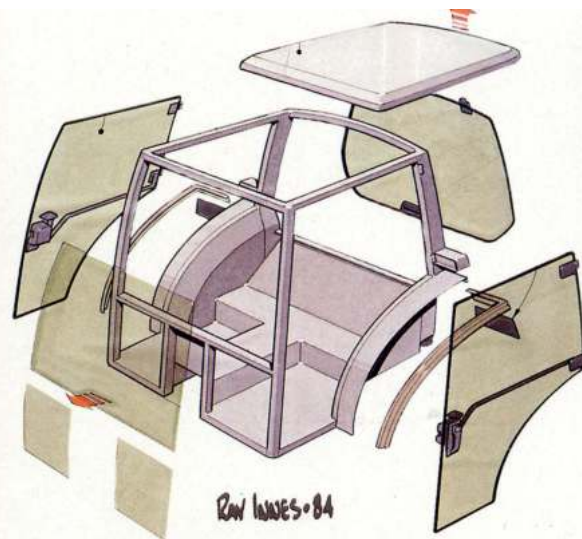
Ray didn't care much for suits and ties so this must have been a promotional photo for the design studio

In 1952, at the age of 16, he started working as an engineering apprentice within the aircraft industry at Armstrong Siddeley.

His main focus was working as a draftsman in the drawing office, but his creative talent was spotted early on and he soon joined a project team tasked with finding innovative applications for gas turbine engines that had initially been developed for the aero industry but had potential in other areas where extreme power was required.



LEFT: One of Ray's typical renderings during his time at Triumph featuring a stylized treelined Highland backdrop complete with buzzard flying in the distance



ABOVE: Innes Design and Bosal-Sekura led the field by showing the world that forward thinking and good design was as important to highly functional industrial products as it was to consumer goods

ABOVE LEFT: Typical hand-drawn concept rendering: questioning convention, but always considering practical requirements and human factors

Such was his self-motivation and creativity that, in addition to his day job, he entered various industry-sponsored design competitions in the hope of furthering his career prospects, and by this time he had his sights set on the automotive industry. After being awarded a prize in 1962 for an innovative car design study that challenged technical aspects such as aerodynamics and interior packaging, resulting in a strikingly different styling direction, he was offered a job as a designer with Harold Radford & Co. in London.

The timing was perfect. It was the start of the Swinging Sixties and he relished the opportunity to work for the highly renowned specialist coach builder, working on special Minis for the likes of The Beatles and Peter Sellers, all the while developing his drawing techniques because at this time, Magic Markers (chisel-tipped solvent markers) were just beginning to become available, which, when combined with traditional colored

pencils and painted highlights, offered much quicker ways of achieving striking sketches of highly photographic quality.

While he was there he met people within the motor racing world and was asked to work on various projects, including, in 1964, for Alan Mann Racing, which further enhanced his professional experience.

New horizons

Ray's time in London was quite short however, due, in part, to family circumstances, but also to an opportunity to join the design team at Ogle Design, which gave him the opportunity to broaden his experience with products such as mainstream electrical goods, while still working on automotive designs.

Whether they were small or large, he was responsible for some superb products, such as the compact inhaler which, thanks to his innovative approach, could now be carried easily at all times and be operated



ABOVE: One of Ray's early hand renderings using solvent markers and pencils on colored paper to great effect

OBITUARY

single-handedly and discreetly, while being produced at a very low cost, to the benefit of millions of asthma sufferers worldwide. It was such a simple product, yet the epitome of what great product design is all about.

Reliant Motor Co. was one of Ogle's clients and Ray was asked to work for it shortly after it bought the car concept designed by Ogle initially for Triplex Glass, which then became the Reliant Scimitar.

From there, he was offered the job of running the design studio at Triumph Motor Company, where he worked on models such as the Spitfire and the 2000TC while experimenting with future concepts.

As if his responsibilities there weren't enough, Ray worked on his own hobby projects, notably boats. After completing and testing his feature-rich GRP dinghy design with a cathedral hull that he had developed to be able to plane with just a very small outboard motor, he was asked to design larger boats. In turn, this led to designing caravans. By this time he was earning as much from private work as his employment at Triumph, so given the frustration he felt with British Leyland and its constant union and management clashes, he decided to go it alone with his own company, Innes Design, and move back to Scotland where he was born and raised.

Joint venture

We could at this point use the phrase 'the rest is history', but this was just the start of a whole new area of design – because at that time Ray was approached by the chief of a Danish cab manufacturer, Sekura (Bosal-Sekura Industries), with big ideas to expand its business both in and beyond Scandinavia.

The significance of that pairing should not be underestimated within



Ray out testing one of his boat designs

the industrial vehicle industry. Ray's creative direction brought principles of construction to cab manufacture that are now accepted as the industry standard all over the world.


His aesthetic design skills and his engineering experience brought both style and innovation to cab design and manufacturing, which in turn stimulated design advancement in industrial vehicles as a whole. This started with designing the first 'Q' cab, which had an integrated steel floor and was isolated from the machine using special rubber iso-mounts, but the innovation didn't stop there.

The cab featured the first special section profiled tubing that increased structural integrity while improving operator vision angles due to the overlapping tubes that also carried the glazing, which was, in turn, bonded to the tubes, giving greater strength and at the same time giving the whole cab a sleek and extremely clean-looking finish inside and out.

The benefits of this pioneering profiled tube cab construction included long-term durability and manufacturing efficiency as it greatly reduced the amount of welding that was needed in its construction. The next innovation came with bending these modular profile tubes to further reduce welding and bring new levels of design sophistication – especially as curved glass was just beginning to become more affordable.

Ray also pioneered the use of plastics in cabs and in particular led the way in bringing ever more sophistication and comfort to cabs the world over – not just in high volume production but also in much lower volume specialized applications where tooling budgets are extremely tight. This, in many ways, enabled him to become a design pioneer, making the cab a fully integrated part of the whole vehicle, and also making it more financially viable to provide tractor OEMs with cabs that were styled to their own brand image rather than the earlier, more generic, add-ons.

All through the 1970s and into the millennium, Innes Design and Bosal-Sekura became known to many as the place to come for the best in safety cab solutions. Ray's advanced cab design principles also spawned some interesting offshoot conceptual projects that saw a modular car – featuring gull wing doors and Mini Cooper mechanicals – built using profiled tubing, and even a concept for a Land Rover body using the same principles. His award-winning electric city car, the Danish-made Mini-El was another highlight in his extremely successful and varied design career, despite being 30 years ahead of its time.

Although Ray took more time over his last few years to enjoy life away from the pace and pressure of previous decades, he never truly retired and his sketchpad continued to be a constant companion right up until the end. His work was in many ways his main passion in life – and much of his design legacy lives on in the products that he created and the influence he has had on those who have been fortunate to have worked with him. **ivT** 

David Bowler is an award-winning designer and consultant who worked closely with Ray



ABOVE: The Mini-El electric car designed by Ray and produced by El Trans in Denmark from the mid-1980s and into the 1990s

BELOW: A selection of the extra images and content – including Ray's covers and articles for early editions of **ivT** – that can be viewed in more detail at www.ivtinternational.com/rayinnes



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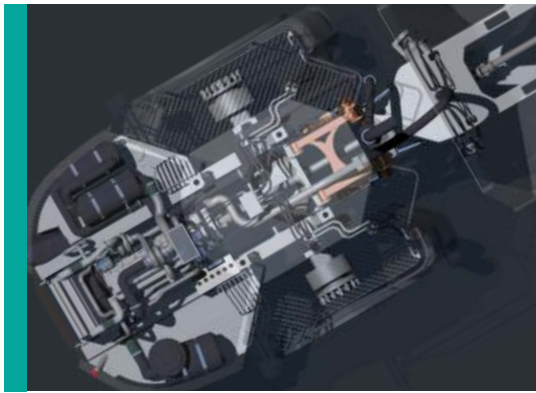
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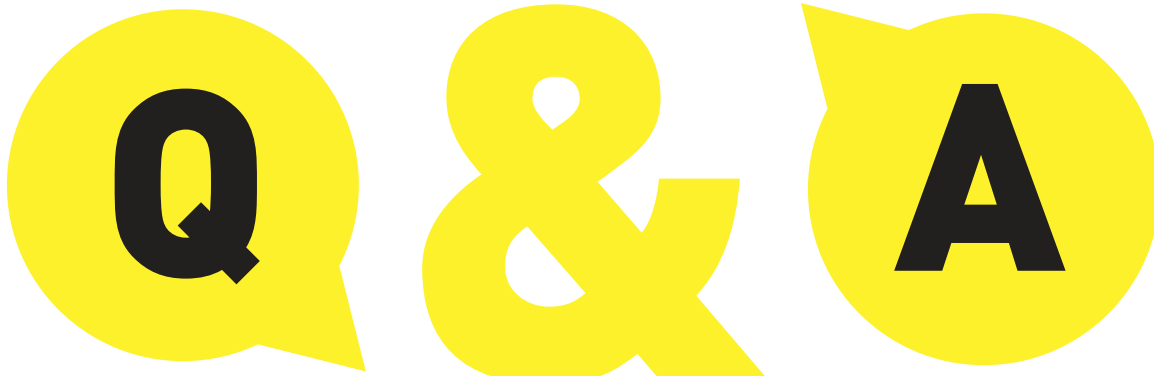


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Electric & Hybrid Industrial Vehicle Technology Symposium

ALL THE COOL OEMs ARE PRODUCING HYBRID MODELS THESE DAYS – HERE’S HOW TO MAKE SURE YOU’RE NOT LEFT OUT



▶ To be held in Cologne, Germany, November 9-10, 2016, Electric & Hybrid Industrial Vehicle Technology Symposium will be the world’s only conference exclusively dedicated to the design and development of electric and hybrid vehicle technology for the construction, agricultural, industrial and off-highway vehicle industry.

The symposium will bring together R&D engineers and heads of design and engineering from around the world to discuss, debate and

analyze the growing possibilities and future developments for the hybridization and full electrification of off-highway vehicles.

Off-highway industrial vehicles pose their own specific development challenges. The Electric & Hybrid Industrial Vehicle Technology Symposium will discuss and debate the technological breakthroughs required for increased deployment. Electrification offers the potential to significantly reduce emissions and noise levels, cut fuel, lower

maintenance costs and eliminate hydraulic systems, as well as a host of other benefits. So this conference is a must-attend event for all OEMs, Tier 1 and 2 suppliers, and anyone involved in the off-highway and industrial vehicle market.

iVT caught up with Dave Ross, Volvo Construction Equipment’s vice president of advanced technology and verification, one of the speakers scheduled to present in Cologne, to discuss some of the issues surrounding this exciting technology.

Q & A



DAVE ROSS, VICE PRESIDENT OF ADVANCED TECHNOLOGY AND VERIFICATION, VOLVO CONSTRUCTION EQUIPMENT

PRESENTATION: THE FUTURE OF THE CONSTRUCTION EQUIPMENT INDUSTRY

Dave will be talking about technology shifts and Volvo CE's focus areas for future technology developments. He will touch on everything, from the company's vision, to hybrids, fully electric machines, connected sites, autonomous machines, sustainability and clean energy. He will also discuss the affordability, reliability and availability of new technology.

VOLVO
Construction Equipment

9:30am
WEDNESDAY,
NOVEMBER 9

Can you outline what Volvo is currently doing in terms of hybrid vehicles, and the systems employed?

We believe there are clear technology trends in electromobility, intelligent machines and connected machines (digitization). We are investigating and developing new innovations in these areas so as to help our customers work in the most productive, safe, efficient and sustainable way.

The L220F was one of the earliest hybrid machines but never saw production. Why, and what would you do differently now?

The L220F shown at ConExpo in 2008 was an early parallel hybrid that used similar technology to Volvo buses. Volvo CE was also developing conventional technology to improve wheeled loader fuel efficiency – and with innovations such as OptiShift – a technical advancement that delivered up to 15% improved fuel efficiency and increased performance in wheeled loaders – the hybrid didn't show enough of a reduction in total cost of ownership to warrant bringing it to market.

Why have so few of the hybrid prototypes launched over the past decade actually entered production?

Firstly, it's connected to the financial business case for the customer. Hybrid technologies are still a relatively expensive solution and it takes a long time to achieve payback on your investment. Secondly, there are perceived risks with new technology like this – so adoption will be slow unless the benefits are several times higher than current technologies. There is still a lot that can be done to improve fuel efficiency by optimizing conventional technology and future developments in this area will compete with hybrids for some years.

But are things changing now?

Yes. The cost of energy-storage systems such as lithium-ion batteries is steadily

decreasing along with other technology that makes hybrids attractive financially. The move to hybrid vehicle technology is also being helped by the on-highway market – think of Elon Musk's efforts to bring fully electric vehicles to the mass market. These kinds of initiatives can reduce hybrid-related part costs and they also attract a lot of media attention, which helps to raise awareness about sustainable transport solutions.

Will construction equipment continue to be the main off-highway hybrid application?

I think it's more about the energy source and its reliability, abundance or scarcity and its capability. As you look at technology shifts in history, much depends on the energy source, our ability to harness it and how well we can apply it. Therefore, I would say that various forms of hybrid technologies will permeate all transport or working machine industries. I think there will be a diversity of solutions as we explore all the potential energy sources we have. The electrical energy source is quite compelling because we can get an endless supply of electrical energy from the sun.

Are there some off-highway machines (or some sizes of machines) that could never benefit? And is full electrification the answer in that case?

Thinking about mechanical or traditional systems with an IC engine, in almost every case there is a situation where energy is wasted and therefore improvements can be made. This applies to construction equipment, where we can optimize everything from hydraulic power to transport speed.

However, ultimately I think we'll see a shift from hybrid technology to fully electric machines. There are big economic factors at work here, though; customers are prepared to pay more for high-productivity machines (for example, in mining) than those who are buying small machines for

rental – which need to be low cost. If you look at the energy source and the application, you can make a pretty good case for certain machines. Take your robotic lawnmowers – they're electric-based, in a relatively low-cost market, but there is a very good case for an electric-driven machine here.

How much potential is there for current levels of efficiency to improve?

We have technologies today that could be applied to machines and drive 30-50% fuel-efficiency gains. If you get very theoretical, and try to eliminate all possible waste and capture every ounce of energy, you can potentially reach around 60%. However, when it comes to serial production there are cost and ROI matters to take into consideration – this is when reality sets in and the business case takes over.

Parallel or series systems – will one of them dominate in the next 10 years?

For construction equipment, I would lean toward series technology. Parallel systems work well in on-highway situations, but when you're moving and lifting you need to decouple the engine and any other power-drawing sources.

Do machines that offer the potential to recapture energy stand a better chance of success than those that rely on other methods, such as generators?

This is probably true – and it explains why we see a lot more hybrid technology in buses as energy is recaptured during the frequent start/stops these vehicles make.

In construction equipment, machine application usage varies widely between excavators, wheeled loaders, pavers, etc – so each one faces unique opportunities and challenges when it comes to recouping energy. However, I would say that you can't generalize too much here; you have to look at each scenario to capitalize on the situation.



Read the full interview and additional speaker Q&As on the iVT website: www.ivtinternational.com

THE PATHWAY TO INCREASED ELECTRIC AND HYBRIDIZATION OF INDUSTRIAL VEHICLES

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debate and analyze the growing possibilities and future developments for the hybridization and full electrification of construction, agricultural, industrial and other off-highway vehicles.



DAY 1 WEDNESDAY, NOVEMBER 9

Keynote speakers | Morning session

Chairman

William Van Amburg, senior vice president, Calstart, USA

9:00am - Innovation convergence: rapid, concurrent change for on- and off-road

William Van Amburg, senior vice president, Calstart, USA

9:30am - The future of the construction equipment industry

Dave Ross, vice president advanced technology and verification, Volvo Construction Equipment, BELGIUM

10:00am - Electrified powertrains for industrial vehicles – motivations, challenges and solutions

Tom Dollmeyer, electromobility program director, Cummins, USA

10:30-11:00am - Break

11:00am - Needs and potential: industrial vehicles in 13 categories, 2016-2026

Dr Peter Harrop, chairman, IDTechEx, UK

11:30am - Electrification off-highway – challenges and solution approaches

Dr Joachim Sobotzik, electric drive systems lead - Enterprise Electric Drives Services Group, John Deere & Co, GERMANY

Dr Martin Lenz, manager e-mobility business development EEA EMEA, Delphi Corporation, GERMANY

12:00pm - AVL's perspective of technological integration for electrification and hybridization in the large engine field

Wilhelm Müller, vice president large engines - Engineering and Technology Powertrain Systems, AVL List, GERMANY

12:30-1:00pm - Panel discussion

12:30-1:00pm PANEL DISCUSSION

Panel:

William Van Amburg, senior vice president, Calstart, USA



Dave Ross, vice president advanced technology and verification, Volvo Construction Equipment, BELGIUM



Tom Dollmeyer, electromobility program director, Cummins, USA



Dr Peter Harrop, chairman, IDTechEx, UK



Dr Joachim Sobotzik, Electric drive systems lead - Enterprise Electric Drives Services Group, John Deere & Co, GERMANY



Dr Martin Lenz, manager e-mobility business development EEA EMEA, Delphi Corporation, GERMANY



Wilhelm Müller, vice president large engines - Engineering and Technology Powertrain Systems, AVL List, GERMANY



ELECTRIC & HYBRID IVT SYMPOSIUM | PROGRAM



1:00-2:00pm - Lunch

Afternoon session

Chairman

Mark Case, engineer principal III, Genie Industries / Terex, USA

2:00pm - Emissions and fuel economy testing analysis of hybrid-electric trucks

Dr Matthew Thornton, principal engineer, NREL, USA

2:20pm - Energy saving hybrid technology on hydraulic construction machinery: Efficiency through modern technology

Burkhard Janssen, general manager product management and engineering, Hitachi Construction Machinery (Europe), NETHERLANDS

What are current and future opportunities for energy recovery? Why is this an important topic? In today's world, there is an ever-increasing demand for energy – but we are faced with limited resources and stringent government regulations for sustainable energy. What does this mean for the construction machinery industry and how can customers keep up with these high demands and still focus on their bottom line? This presentation will give more insight into these questions and also provide a detailed technical explanation of Hitachi's hybrid technology for construction machinery.

Speaker highlight

Speaker highlight

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6.00-7.00pm Wednesday, November 9



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2:40pm - Hydraulic hybrid systems for excavators

Milos Vukovic, team leader systems and controls, Institute for Fluid Power Drives and Control – RWTH Aachen, GERMANY

3:00pm - Electro-hydrostatic actuation – highly efficient implement solution with energy recovery

Dale Vanderlaan, senior program manager, Parker Hannifin, USA

3:20pm - Q&A

3:35-4:05pm - Break

4:05pm - Electric drive integration and control

Anthony Law, systems engineer – business development, McLaren Applied Technologies, UK

4:25pm - High-efficiency flywheel system for hydraulic energy recovery

Steve Hughes, chief operating officer, Torotrak, UK

Joanna Brahova, hybridization specialist, Torotrak, UK

4:45pm - Hybrid powertrain for off-highway applications

Vern Caron, electric vehicle engineer, Oerlikon Fairfield, USA

5:05pm - Digital displacement hydraulics for off-road and on-road heavy hybrid vehicles

Dr Niall Caldwell, managing director, Artemis Intelligent Power, UK

5:25pm - E-motor emulation – testing power electronics without an e-motor

Horst Hammerer, CEO, SET Power Systems, GERMANY

5:45pm - Q&A

DAY 2

THURSDAY, NOVEMBER 10

Morning session

Chairman

Dr Peter Harrop, chairman, IDTechEx, UK

9:00am - Market and technology trends in non-road mobile machinery

Alexander Woodrow, managing director, Knibb, Gormezano and Partners, UK

9:20am - Challenges and solutions to reducing the CO₂ impact of vehicles

Prof Andrew Atkins, global technical lead – senior technologist, Ricardo Innovations, UK

The presentation will discuss issues around working from a pragmatic needs perspective and review available media topologies to provide opportunities for reduction in carbon-bearing energy consumption. The configurations explored will include possible solutions to electrification and other, less conventional, energy vectors.

9:40am - The electrification of a construction site

Johan Sjöberg, research engineer – system controls, Volvo Construction Equipment, SWEDEN

10:00am - Advances in axial-flux motors for industrial vehicles

Dr Tim Woolmer, chief technology officer, YASA Motors, UK

10:20am - Q&A

10:35-11:05am - Break

11:05am - Emissions, electrification and the future of off-highway vehicles

Ananth Srinivasan, senior consultant, Frost & Sullivan, GERMANY

11:25am - Energy management enabling lithium-sulfur batteries in industrial vehicles

Dr Daniel Auger, lecturer in Advanced Control and Optimisation, Cranfield University, UK

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11:45am - **Tigon technology – for performance and environment**
Lars Lindahl, CEO, Huddig, SWEDEN

12:05pm - **Cable feed electric tractor for heavy field work**
Kurt Anders Hansson, project initiator, Swedish University of Agricultural Sciences, SWEDEN

12:25pm - **Q&A**

12:40-1:40pm - Lunch

Afternoon session

Chairman
Ryan Maughan, managing director,
Avid Technology Limited, UK

1:40pm - **Modeling and simulation of hybrid-electric compactors and their controls** Speaker highlight
Dr Ashraf Zeid, principal engineer, Volvo Construction Equipment, USA

This paper describes modeling and simulation of hybrid-electric eccentric/drum drives for an asphalt compactor. The objective of the simulation is to size and evaluate, by simulation, the energy and fuel consumption, as well as the performance,

of a hybrid-electric compaction machine. The focus here is to create a dynamic simulation to investigate the dynamics of such a design, with special focus on energy consumption and maximum power requirements. We describe the development of the hybrid-electric compactor controls that drive performance. We discuss the impact on engine power, energy and state of charge of the ultracapacitor.

2:00pm - **Flexible high-dynamic test rig for electrified commercial vehicles**
Prof Moritz Gretzschel, Hochschule Aalen, GERMANY

2:20pm - **Potential through consistent use of co-simulation throughout the development process**
Dr Martin Benedikt, group leader co-simulation and software, Virtual Vehicle Research Center, AUSTRIA

2:40pm - **Development of hybrid aircraft pushback tug: modeling of hybrid powertrain**
Tushar Kulkarni, hybrid consultant, Douglas Equipment, UK
Robin Shaw, engineering director, Hyperdrive Innovation, UK

3:00pm - **Q&A**

3:15-3:45pm - Break

3:45pm - **Analysis of overcharge tolerance off aged LMO cells**
Dr Bapiraju Surampudi, staff engineer, Southwest Research Institute, USA

4:05pm - **Advanced energy technologies for clean and efficient industrial vehicles – an implementation example**
Matthieu Desbois-Renaudin, battery system expert, CEA Liten, FRANCE

4:25pm - **Power electronic solutions for fuel cell vehicles**
Dr Peter Barrass, vice president engineering, Sevcon, UK

4:45pm - **Q&A**

Companies already confirmed for 2016 include:



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▷ The next time you fancy an unscientific dose of reality about the human condition, take a stroll down to your corner market and get a good look at your fellow citizens. Then go and watch an old movie from the 1940s or 1950s. See the difference? It would be difficult to miss: people, on average, and all over the world, have become bigger – some of them a whole lot bigger!

Although a number of factors are at work in this overall 'growth' progression, it is in part a function of a trend that has been unfolding for over 150 years. The consequences of these changes in body size – as well as other population changes that have occurred in the span of just a few lifetimes – are of particular importance to producers of vehicles that are occupied and operated by real people.

The secular trend

The formal term for the changes in human height, as well as changes in the age of onset of maturity into

adulthood, is 'the secular trend'. Adult human height is believed to have been quite constant for the two millennia up to the early part of the 19th century. So the secular trend did not really exist until two centuries ago, when the average male height was well under 170cm.

Although there has been some variation for assorted populations and societies, adult male height has increased by an average of roughly 1cm per decade since about 1850. For example, average US adult male stature increased 10cm (nearly 4in) during the 20th century.

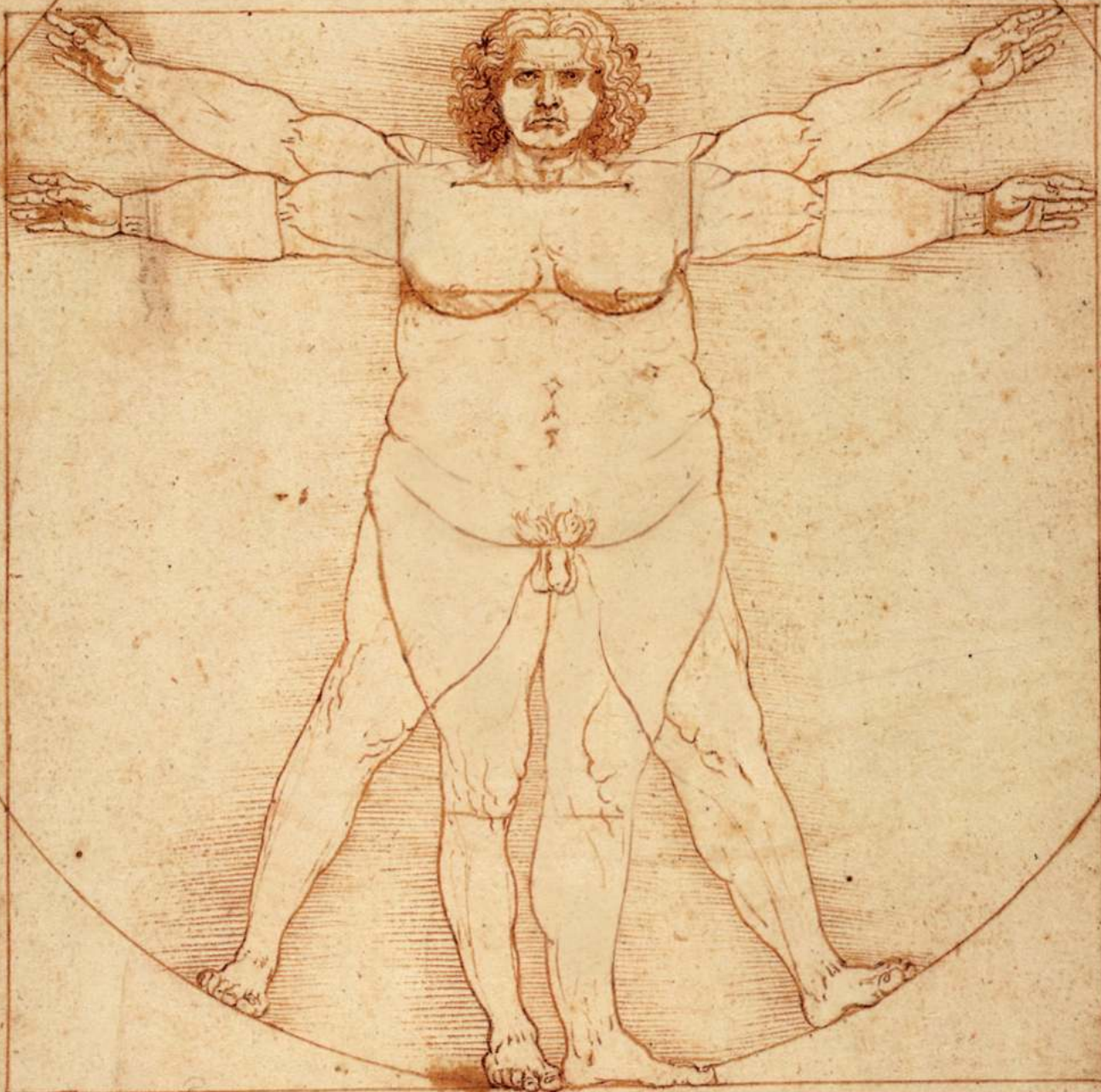
A number of factors are believed to be responsible for this increase in stature over the course of six or seven generations – first and foremost being enhanced nutrition.

Although virtually all North American, Australian and European populations have become taller in the past 150 years, there has not been any increase in the stature of newborns over this period – yet each successive generation of adults has

Grumpy old men

TALLER, FATTER AND GRAYER – MAJOR CHANGES IN POPULATION ARE HAVING A MAJOR IMPACT ON THE PROFILE OF A TYPICAL VEHICLE OPERATOR. HERE'S HOW TO MAKE AN OLD (AND POSSIBLY QUITE FAT) MAN (OR WOMAN) VERY HAPPY

Handwritten text in a cursive script, likely a Latin manuscript, located at the top of the page above the Vitruvian Man drawing.



Handwritten text in a cursive script, likely a Latin manuscript, located at the bottom of the page below the Vitruvian Man drawing.

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In 1900, 4% of the US population was over 65; now it is over 11%

been taller than its preceding generation. Adult body proportions relative to height (such as leg and arm length) have also remained largely consistent – the same, however, can not be said of body dimensions associated with body fat (see page 29 for further details).

The second factor responsible for the secular trend is population morbidity and a host of related factors impacting human health. The control of infectious diseases, improved sanitation, and enhanced living and working environments have all contributed to improved health, taller people and extended lifespans. In sum, the secular trend is not due to a change in our genes or an inherited trait, but, rather, improvements in nutrition, health and living conditions.

There is some evidence that the secular trend may have played itself out in some populations that have experienced more than six generations of continued increases in height. Adult height in much of Scandinavia has begun to plateau, and has flattened out altogether in the Netherlands, which has the tallest average adult heights in the world.

Population age

Changes in population age can also be a factor to consider in industrial

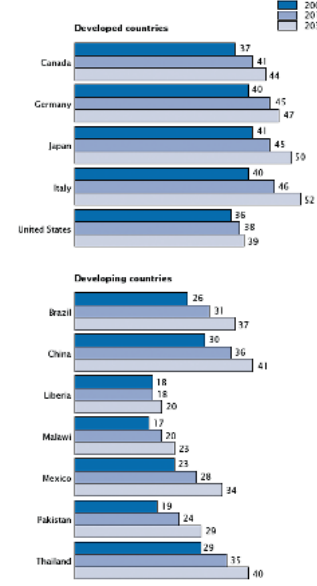
vehicle design. Although there are some variations by region, overall, virtually all nations are experiencing growth in older populations as well as the average age of the population.

The most important factor in this shift in age is declining fertility. Many countries are at or below replacement levels. In addition, worldwide, life expectancy has increased substantially since 1900. As an example, male life expectancy at birth in the UK has increased from 46.4 years in 1900, to 66.2 years in 1950, to 75 years in 2000. Similar increases have occurred throughout most developed and developing countries, although life expectancy at birth remains notably lower in much of Africa.

With regard to the shift in population age, let's look at the USA. In 1900, 4% of its population was over 65; now it is over 11%. Since 1970, the 60-and-over age group has increased twice as fast as the total population. Japan, South Korea, Canada, Australia, Greece, Italy, Eastern Europe and Western Europe have experienced shifts of even greater magnitude.

The median age of most populations has also shifted to the right and will continue to do so for the foreseeable future. In 2000 the average age of Italians was 40; by 2030 it will be 52. China's average

Figure 2-9. Median Age in 12 Countries: 2000, 2015, and 2030 (in years)

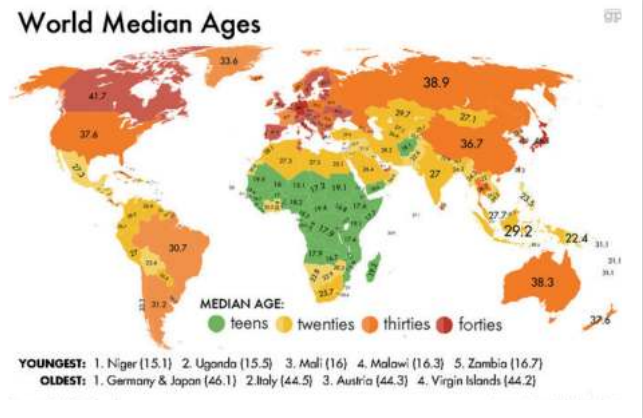
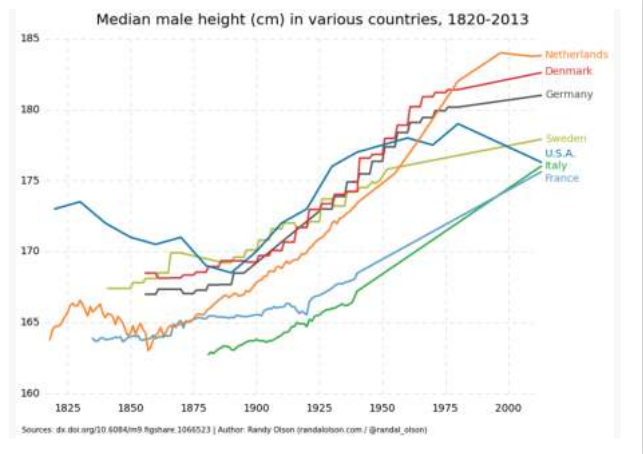


FAR LEFT: Farmers in particular may appreciate design considerations that make access safer for the older operator

LEFT: Projections show the median age is set to increase throughout developed and developing countries alike

BELOW: An article about the increasing height of the human race can be found at www.randalolson.com/2014/06/23/why-the-dutch-are-so-tall/

BOTTOM: Median ages are generally higher throughout the developed world due to declining birth rates (Source: CIA Factbook)



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In 2002 the average American male weighed 85.77kg – an increase of about 9.07kg (20 lb) in 30 years

age in 2000 was 30 years; by 2030 it will be 41.

Although there has been a recent decrease in the percentage of 60+ individuals remaining in the labor force in many developed countries, overall, the worldwide shift in the mean population age will likely result in a similar shift in the age of the pool of vehicle operators. In the coming decades, the pool of industrial vehicle operators will be older in almost every world region.

Design considerations for the future operator

When considering the design implications of having a taller, fatter and older pool of operators now and in the future, it should be kept in mind that a tenet of ergonomics is that the user interface accommodate the range of user characteristics.

There are still going to be short users, thin users and relatively young users, even though the average age, weight and stature are increasing. The central questions will revolve around these additional numbers of individuals at the expanding extremes of the distributions.

With regard to the aging of the user population, it is also important to remember that older populations are generally more heterogeneous than younger populations. For example, a sample of 20-year-olds will generally be more homogeneous in perceptual, physical and cognitive abilities than will be a sample of people in their 60s. While some older operators may be noticeably

weaker than their more youthful counterparts, some older users will be quite fit and just as healthy as the average person who is 20 years younger.

Vision: There are a number of age-related changes in vision that become of greater importance as the average operator age increases. Many can be accommodated and addressed with corrective lenses. Most adults entering middle age will experience the onset of presbyopia due to loss of flexibility of the lens and the muscles that control focusing. As a result, near vision and distance vision can be somewhat restricted, a condition that can be rectified with bifocals.

Increased sensitivity to glare is an important consideration when designing for an older population. The pupil shrinks with advancing age, and the lens and fluids of the eye become less clear, resulting in greater light scattering within the eye and increased susceptibility to glare. Effective sun shades in cabs, as well as interior light levels that can be modulated by the user, are effective at combating this. Less



TRENDS IN WEIGHT AND OBESITY

Perhaps the most drastic population change is not considered to be a part of the secular trend in stature – rather, it is more a direct result of the growing divergence between human energy intake and energy expenditure.

Most notably the US population, and also many others in Europe and elsewhere, are experiencing what many experts consider to be an epidemic of obesity. This trend began in the USA in the 1960s and has spread to many other areas.

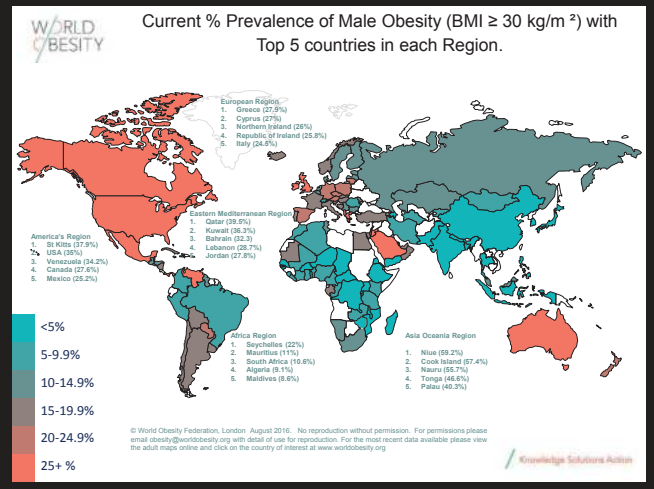
Obesity is best described using a calculation of body mass index, or BMI. The generally accepted BMI measure is weight in kilograms divided by the square of height as measured in meters (or kg/m²). For example, a person who is 1.83m tall (about 6ft) and weighs 80kg (about 176 lb) has a BMI of about 24. A BMI of 25 or more is generally considered to be overweight, and 30 or more is generally classified as obese.

The average American male in his 30s weighed 77.11kg in 1963,

80.74kg in 1972, 82.69kg in 1990, and 85.77 kg in 2002 – an increase of about 9.07kg (20 lb) in 30 years.

Perhaps even more disconcerting is the growing prevalence of obesity in much of the world. In the USA, rates of obesity have more than doubled from 15.8% in 1960 to 36.6% currently. The rate of increase has leveled off somewhat in the last 10 years, but is still on the upswing. Fully 75% of US adults are now classified as overweight or obese.

But the USA is no longer alone in this regard as calorie intake increases and lifestyles become increasingly sedentary in the developed nations. In the UK, for instance, 67% of men and 57% of women are defined as overweight or obese. The weight of adults in Germany is currently averaging an increase of about 0.25kg/year. Although rates of increase have recently slowed in some places, no country has been successful in actually lowering rates of obesity. The majority of obese adults will remain obese!



ABOVE: **Obesity is largely a scourge of the developed world** (Source: World Obesity Federation)

LEFT: **Obese and aged operators alike would welcome lower step heights to simplify access to the machine**

reflective interior cab surfaces and matt finishes are very effective at reducing glare within a vehicle cab.

The aging of the eye and the yellowing of the lens in particular result in a loss of color sensitivity. Blue, in particular, becomes less intense. Small discriminations in color become more difficult. Color palettes used on displays should therefore be clearly distinguishable by older as well as younger viewers.

Once dark-adapted, such as when operating in a dark cab at night, the older operator will require more

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ambient light to see inside the cab. Providing good control over lighting levels inside a darkened cab when the operator is dark-adapted will further benefit the older user.

Finally, there is a reduction in the visual field that is minimal at age 55 but clearly measurable at age 75. An operator of advanced age will be less likely to detect a visual signal, such as a blinking warning light, if it is located in the periphery, such as far to the left or right or high up or down in the visual field.

Hearing: Designers should consider sound levels as well as the spectrum of sound and alarms relative to an aging operator population. About 30% of the over-60s have some degree of hearing impairment, a level that increases to 50% by the age of 85. Older operators are more susceptible to background noise and reverberation, which may require minimizing cab noise levels even

further, as well as reducing sound reflectivity within the cab.

Also, higher frequencies are more likely to be missed than medium and lower frequencies, so designers should verify that alarms, auditory feedback and computer-generated voices are intelligible by older users with typical levels of hearing loss. Younger users should benefit as well.

Physiology and biomechanics: There are a number of design-relevant physiology-based factors related to an increase in the number of larger, as well as older, operators.

First is the issue of operator size. Wider seating surfaces are going to do a better job in accommodating larger operators. A larger seat may also allow for movement within the seat and the assumption of varied seating positions. Seat manufacturers may also need to verify that any substantial increases in operator weight are reflected in their seats'



Ambient lighting – like this innovation in the Genius Cab – is crucial for older operators



ABOVE LEFT: Color palettes on displays should be easily distinguishable

LEFT: It is logical to assume that the average age of a typical operator will increase in line with that of the median world population



suspension capabilities, as well as durability. Seat ventilation, cooling and even powered massage features might benefit a larger and heavier individual, improving circulation and increasing comfort.

Steering wheel adjustability may further benefit an operator with large thighs or an expansive waistline.

Muscle strength generally declines with age. Peak strength tends to occur at age 25, and declines to 80% in the 50-60 age range. Control force requirements may therefore need to be lowered to reflect the capabilities of older operators. Older operators with less strength will benefit from slip-resistant flooring surfaces and substantial, well-placed handles for ingress, egress, and moving about a cab. All users, especially older ones, will benefit by having uncluttered and unobstructed movement areas within a cab.

ERGONOMICS



LEFT & BELOW:
Highly adjustable steering wheels will make access to the seat, as well as machine operation, easier for those with large thighs or waistlines

The irony of it all

In sum, manufacturers of industrial vehicles and their many components must consider the secular trend and related shifts in user characteristics over time if they are to continue to meet the needs of operators.

Contrary to popular belief, people do actually change! The irony in all of this is that the industrial vehicle in its many forms has contributed immensely to the improvements in human nutrition, health and workplace safety and infrastructure, and greatly reduced physical labor. This has helped to bring about changes in human height, age and weight.

Industrial vehicles have changed humanity. From the harnessing of power and the unburdening of 'the human motor', to the mechanization of work and the development of all manner of machines to improve our lives, the past two centuries of technological advances have led to the huge population changes that we have seen, and will continue to see for some time. We helped create these conditions, and now we must deal with their consequences. **ivT**

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*5290 Overpass Rd, Suite 103, Santa Barbara, California 93111, USA
Tel: +1 805 683 6610*

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Slip-resistant flooring and well-placed handles will help older drivers with reduced strength

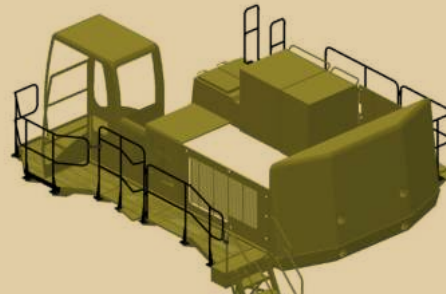


STEPPING UP TO THE CHALLENGE

Older operators typically have a wealth of experience and skills that could go to waste once they are no longer able to access the machine. So when a highly valued operator employed by John Wainwright & Co began finding access to his Caterpillar 365C hydraulic excavator increasingly tricky, the Somerset-based quarry operator turned to Cat's UK dealer, Finning, for a solution.

The customer required a continuous walkway and guardrail system on the left-hand side, meaning the access/exit point had to be at the rear end of the walkway. Finning manufactured and installed the requisite mounting, walkways and guardrails, but the masterstroke was the fitting of a hydraulic extra stair module manufactured by Australian Equipment Engineering. With the lowest step height at just 400mm above the ground, and stowing vertically when the machine is in operation, this also features complete edge protection to support better access and safer use for both the operator and any service personnel.

The installation process was not without its difficulties however, as the step mounting had to be integrated into the rear of the upper frame assembly to support the weight and orientation of the step assembly. The solution was the use of an extremely robust box-section beam with a detachable end to reduce the overall machine width for transportation requirements. The front and intermediate walkway supports were also integrated into the upper frame assembly to support the wider walkway section around the cab area.

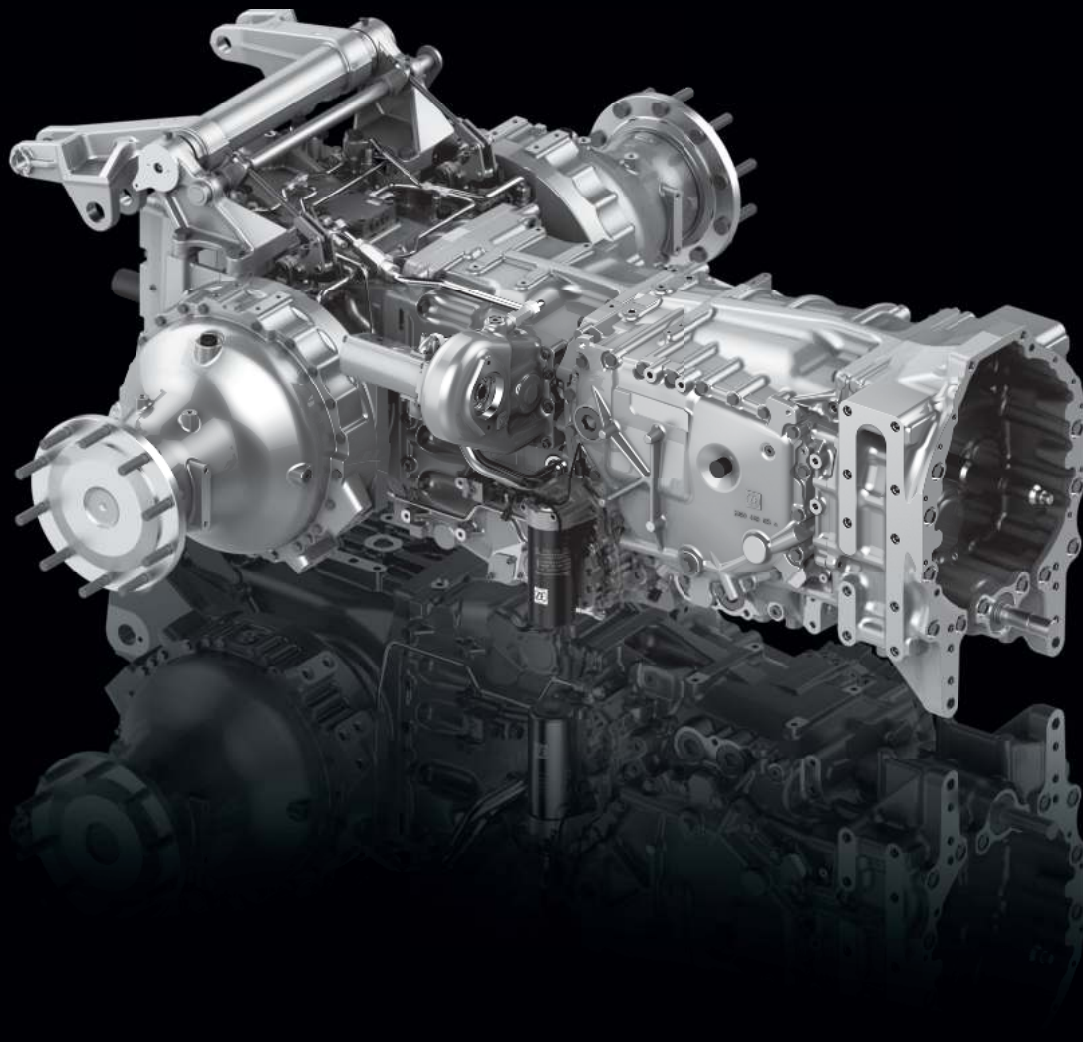


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BEFORE YOU GET CARRIED AWAY WITH DESIGNING A STUNNINGLY STYLED INDUSTRIAL VEHICLE, HAVE YOU CONSIDERED HOW ACCESSIBLE IT WILL BE TO THE OLDER OPERATOR?

▶ Aging is a fact of life and an aging workforce is something that employers and designers need to be aware of. A good designer will always seek to identify and gain a complete understanding about the users of the product or service before putting pencil to paper (or hitting the keyboard).

Industrial design is no different. When starting a project to design or redesign equipment or services, the very first step is to identify the relevant user groups. In an industrial setting these are often the workers on the shop floor, the people who use the equipment every day.

It is also important not to jump to conclusions – you may know that Joe is the guy who drives the forklift, however you may not realize that there are two or three others who are qualified and who also operate the forklift occasionally.

Identification and validation

A good principle is therefore to hold an initial workshop where all of the processes and users of the equipment in question are identified. At this workshop, service design professionals can begin to map out user journeys and generate provisional ‘personae’. These will represent the project group’s current understanding of each user group who will operate the equipment, whether they are the primary, secondary or tertiary user – or even an occasional user.

Once the user groups have been identified, the next step is to validate them. This means checking that the users and the use cases are true to real life, putting on high-vis jackets and hard hats and going to where the action is. Researchers shadow people on the job, using equipment in the workplace. They then discuss



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use cases with the operators and gain insight into not only how the equipment is actually used, but also any of their frustrations or ideas for further improvement.

By observing the real-life context (a.k.a 'the field') the researchers might notice that during cold mornings Joe uses gloves when operating the forklift. Only through observations such as this can they understand that this is a factor that needs to be taken into account in design – for example a touchscreen interface will not necessarily work with gloves.

In the context of designing for older users, the next step would be to observe a control group of 'younger' users and then compare and contrast the results. This would highlight the challenges for the older operator and enable the designer to take account of them in the new design.

Contextual observation is especially important when designing for older users and is something that is often missed. We must remember that with increasing competition for employment and a higher overhead cost often associated with an older employee, a researcher simply asking questions may not generate 'real insight'. Older operators will not necessarily want to highlight age-related issues. A skilled researcher will be aware of this and work with the operator to observe real-life situations for greater insight. An operator with many years' experience of using the same equipment on a daily basis is often the designer's best friend!

Generating personae

Using the insights gained through these contextual observations and operator interviews enables the generation of personae that bring the user groups to life. Each user group, each persona is given an identity, a name, a profile picture, and a bio, with critical information on how, when and why they use the equipment included. This will ensure the design process is centered around the actual users.

With industrial equipment being increasingly digitized – for example, touchscreen user interfaces are now common in the workplace – it is also important to consider 'digital inclusion'. Digital inclusion involves understanding the operator's level of knowledge of, and comfort with, using digital systems and interfaces. Next to the persona descriptions, researchers will create a 3D map of their personae, plotting knowledge and comfort levels of digital inclusion. These will help designers and developers keep the actual users in mind while working on a prototype. In other words, this increases designers' and developers' empathy toward the users.

Building a prototype

The next step is to design and build prototypes. This is relatively easy for a consumer product, but offers a few more challenges when designing industrial equipment. Techniques that have proved successful include using virtual reality to create a

SUIT YOURSELF



While the changing operator demographic affects most sectors and vehicles, volunteer fire departments in particular are finding it increasingly difficult to attract new members. As a result, the age of these firefighters continues to increase, leading fire truck manufacturer Ziegler to focus even more on the ergonomic aspects of its products. Therefore, when the OEM introduced its 'year of security' in January 2015, it began accounting for this demographic shift by paying more consideration to age-related issues during product development, specifically testing the design of its vehicles with the gerontologic (GERT) age simulation suit.

By artificially recreating common ailments of the elderly, the suit enables a younger wearer to more accurately understand and empathize with factors that they would not otherwise realize could be a source of difficulty. Its headset, for instance, incorporates goggles to change color perception, create grainy blurring and sensitivity to glare, and narrow the visual field. It also replicates high-frequency hearing loss and restricts head movement.

A heavy vest creates postural weakness, mobility restrictions and a decreased sense of balance; weight

cuffs change coordination, and the special gloves reduce tactile perception and restrict grip ability. Like the elbow wraps, knee wraps restrict joint mobility, while the weight cuffs and special overshoes produce an unsteady, shuffling gait.

The suit has therefore enabled Ziegler to perform realistic testing so that it can optimize the ergonomics down to the smallest detail. Improvements have been made in terms of easier-to-use controls, larger buttons, and drawers that slide in and out more easily. The large, pneumatically operated folding steps enable easier entry.

ERGONOMICS



realistic representation of the working environment. It is important that the virtual landscape is as realistic as possible and that the prototype equipment or interface will work realistically within this landscape.

When designing such systems in a marine environment, in particular, it is the detail that counts. The movement and reflections from the water are critical in creating a true-to-life scenario into which a user can be placed to validate the prototype, especially for a user who has not grown up on a diet of Xbox or PS4 simulations. Without detailed realistic situations, the user will be distracted and can potentially give false readings and misleading feedback.

Time and cost savings

Additional benefits of using virtual reality for validating prototypes in an industrial setting are speed and cost. The Leadin team worked with Sandvik to explore whether an automatic drill boom control would make the positioning of drill rigs more accurate, efficient and safe.

These drill rigs are used in various locations around the world, quite often in places where the temperature and weather conditions play a major role. Many of the techniques that have been described above were used to identify user groups and to observe users in the mine. A lot of them had worked in the mines for several years and the insights gained from their time sitting in cramped

cabs drilling holes in sub-zero temperatures were invaluable.

To design and build a prototype automated drilling rig would cost tens of thousands of euros, and to then transport this around several mines for testing would be very challenging. However, using virtual reality techniques to recreate the working environment and using these with actual users representing each persona would save both time

PERSONA CARDS BRING OLDER USERS 'TO LIFE' AND MAKE SURE THEIR NEEDS AREN'T FORGOTTEN

and money while generating critical feedback on the prototype designs. It is also possible to validate prototype designs with a much larger, diverse user-base without having to transport bulky machinery and equipment.

Building your product

Once the prototypes have been validated, it is time to build your new product/equipment or service. Even at this stage, it is important to continue to use personae. It is often the case that the team that takes the designs into development overlooks the end users, and critical insights are lost. By using persona cards – physical cards with the persona picture, bio, use cases, etc – all members of the team are connected to the end users. Ultimately, this adds value to the end product, helps

the development team to keep the actual users' needs in mind, and helps gain user acceptance.

When designing for an aging operator this is vital as the design team may find it difficult to relate to a user from another generation. Persona cards bring the users 'to life' and make sure that their needs are not forgotten.

It is very easy to go for the quick and low-cost solution, but it is not so easy to find the 'right solution'. Identifying your users, generating personae and validating every stage with real end users is a big step toward the right solution. This may require the company to change its product design strategy to a more user-centered one. This change, however, will result in a better user experience and a solution that not only works for all operators, old and young, but is also a pleasure to use, increasing productivity and avoiding errors and safety issues.

So the principles of good design hold true regardless of who you are designing for. Particularly in an industrial environment, where safety and efficiency go hand in hand, inclusive equipment design where the end user is central is a valuable tool. We must recognize operators' varying levels of digital inclusion as well as the unique requirements that come with age.

When all is said and done, great design is inclusive, whether you are designing industrial equipment or a new smartphone. **ivT**



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WHEELCHAIR OPERATING SEAT



POPE DESIGN & CURTIS INSTRUMENTS

Jon Pope has designed heavy equipment for over 18 years. He has worked for a variety of off-highway OEMs, whether as an independent design consultant or employed by Teague

Immobility affects people for many different reasons. But becoming immobile when your job is farming or working as an equipment operator does not have to mean the end of your career. Over the years the heavy equipment world has made several accommodations for disabled operators with custom cabs that lower to the ground, but they are complicated systems and often require a whole new set of controls to accommodate the wheelchair. So why not have a simple cab-lowering system that works for both the able-bodied and disabled that's easy for all to use?

Pope Design and Curtis Instruments teamed up to create a concept system to help the disabled equipment operator of the future. The result was a simple cab design that offers all operators easier ingress/egress. But a special feature option cab would allow the disabled operator to use an electric mobility wheelchair in the cab – and what makes this system different from other existing handicapped cab modifications available today would be that the mobility chair's controls would also function as the machine's controls when in the cab.

It's a simple, almost seamless, system. The cab would swing down to the ground on a boom. The special feature option cab would have a rear entry facility that uses the door as a ramp. Once the operator is inside the cab, the wheels of the electric mobility wheelchair are automatically locked down. Bluetooth connection allows the electric mobility chair controls to switch from operating the chair to operating the machine (in this case, a combine harvester). The only control in the cab itself would be an E-stop button. All machine functions would be controlled by the electric mobility chair. Machine systems would be monitored and controlled by a tablet mounted to the electric mobility chair.

The full suspension cab would come as standard with standard controls but with the ability to lower to the ground. The special option cab would be the same configuration, but stripped out of all controls and IP displays. It would also have the rear access ramp for easy ingress/egress with an electric mobility wheelchair. Side door access would remain for safety reasons and to keep the cab as standard as possible. In theory, a cab with this level of technology that lowers to the ground could in future be designed into most farm equipment, and potentially most earthmoving equipment too.

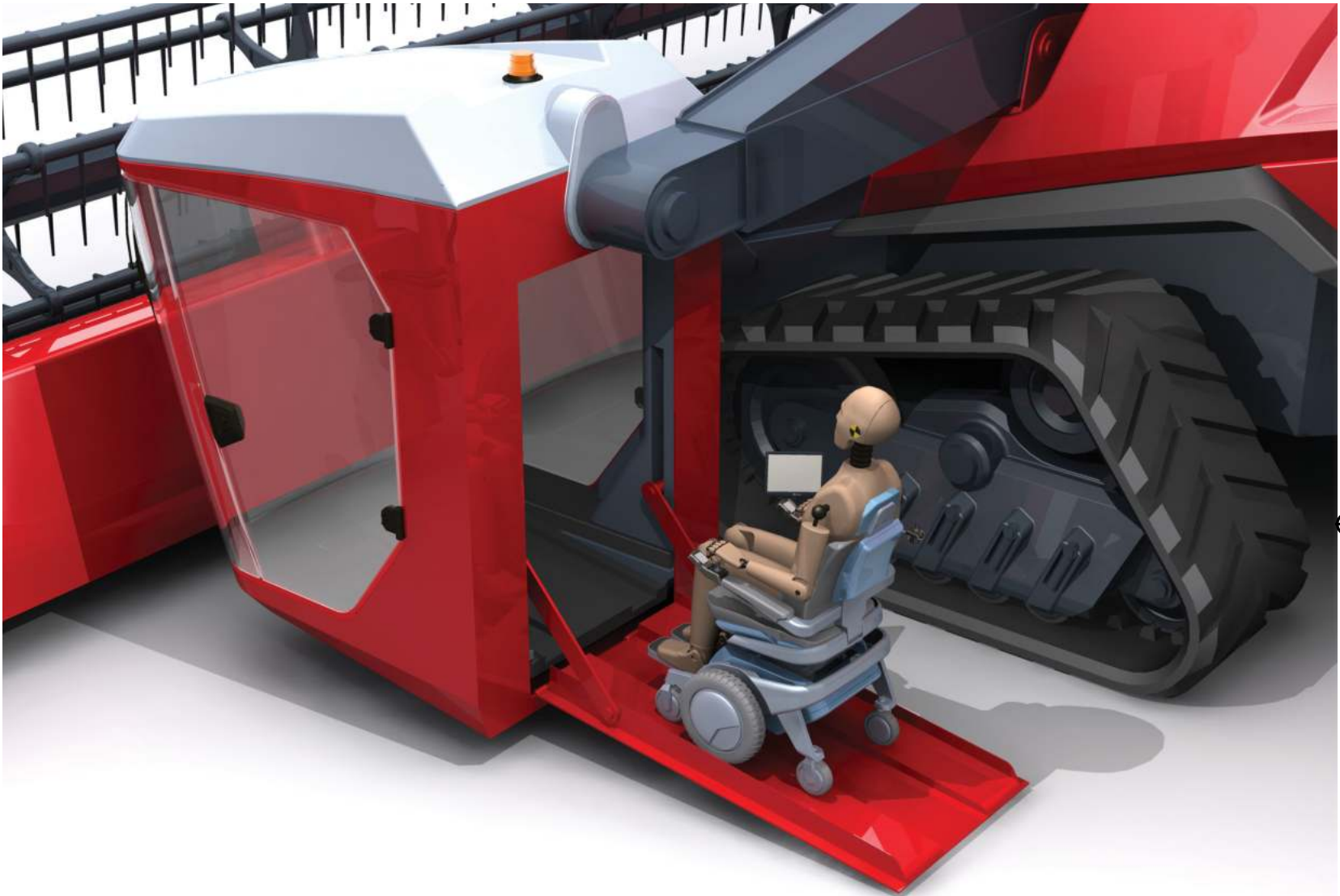
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Curtis Instruments' concept electric mobility wheelchair could also double as a fully mobile operator's seat in the future



CHALLENGE



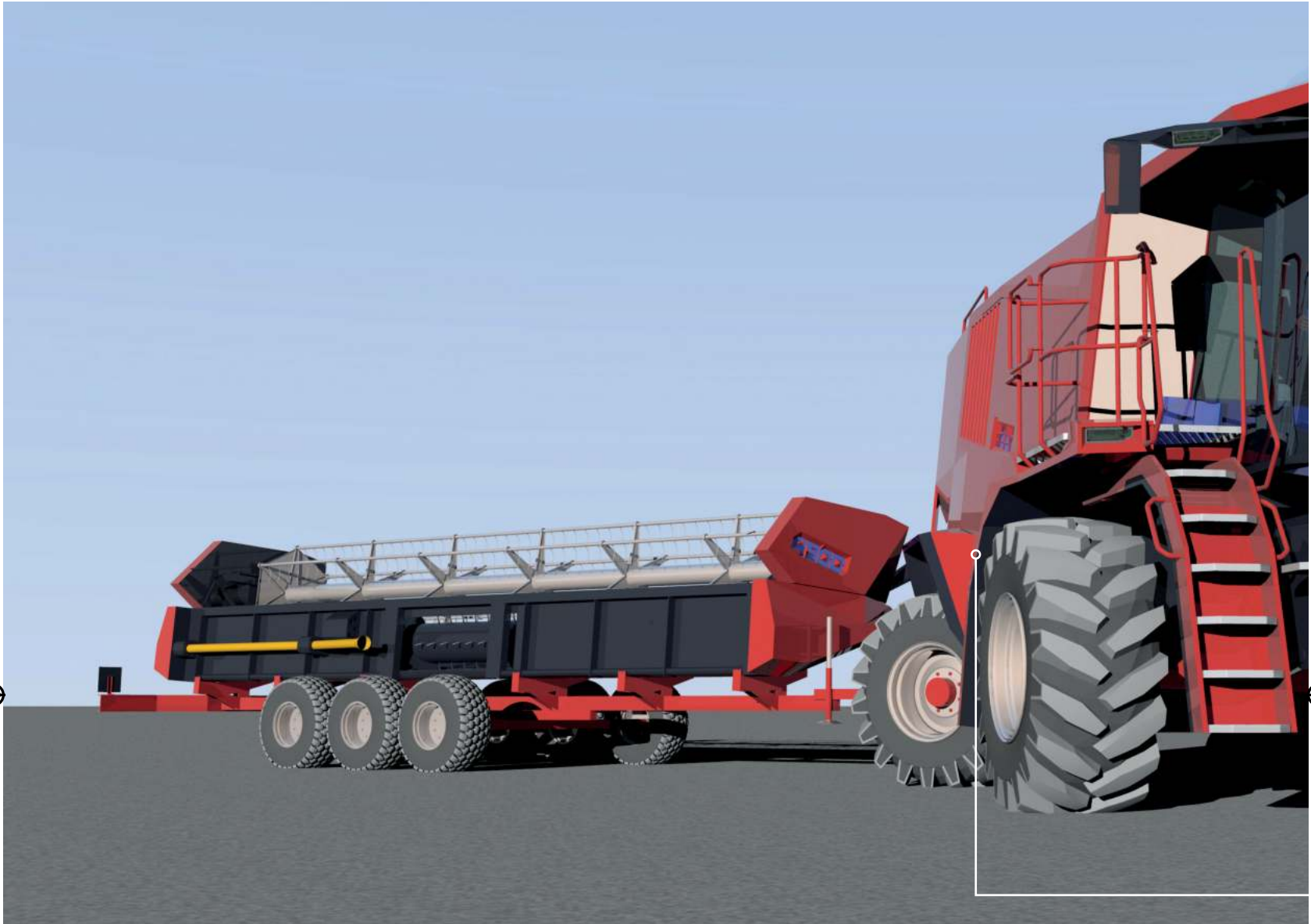
The cab swings down to ground level for ease of access; cab suspension is built into the boom



The cab's rotational ability is also useful for when harvesting on hillsides



DESIGN CHALLENGE



Convenient rear access to the drivetrain from the chopper-mounted ladder with a 65° incline. Ladders for accessing the cab can be seen in side-access mode

V-shaped rear end translates the interior disposition of dual ladders to the maintenance platform. The PC blue transparent window improves interior light on this dual-access structure



HELPFUL SYMMETRY



ALBERTO SECO

Alberto has been involved in design projects from cell phones to heavy equipment. After a spell at an Italian design consultancy and as an industrial designer, he now works in the automotive sector

The symmetrical design of the IASA concept is its main difference over current combine harvesters, a feature that offers considerable advantages for an aging operator. Access to the cab is now possible from both sides, with dual ladders removing the need to walk around the machine. Instead of a vertical ladder, access would be further eased by steps with a 75° incline. With plenty of handrails, the ladders have three positions:

- Integrated under the combine body to avoid damage during operation;
- Side-access mode, directly to both cab doors; and
- Front-access mode, more accurate while the header is not mounted during transport duties in tight spaces.

When in the autonomous driving mode, projections on the windscreen and aural signals would advise the operator about the performance of the machine and any potential decisions that may be required. Of course, the driver could modify the route and operation when necessary.

During conventional driving, the operator would be continuously informed and advised for improved performance and added safety. Vibratory warning systems on the seat would enhance the communication between machine and operators with aural problems, making HMI an integral area of the IASA concept.

While safe rear movements would be guaranteed by means of a rear camera, a real view of the harvesting and unloading operations is still desirable. The chamfer design of the combine body or grain tank therefore offers a clear view of the unloading operation on either side. The flexibility provided by the central unloading auger would offer the possibility of placing it where the operator feels most comfortable to match the trailer and check the unloading, overcoming problems related to constant twisting of back and/or neck in the same direction.

The access to the engine, fuel and other mechanical components has been placed at the rear of the combine. The tailgate would leave a 1.8m height free for access to the first ladder section placed at the chopper. The V-shape of the rear end translates the interior disposition of dual ladders for accessing the exterior maintenance platform to each side of the unloading tube. The three sections of ladders keep a 65° incline for all the steps, making it easier to reach that height. Convenient handrails are displayed from the chopper to the upper platform. To better illuminate the hidden ladders, the rear body includes a window made of blue transparent polycarbonate that also supports and highlights the IASA brand.

Despite the large size of the two side platforms, their shape has been studied to increase visibility from the cab corners, even with the ladders in front-access mode. Convenient front access for manual cleaning of the windscreen is via a front-mounted platform and a step, plus handrails on the throat of the combine that complement the cab's right ladder on the front-access mode.

In case of rollover, an aging operator would have serious difficulties leaving the cab. The entrapment hazard would be very high. Cab safety would therefore be based around three elements: ROPS would maintain the interior space inside the cab; an antilock alarm and vibratory warning for seatbelt would force the operator to use it; and airbags on the roof and cab pillars would create a bubble around the driver, avoiding any impact with the cab structure.

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MAIN: Cab dual ladders in front-access mode provide quick access to the cab without any increase in the width of the machine. Folding away under the combine body (inset) is an ideal solution for transport duties on narrow paths or through old towns

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MOTIVE POWER



As a director of Motive Power in Sydney, Australia, Lance Procter specializes in designing complex vehicles. Many have related to mining equipment, and he's designed towing tractors for heavy aircraft up to A380 size



An ideal retrofit, the powered vertical lift relies on a single-post telescopic actuator



Many of the best operators have had years of experience working on-site, often working harder than they should, putting in long hours in sub-optimal conditions. And many of them suffer from the results of that hard-working life. Key among the ailments are knee and hip issues, both of which make it painful and difficult to elevate the feet to the level required to climb ladders or steps, or to clamber up the side of an excavator or loader.

Powered and folding ladders do exist, typically for larger machines, but still require the operator to lift their feet repeatedly for considerable distances to reach the cabin. An alternative, particularly for mid-size excavators, is a cabin that moves vertically on linear actuators, allowing the operator to lower the cab to ground level to enter/exit the machine. There is therefore only one, relatively low step involved.

The power systems remain connected to the cabin via an 'elephant trunk' or energy chain, ensuring that the operator has full control whatever the cabin position. Limit switches prevent the excavator slewing until the cab is in the full Up position. Once it reaches that position, latches retain the cabin, and ensure it can be certified to ISO 12117.2 for ROPS.

A further alternative, particularly for mid-size excavators, is a powered vertical lift, requiring only a short step onto a platform. With a folding gate, and perhaps even a drop-down ramp, such a lift can take an operator with limited mobility straight from ground-level to level with the cabin floor. Using a non-rotating single-post telescopic actuator, the lift could be retrofitted to existing machines, and even changed between machines as required. Power would come from an electrically powered hydraulic pump, or from the main hydraulic system if there is provision to stop/start the excavator from ground level.

On mid-size excavators, the platform would still be within the swing circle and would not impact the operation of the machine – although the platform might need to be detached when tramming through a tight entrance.

Of course, getting the operator to the cab is only part of the task. Conversion of the door assembly to sliding rather than hinged reduces the number of steps required to open and enter the cab, and providing a clear floor without trip points, or the necessity for operators to rotate their feet sideways, will help make this whole unit more user-friendly.

The left-hand joystick should also be able to flip rearward to provide a clear path to/from the seat, and grab points to assist when getting out of the seat are also a great idea.

lance@motivepower.com.au • www.motivepower.com.au



Using linear actuators, this solution only requires an operator to take one small step into the cab



CAB-RAISING SYSTEM



JAVIER GUTIÉRREZ CASAL

A freelance mechanical design engineer based in Pontevedra, Spain, Javier has worked for many companies specialized in the development of industrial equipment

One of the biggest problems for persons of reduced mobility is the access to the operator cab. So on this occasion, I designed a cab that would facilitate access to a medium-sized telehandler with 4-ton lift capacity. Between this cab and the chassis, there is an articulated parallelogram mechanism formed by two bars and a hydraulic actuator that enables variations in the cab height. This cab-raising system is completed by a mechanical lock device that prevents any failure in the hydraulic actuator.

To use the machine, an operator merely has to push a button on the remote control access key – the cab lowers, then the door will open and automatically the retractable steering wheel and the elevating roof permit the operator to enter the cab without any torsion of the neck or vertebral column. After closing the door, a sensor in the cab floor detects the driver's presence and signals the seat to rise, approaching him while tilting forward slightly for easier access. The seat returns to the normal driving position while the operator is in it, then in a few seconds, the steering wheel reverts to the operating position and the roof will close. After this, the operator will be able to turn on the raising cab system and lock the mechanism.

If the operator wants to leave the cab, pushing an icon on the touchscreen causes the cab to lower and the steering wheel to retract. Thanks to the rising movement of the seat and a handle in the elevating roof, the driver has to use less energy for standing up.

This cab can be further adapted for wheelchair users. In these cases, the door is larger and the seat has an automatic system that works like a transfer seat installed in cars. For driving the telehandler, the stick lever that controls the movement of the boom can be adapted to include the transmission controls, so the operator only has to move the lever for driving forward or in reverse.

You may now be asking the question: "What about the wheelchair, then?" Well, that is a challenge only the operator – or another designer – can solve...

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An articulated parallelogram formed of two bars operated by a hydraulic actuator enables the cab to move up and down



On the Web

For additional images and animations, visit:
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A touch of Genius

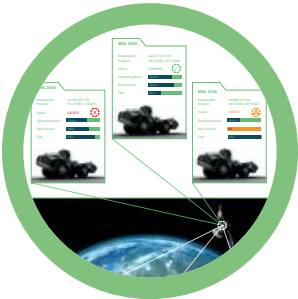
THIRTEEN COMPANIES COLLABORATED AS PART OF THE CAB CONCEPT CLUSTER TO DELIVER A CONCEPT THAT WAS THE TALK OF BAUMA. HERE ARE THE KEY ELEMENTS IN A NUTSHELL



Cab manufacturer **Fritzmeier** created the modular structure, which consists of an aluminum soft cab and a hybrid steel ROPS/ FOPS attached to the outside



Hella provided the LED work lights, signature light, interior lighting, vehicle key, transponder system, accelerator pedal and rain-light sensor



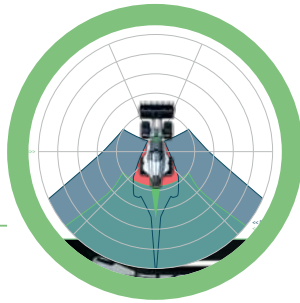
Cloud-based access and identity management from **Savvy Telematic Systems** controls access to authorized vehicle functions and enables custom configuration of the workstation



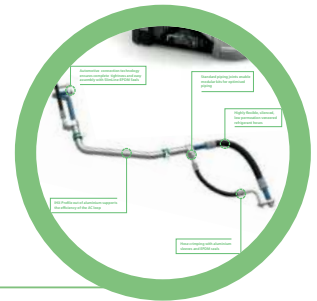
Grammer provides an ergonomically optimized complete seating system, which comprises a suspended operator's seat featuring electrically configurable features, multifunctional armrest and 12in multitouch display designed in association with **Dresden University of Technology** (for more details see page 111)



Superb all-round visibility results from **Mekra Lang**'s mirror-replacement system (a camera/monitor system on either side of the cab) and a rearview camera system that displays pictures on the operating terminal



Aurora's Vario modular HVAC unit features a central CAN controller to enable single- or multi-area climate zones



Efficient aluminum refrigerant pipes from **SMA Metalltechnik** using the countercurrent principle extract more energy from the evaporator to boost cooling efficiency



Hydac's CabinAirCare modular filter system is employed for optimum protection against dust, nanodust and harmful gases. RFID monitoring of filter soiling prevents unnecessary replacement

The body computer – the heart of the Genius Cab – enables implementation of a centralized network architecture, reducing the number of supply cables, relays and fuses, and is supplied by **Bosch**



Inspired by a cut diamond, the design of the cab was provided by **Lumod**. The emphasis on system integration and brand-building elements is evident in the protection rails positioned in the blind spot of the A-pillars, but they also serve as handrails, cable conduits and heat sink for the integrated work lights



On the Web

For more detailed information, see: www.iVTInternational.com



Designer stubble

WHEN ROSTSELMASH NEEDED A COOL, STYLISH LOOK FOR ITS LATEST COMBINE HARVESTER, IT TURNED TO A LEADING DESIGN AGENCY TO PROVIDE THE 'ITALIAN CLOTHES'



MAIN IMAGE: The definitive design approved by Rostselmash in the final stage of concept design

INSET LEFT: Antonio Pinato and Paolo Varotto are owners and founders of AMV Design, a company working internationally since 1988 (www.amvdesign.it)

INSET RIGHT: One of the first sketches of the initial concept design proposals



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Piston Pump



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Ranked fifth of the world's leading manufacturers of agricultural machines, with 150 models produced over the past 85 years, Russia's Rostselmash has consolidated its success with a new generation of combine harvesters that has gained many important plaudits from customers and experts alike.

Presented for the first time in Russia at Agrosalon 2014, the RSM 161 has seen growing interest and sales enquiries thanks to positive results from field tests. Exhibited in Europe's most important trade fairs, and appreciated by farmers all over the world, the new model has now reached Africa.

Designed to harvest all traditional grain crops, the RSM 161 stands out for being highly productive due to its state-of-the-art engineering. With its double-drum configuration, this model can manage the grain weight more efficiently, even on difficult terrain. And even though it is a class 6 combine, in some circumstances the machine demonstrates the high efficiency exhibited by class 7 models. Boasting proven productivity of approximately 45t/h, the combine can process up to 2,000ha per season.

Combining a brand new Tetra Processor threshing system, a straw walker with six working elements, an Adviser III notification system, a Cummins engine providing up to



360hp and a comfortable working environment referred to as a 'Luxury Cab', this harvester is set to be one of the best solutions available.

If further proof were needed, recognition of this potential did not take long to arrive: at Agrosalon 2014, the RSM 161 received two medals for its innovations. And most notably, Rostselmash will be awarded a silver medal at Agrosalon 2016 for the implementation of new solutions for the cleaning systems of combine harvesters in the form of its novel multidimensional OptiFlow technology.

This proprietary solution ensures a uniform distribution of the airflow and prevents leftovers from becoming stuck in the sieves. The cleaning system utilizes a six-vane double-flow turbofan with electrically controlled louvers, the fan speed being controlled from the cab and also displayed on the control panel. Sieve and component cleaning is

easy, as the operator can quickly adjust them from the cab.

More than skin deep

But the RSM 161 doesn't just boast deeply innovative technology – it also boasts a surprisingly majestic appearance thanks to the exclusive design of its 'Italian clothes'. AMV Design was able to give personality to the product, producing ergonomic and dynamic shapes with the goal of creating not only an innovative and surprisingly high-tech product, but also a flexible instrument across all of its functions.

Everything revolved around the OEM's real need: to give a completely new, modern look to a machine that would enable it to compete with the best global brands. Rostselmash's marketing and product engineering departments prepared a detailed technical briefing that highlighted the needs of the market, production and maintenance.

Initially, AMV proposed a design style in three variations requiring different tooling and production costs. All submitted options were developed to accommodate any restyling needed during the product's lifetime. Rostselmash reviewed the proposals and selected the final design based on the market and likely production quantities.

Visualizing a project across all the stages enables a more thorough

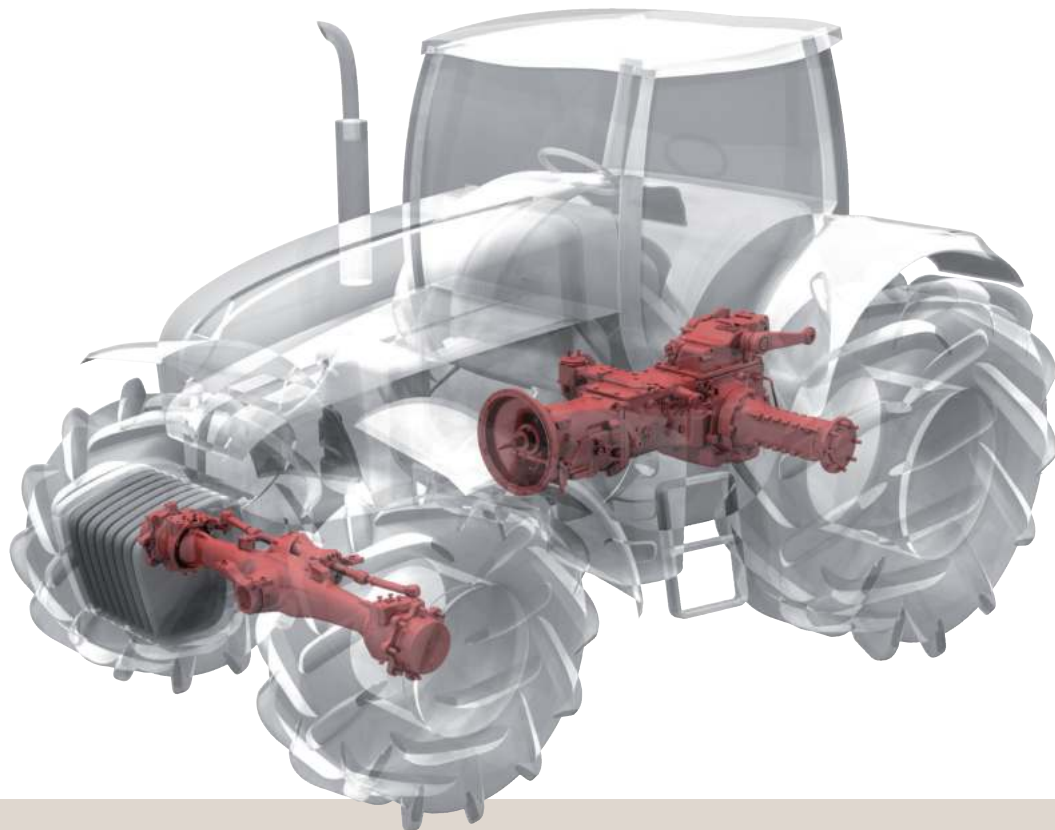
MAIN IMAGE: This study of the interior mechanical spaces was used to define side openings

ABOVE: The RSM 161 in action, boasting its aggressive and dynamic style

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evaluation, which is why a 1:5 scale mock-up of the harvester exterior was produced. As for the cabin, on the other hand, several full-scale polyurethane mock-ups were produced to enable the OEM to verify ergonomics and double check the new values with the standards initially provided. In this case, the cab was designed according to GOST 12.2.019-2005, GOST 12.2.120-2005, GOST EN 632-2003 and GOST ISO 4254-7-2005. The realization of a mock-up also enabled considerable changes to be made, particularly improvements concerning ordinary and extraordinary maintenance.

The entire project was completely developed in 3D with the aid of Pro-E /SolidWorks engineering software. Engineering then had to precisely consider the volumes of the elements of the cabin structure (i.e., section of pillars and onboard devices) and combined elements, such as the structure and moving operating elements. Particular attention was also dedicated to visibility areas projections.

The whole process, from initial concept to first pre-series production,

WORK IN PROGRESS

AMV's study covered the exterior styling of the machine and cabin, as well as the interior styling of the cab. The work began with a thorough analysis of the best brands on the global market, with the development following AMV's typical work process as detailed below:

Concept design: This phase produces the ideas and the shapes for the main features of the project. It involves devising the style guidelines, as well as a range of construction and assembly solutions for the bodywork parts. Once a style study has been conducted, the best proposals are selected and evaluated in terms of their technical and construction feasibility.

Feasibility and ergonomic studies: This stage is vital as it will either make or break a concept. Ergonomics, along with style, is a key factor while feasibility determines whether a product is viable in terms of costs and technology. Ultimately this means that clients can be presented



Considerable attention was given to ergonomics during the control joystick engineering phase

with a definitive project that will not need to be overhauled during the manufacturing phase.

Final style proposals: The final style is presented in a series of images that afford a detailed look at the complete vehicle and its main parts from a variety of angles. This stage



also includes a full description of the style and feasibility studies, as well as an estimate, on demand, for the costs of the equipment and the bodywork parts.

Style surfaces: Once the design is approved, a mathematical model of the style surfaces is created. This stage brings the forms to life in a blend of style and engineering.

Accurate data transmission and constant supervision by the design manager ensure that the original style concept is maintained and that the finished product is first-rate.

Mock-up: Rapid prototyping or CNC machining is used to produce a full-scale or scaled mock-up for style and ergonomic approval.

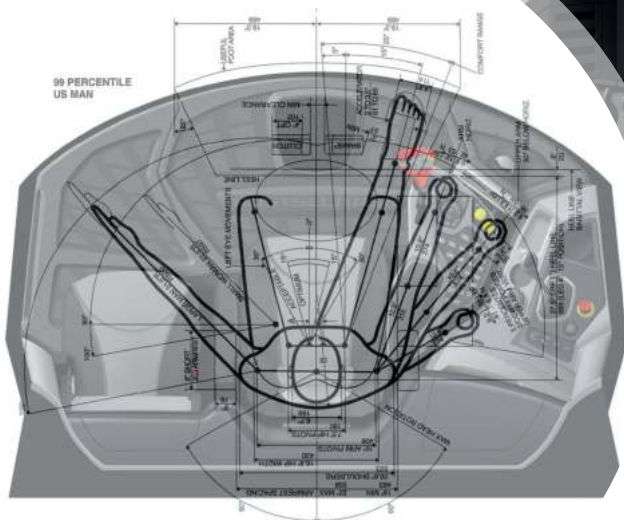
Engineering: AMV designs the plastic and mechanical parts of the chassis and bodywork. It also installs commercially available parts, and the OEM's own parts, until the whole vehicle has been assembled.

A 1:5 scale model was produced for final approval of style

RIGHT: In developing the cab interior design, AMV had the chance to put into practice all of its experience in industrial vehicles



LEFT: Everything was designed around the operator for greater comfort. Extensive studies were conducted to optimize external visibility



lasted from January 2013 to February 2015. It is worth stressing that the key factor in this project's success – as in all successful projects – was the complete integration between the Rostselmash managers and supervisors' decisions and the technical indications. This efficient cooperation allowed the company to quickly reach its goals.

A luxury cab

AMV Design also developed the harvester's new cab, which features panoramic glazing and comfortable dimensions, being 30% larger than the average cabs from competitors. The design focused on the comfort and ergonomics of the seats and control devices, both of which are directly linked to a reduction of the operator's strain and fatigue, and consequently to an improvement of overall performance efficiency.

Designing a 30% larger cabin not only required increasing the outside dimensions, it also involved creating the most ergonomic interior surfaces for the operator and covering those parts that should not be visible, to optimize the interior space. AMV

CASE STUDY



assessed the most ergonomic layout for the operator based on various elements: the components that needed to be inserted, operational space for moving external devices, and maneuverability. An important modularity study related to this point resulted in the creation of single groups (for example, the multifunction armrest) that can be inserted in smaller versions of Rostselmash cabs, too. The final result is a cabin volume of 2.3m³.

In terms of structural issues, an engineering study led to the development of an ergonomic profile for the A-pillars so that they obstructed the operator's visibility as little as possible. Furthermore, to optimize visibility, the air conditioning pipe was attached to the same pillar, facing the operator.

More glass has also been added. It now covers an area of more than 5m², further optimizing visibility.

The special design of the entry door allows for easy access and egress. The steering column has been shaped to make maximum space available for the operator's legs. The result is a compact design allowing maximum front visibility, while also providing precise adjustment down to the millimeter according to the operator's height.

Special attention was also given to the creation of several functional technical compartments, allowing the operator to organize the working



TOP: A rearview sketch and picture of the production RSM 161, with work progress details of the multifunction armrest
ABOVE: The new RSM 161 driving station highlights the style revolution

space in the best possible way. Spaces were designed to host various objects, clothes and technical work documentation, with a cool box for food and beverages.

The study aimed to produce an integrated system that would deliver maximum comfort and ergonomic driving for the operator. In terms of technological comfort, the cab is equipped with the advanced Adviser III video monitoring information system, which incorporates a 10in full-color and fully adjustable touchscreen, a control console with a multifunction armrest and keypad that is adjustable for all users, and a joystick with 16 functions.

The HVAC system layout was also created with the operator's comfort in mind: its pipes were inserted in the main structure frame to achieve uniform conditioning, and airflow directed to the glass surfaces to grant a complete defrosting.

The RSM 161 reaches the material standards of the most well-known brands, utilizing parts in soft-touch materials or specialist finishings for plastic parts. A major improvement over previous models is the quality of finish, most notably in managing to combine different components without sacrificing materials quality.

Finally, yet just as importantly, even aesthetic aspects such as color play a crucial role, as chromatic studies are key to granting maximum visibility comfort and a long-lasting 'clean effect'.

A new approach

The RSM 161 offers a very extensive example of AMV Design's philosophy: developing a new industrial design means giving new life to the product, and creating a winning product requires both a solid technological background and a careful focus on the aesthetic impact. The boost that good design can give to an industrial vehicle is not just restricted to its outside appearance – a captivating stylistic line is a leading force in a product's evolution.

Bearing all this in mind, AMV decided, together with Rostselmash, to develop the RSM 161 with an automotive approach. The new design is impressive but it does not come out of nothing. It is part of a story, it constitutes the evolution of its past and already foresees a future. Just as in the automotive industry, the future will not be a complete revolution of the present: partial restylings of chosen details are going to make the difference in the next generations of RSM 161.

The RSM 161 is Rostselmash's demonstration of how Russian development is keeping up the pace of agro-industrial advancement, both in terms of competitiveness and technological innovation. The Russian giant chose AMV Design to achieve its objective, and AMV made the challenge its own, adding that 'extra something' that made the machine unique. Designer and manufacturer worked in synergy, and their passionate cooperation created an outstanding machine that can easily compete as a leader in the international market. **ivT**

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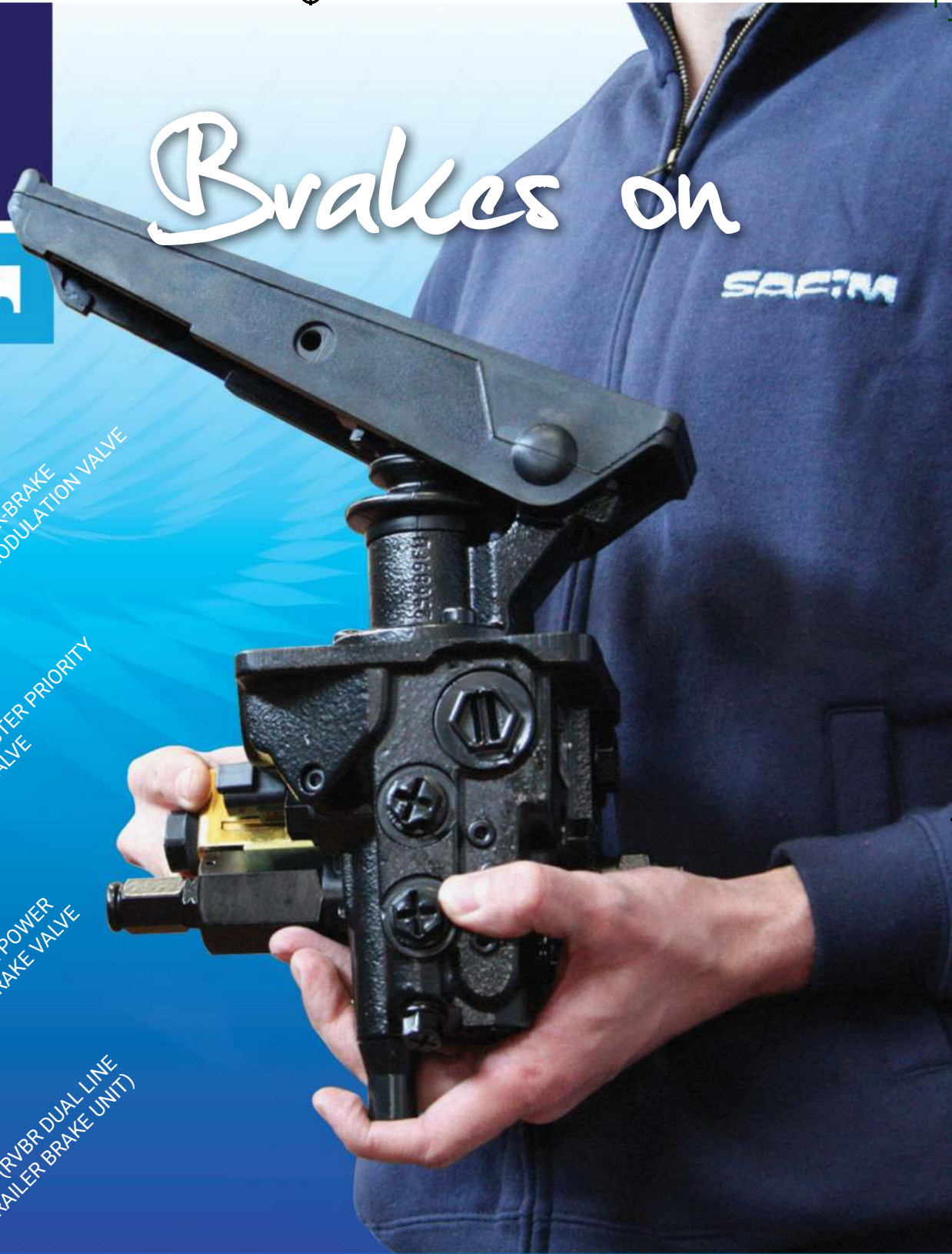
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In the family weycor

WEYHAUSEN'S 250e WHEELED LOADER WAS NO MORE THAN A TWINKLE IN ITS HEAD OF R&D'S EYE 10 YEARS AGO. BUT ITS SPECIALLY DEVELOPED TYPE 40 CAB WILL HELP THE WEYCOR RANGE TO EXPAND EVEN FURTHER IN THE NEAR FUTURE

MAIN IMAGE: An optimum all-round view through large areas of glass characterizes the new weycor Type 40 cabin

RIGHT: One of the first sketches documenting the visual concept of the cabin

BELOW: Optimum visibility to the rear thanks to the descending lines of the hood. The 'central fin' serves for mounting the rear-view camera







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▷ Weighing in at 13.8 metric tons in standard configuration and scheduled for series production by the end of 2016, Atlas Weyhausen's new weycor 250e wheeled loader is its top of the range, Stage V-ready 160kW model in the 2.5m³ class. It offers a maximum tipping load of 8,800kg when not fitted with a quick coupler, though such a unit is available for the machine as an option. The hydraulics are a package developed in close cooperation with Bosch Rexroth to provide efficient loader, steering, drive, control circuit and fan functions.

One design goal was to reduce fuel consumption while at the same time enhancing overall efficiency. Electronic control of all systems ensures that the engine delivers exactly the power level required at any given time, decreasing fuel consumption, emissions and noise levels. Ease of maintenance is provided by means of central consolidated service points.

An evolving design

Atlas Weyhausen, given its relatively small size, does not have its own internal industrial design capability and therefore engaged independent industrial designer Lutz Meyer of Lumede Design at the start of the process to provide the necessary input. He has delivered this service to the company for the past eight years and was responsible for all aspects of the design of the new machine.

Work on the 250e began three years ago, with the intention being, from the very beginning, to show the result at this year's Bauma exhibition. Meyer was embedded

TOP: An unobscured forward view to the ground

ABOVE: Lutz Meyer has worked on Atlas Weyhausen designs for eight years

BELOW: First sketch of the operator console

with the engineering staff, ensuring rapid and efficient communication between all parties during the development of the machine specifications and design.

He does not believe, however, that the development program was a long one: "We were starting from zero where the 250e was concerned," he explains. "We had a small team and had to develop the designs of all the elements on the machine – the hydraulics, the cab, the control systems, the engine packaging etc. Everything is new."

The first requirement of the design was to produce styling that



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MARINE

ON ROAD

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matched other Weyhausen products so as to promote a distinctive 'family' appearance. Given that Meyer had already carried out previous product redesigns over those eight years, this was relatively easily achieved – although reaching an efficient compromise between the demands for the engine packaging and those of the cab space was rather more challenging, especially as the engine choice changed midway during the development of the design.

The other main design criteria involved the ergonomics of the machine. The aim was to provide an efficient and comfortable working environment for any operator.

Form meets function

The result is the all-new Type 40 cab. A key feature of the new design is its single-piece front windscreen. This was a design requirement from

the very beginning as it would simplify the manufacturing process by eliminating the need to assemble a multi-element unit, would play a part in the development of a distinct 'look' for the weycor machines, and would also extract maximum wiping efficiency from just a single windscreen wiper.

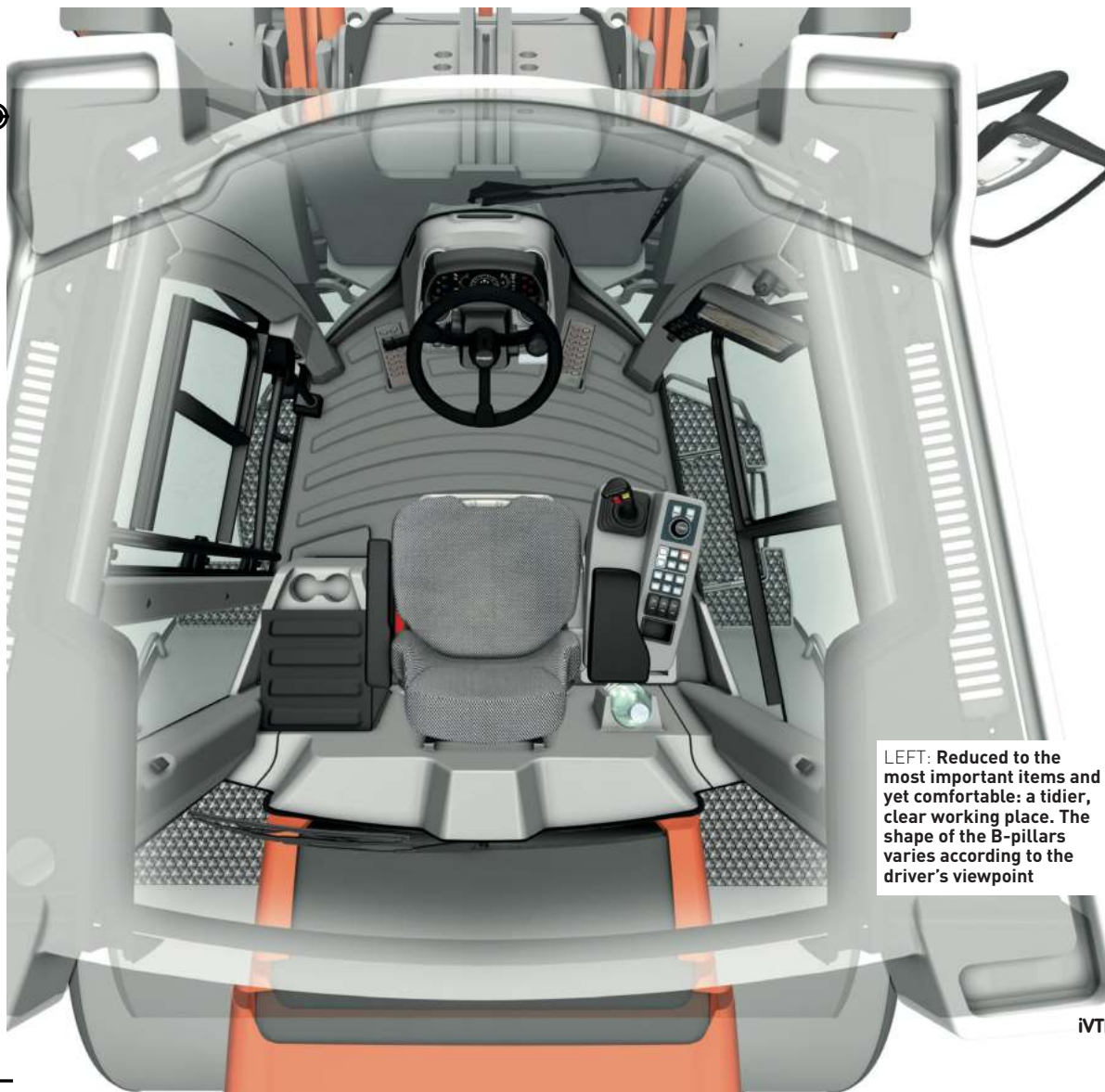
In order to ensure a clean and comfortable cab that offers operators a roomy work environment, the Type 40 is as wide as possible at the rear and then narrows toward the front. The rear space this provides therefore allows for the installation of a euro box to the left of the seat for storage purposes. The air filter and the intake for the ventilation system have been installed in the roof of the cab to ensure a fresh air supply, while the cab is also overpressured to prevent the ingress of pollutants.

FIT FOR ALL

To ensure that the new machine could be used by any operator – older, younger, taller or larger – the prototype was trialled with a wide range of operators to gain feedback on the cab layout and control positions. The result is that the Grammer suspension seat and right armrest that carries the joystick and other controls are fully adjustable, as are the steering column height and angle. There is also an elbow rest on the right of the seat that is also fully adjustable in terms of height and lateral position. This allows an individual operator, irrespective of height and size, to tailor his or her position to suit their specific physical requirements quickly and easily.



Versatile adjustment possibilities allow for maximum customization in the control console



LEFT: Reduced to the most important items and yet comfortable: a tidier, clear working place. The shape of the B-pillars varies according to the driver's viewpoint

Careful sound insulation ensures the lowest possible internal noise levels, and the steering column only takes up a third or so of the front of the cab. This allows for a clear, unimpeded view from top to bottom of the windscreen, with the visibility further enhanced through the use of a deep-drawn rear screen and a one-piece lateral glass panel on the right. A rear-mounted camera is also fitted as a viewing aid.

To ensure maximum visibility levels during the development of the cab design, extensive use was made of EMM-Check, developed by German software specialist Reknov.

EMM-Check is a CAD-neutral 3D-software application for visibility field analysis of trucks, earthmoving machinery and agricultural vehicles according to international standards. It is intended to support engineers throughout the product development process in the rapid analysis of visual field defects and the calculation of mirror and camera visibility fields. In addition, the illumination fields of work lights can be simulated.

As soon as the first 3D designs are available, designers can start the first tests to ensure a standard compatible design. CAD data is exported from the user's system. Only the 3D data that may cause field-of-view restriction is required.

CASE STUDY



EMM-Check analyzes the field-of-view restriction based on the geometry and evaluates compliance to international standards. Mirrors, cameras, work lights and forks/load platforms can be added from EMM-Check catalogs.

EMM-Check's modern ergonomic user interface can be operated intuitively. It calculates the areas that are not in the operator's field of vision, mirror or camera fields of view as well as the illumination fields of working lights. Non-visible areas are displayed as field-of-view restrictions on standard specific planes.

Ease and intuition

The machine display is a weycor-specific design that was developed in conjunction with Reichardt Elektronik, a specialist in the production of electronic subsystems and related software for vehicles of all types. It consists of a single 7in unit that is controlled by one knob, allowing operators to rapidly switch from one display function to another.

"We decided not to use a touchscreen display because that would mean the operator would have to reach through the steering wheel," explains Meyer. "Instead, we positioned the display control on the armrest. The goal was to make it as simple as possible to use. The operator can easily switch



TOP LEFT/RIGHT: The control of the machine should be intuitive and easy to understand. From the buttons on the display controller to the user interface, everything has been developed or fine-tuned especially for this cabin

ABOVE: A completely new development, the weycor 250e boasts the highest standards of ergonomics and ease of use

On the Web
For additional images, visit:
www.IVTInternational.com

between the various display options using this control."

The joystick controller is another weycor-specific design, and was developed in conjunction with W Gessmann, which has been developing, producing and selling high-quality industrial controllers for customers all over the world for more than 85 years. The new design will appear on all future weycor wheeled loaders and has been designed to suit all hand sizes.

Overall, the control systems on the new machine have been tailored to provide what the company describes as 'intuitive handling'.

Look the other weycor

It is the company's intention to use the Type 40 cab on the weycor 200e, which should appear in the iron in 2017 and, according to Meyer, this will allow for a wide range of future

variants and customization to meet individual customer needs.

The Type 40 cab will not appear on smaller weycor wheeled loaders due to cost and size constraints, however. It is really designed for use on machines that operate in intensive duties where the operator does not leave the cab, which typically is the case where larger machines are concerned.

The 250e is a new departure for the company and Artur Gabriel, Atlas Weyhausen head of R&D, says, "I basically started to think about it as early as 2006. From then on, I could not get the idea out of my head. And when the budget for the project was finally approved, we jumped at the opportunity. For a medium-sized company like ours, this process was a massive effort.

"I have to say that in the last few years, in our industrial sector, we sometimes felt we were kept busy by the constraints we were under, because of the fact that we had to keep adapting our technology to the latest EU emission standards, which were changing much more rapidly than in the automobile industry.

"Those changes are absolutely right and necessary, in view of environmental protection, of course, but they made great demands on our time and resources, which, in a way, reduced the leeway for innovations. Against this background, what we have accomplished here at Weyhausen is an extraordinary achievement." **IVT**

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An ether/or situation?

IS DETERMINISTIC ETHERNET THE NEXT CAN? MIGHT IT EVEN REPLACE CAN? OR BETWEEN THE TWO, WILL THEY TAKE THE CONNECTIVITY OF THE NEXT GENERATION OF OFF-HIGHWAY VEHICLES TO NEW HEIGHTS?

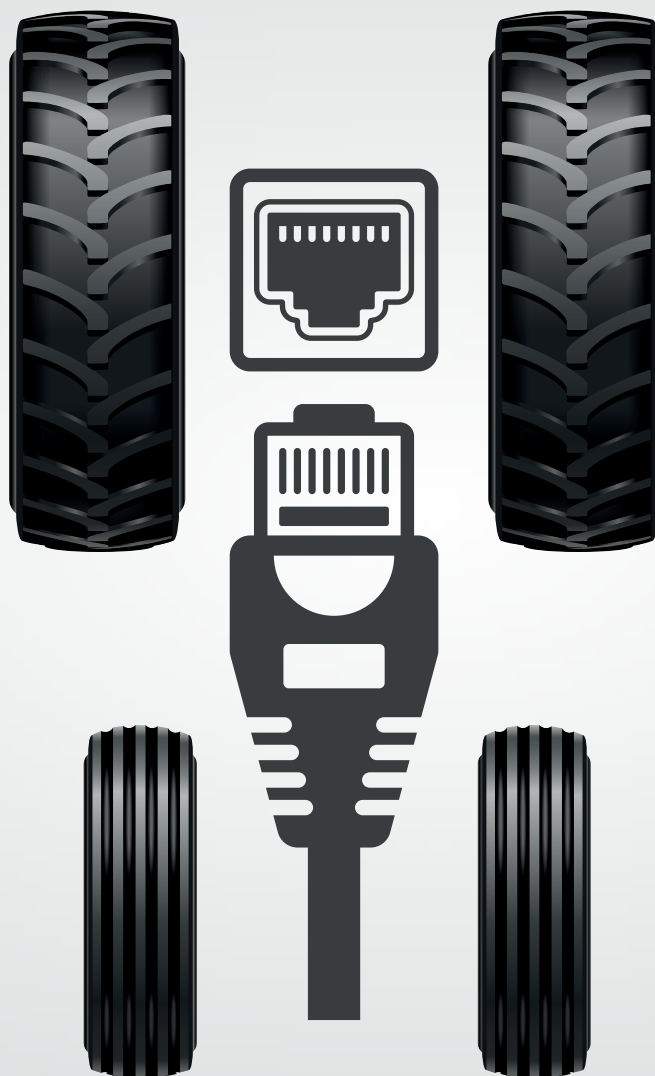
As was the case with the automotive industry some years ago, the manufacturers of off-highway industrial vehicles are now faced with ever-increasing data that needs to be transmitted over the machine network.

On many machines it has become necessary to use several CAN networks – thereby increasing system complexity considerably. Data volumes are being continually raised by devices such as cameras, radar sensors, laser scanners and ultrasonic sensors, all required for implementing operator assistance systems and autonomous working and driving functionalities.

The bandwidth of CAN is limited, however, and cannot cope with the rapidly increasing data volume. This is ultimately why the leading off-highway industry OEMs are now searching for a next-generation communication technology that can offer large bandwidth as well as the possibility to transmit safety-critical data and best-effort data at the same time and on the same channel.

Why Ethernet?

This is where Ethernet can take over: this very well standardized and open technology is easily accessible to everyone, provides a wide range of bandwidth and physical layer



options, and has a high level of support in a diverse range of application areas. Because of the open development of Ethernet standards, its technical functions and operational speed are evolving rapidly, which results in low-cost solutions through commercial off-the-shelf equipment.

Ethernet was originally used as a platform for converging divergent IT networks. Of course the requirements of a communication technology in an automotive environment are different from those of desktop networks, where Ethernet is the technology of choice.

In an embedded environment, the network needs better real-time performance and a more robust and cost-efficient physical layer. With the deterministic real-time communication over Ethernet achieved by TSN (time-sensitive networking), off-highway, industrial, and automotive applications can now follow this route of convergence for all applications, including those with strict real-time communication requirements.

Ethernet in automotive applications

Ethernet has been employed in automotive applications since 2008 – predominantly for diagnostics

ETHERNET

communication and data download. The large bandwidth that Ethernet can provide compared with other automotive in-vehicle networking technologies such as CAN has made it an obvious choice for applications such as camera-vision systems and infotainment systems in the last few years.

In a next step, Ethernet shows its potential for use as backbone network communication throughout the vehicle. This includes safety-critical applications that enable piloted and autonomous driving – a major trend in the automotive industry today. For these hard real-time applications, guaranteed communication latency is a key requirement. While regular Ethernet can at best provide quality of service for prioritization of traffic, safety-critical applications require strict guarantees that any critical messages will be delivered through the network in time.

In response to this requirement, the TSN task group was formed in

2012 within IEEE 802.1. The new generation of Ethernet based in-vehicle communication that emerged through AVB (audio video bridging) is now being developed into a set of fully deterministic Ethernet standards in IEEE 802.1.

A two-step approach for mobile machinery

The TSN standard offers the required latency guarantees for communication of critical control traffic in modern cars and industrial vehicles.

Deterministic Ethernet standards are transforming the way that in-vehicle and in-machine networks are being designed and built. The integration of Ethernet in vehicles and mobile machines can be broadly shown in two phases, each bringing new opportunities and new levels of value for manufacturers and their customers.

Phase 1: Download interface and subsystem level

In the first phase, Ethernet is used as a high-speed interface to the machine

control system for software download and as a high-speed in-machine connection for applications with high-bandwidth requirements. Systems such as video cameras can be connected over regular Ethernet.

Examples of phase 1 applications include download, diagnostics, and Machine2x (IP), as well as surround sensing (e.g. video and radar).

Phase 2: Domain level

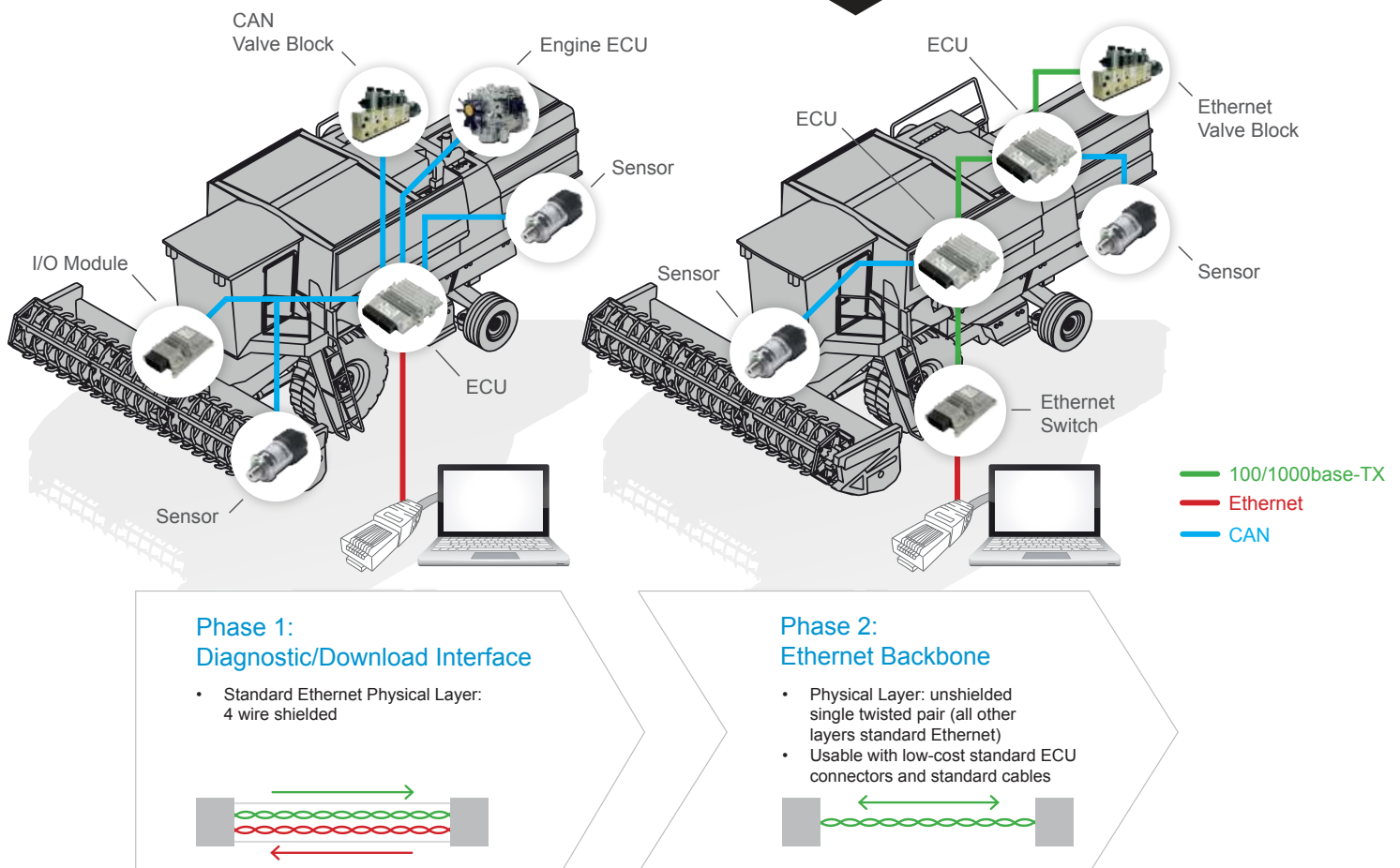
The second phase extends to the use of Deterministic Ethernet as the backbone network that integrates all traffic classes on a single in-vehicle network. An operator assistance system with video top view or surround view (rendered and then displayed on the operator terminal) requires the communication guarantees provided by TSN.

Application examples include:

- Operator assistance systems;
- Semi-autonomous working and driving functions;
- Autonomous working and driving functions.

The requirements include:

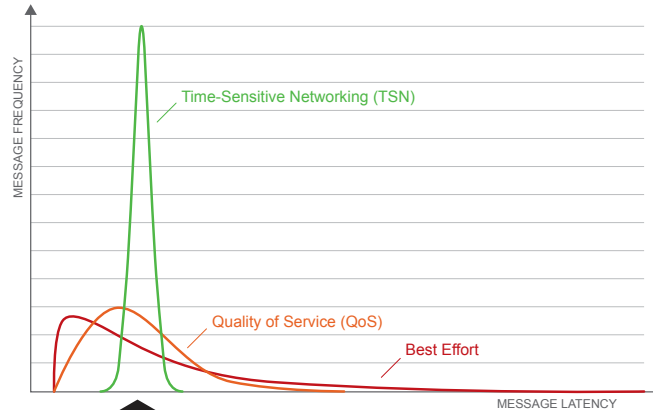
BELOW: Integration of Ethernet in mobile machines – from use as a high-speed interface for software download to the use of Deterministic Ethernet as the backbone network



- Control loops (real time and synchronous);
- Safety (real time, synchronous, and ISO13849 PL d);
- Availability (fail-operational systems).

As an example, time-scheduled Deterministic Ethernet is being deployed in ADAS (advanced driver-assistance system) hardware for use in piloted and autonomous driving, where functional subcomponents of the safety-critical system are connected on a shared network infrastructure. This system will be available in the next generation of automobiles.

In-machine network solutions need to take weight and the cost of the cable harness into account and generally be as robust, serviceable, and efficient as possible. For this reason, technologies such as BroadR-Reach for 100Mb/s and RTPGE for Gb/s connections have been developed and standardized. These unshielded twisted single pair cables can drastically reduce the weight and cost of in-vehicle/in-machine



ABOVE: A Deterministic Ethernet network will guarantee latency of critical scheduled communication. Time-scheduled traffic partitioned from other network traffic is immune to disturbance

infrastructures while still fulfilling automotive EMC requirements.

Will Ethernet replace CAN?

CAN is a well-established standard for connecting control units in the distributed control systems of mobile machinery and will remain a key technology for connectivity in the near future. Nonetheless, in modern systems, other communication technologies will gradually support and complement CAN connectivity

between ECUs. Ethernet is a good choice for several reasons:

- Regarding debugging, downloading, logging, and a host of additional supporting activities, the bandwidth available on an Ethernet connection drastically reduces cycle time for development and maintenance;
- Visualization, process monitoring and video streaming are frequently required in the operational mode of a system and demand a higher bandwidth, such as the rearview cameras of vehicles;
- Automotive physical layer technologies such as BroadR-Reach combine the advantages of the easy and cost-effective wiring of CAN and the high-speed data communication of Ethernet;
- Demand for deterministic real-time communication can be fulfilled by the Ethernet standard TSN;
- Ethernet connectivity simplifies the integration of the IoT. **ivT**

Marc Weissengruber is product marketing manager at TTControl

DETERMINISTIC ETHERNET AND THE INTERNET OF THINGS

The Internet of Things (IoT) is often discussed in terms of its business impact and the exciting opportunities it creates. In the area of real-time systems the impact of the IoT is not yet noticeable due to connectivity reasons: features offered in the IT world such as analytics software and cloud computing rely on open, standard IP or wireless connectivity to gather data. However, in the environments of mobile real-time applications, this type of connectivity is rarely found.

For example, in industrial automation and energy production, the improved connectivity of robots, wind turbines or substations can lead to a boost in production efficiency, human-machine collaboration and reduced system downtime. To take advantage of the improvements in efficiency, uptime and functionality that IoT can deliver, the underlying networks must provide reliable and deterministic M2M and machine-to-cloud connectivity, at prices that only open standards can ensure. Similarly in automotive and off-highway, deterministic connectivity in vehicles enables advances in remote diagnosis, machine-to-X, and autonomous working and driving.

These functionalities will also be applicable in other areas, for example in agriculture. Machinery will be able to send data collected during fieldwork to the farm office or another machine on the field, while receiving data in real-time that could be used by the machine control system to adapt the ground speed to optimize the task.

Generally speaking, data must be sharable between machines for control and synchronization, and from machines to the enterprise space for analysis and optimization. This is being described as the convergence of operational technology (OT) and information technology (IT). For this to happen, the network must be open and be subject to an overall standard. However, there are strict real-time communication requirements that cannot be met by Ethernet in its established form.

With the TSN extension to IEEE 802, Ethernet obtains the characteristics missing. Low latency and guarantees for communication of even the most critical control traffic mean that all systems are able to share a single communications network. When critical and non-critical applications share the same communications



infrastructure safely and securely, OT and IT are brought together and data access is improved immeasurably. This will enable new business models, cut downtime, simplify system integration, and reduce the cost of maintenance.

As an example, consider a job site with multiple machines working on a major project. Today, these vehicles are controlled locally, with limited synchronization between them, and bottlenecks for data access from beyond the jobsite. Where there is connectivity, it is either via proprietary networks or gateways. By converging non-critical traffic in the same network, the guarantees for communication of critical messages are jeopardized.

Now consider a TSN connection between these machines. The controls

communication is guaranteed across the network even when converged with non-critical traffic, and all machines are synchronized to the same global time. This means that control networks can be integrated with data networks, and many control functions can be centralized away from the construction machine, where greater computing power can be utilized.

Importantly, huge amounts of data from the machines will now become visible to higher layer networks without the need for gateways, enabling Machine as a Service (MaaS) type business models – simultaneously improving service and maintenance from machine builders and lowering capital expenditure for end-user manufacturing companies.



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or not 3D?

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▷ As globalization and commodity-swing cycles reshape the traditional industry paradigms, manufacturing companies – not least the off-highway vehicle manufacturers – are investigating avenues to help them become even smarter, faster and nimbler. One of the core technologies that is helping them in the journey to a future of responsive manufacturing is 3D printing/additive manufacturing.

Although the technology has been around for a while, customers are now realizing the true value of this process. And while it does have its drawbacks, such as slow output, the advantages outweigh them on specific use cases.

Caterpillar, for example, recently opened its additive manufacturing (AM) facility in Mossville, Illinois. The OEM uses a spectrum of AM technologies such as direct metal laser sintering, selective laser sintering, fused deposition

modeling, stereo lithography and material jetting technology.

Cat currently uses 3D printing for three broad purposes:

- Low-volume parts/pilot lots and scale models: AM technologies help immensely in crunching the ideate-to-delivery process for low-volume, high-mix production parts.

Also, using AM technologies is a very cost-effective and speedy means of producing design prototypes, pilot lot castings to study internal structures, and scale models when compared with the more traditional manufacturing methods, which would usually require building out machining fixtures, tools and jigs.

- On-demand manufacturing: in manufacturing, as new products and designs come online, stock-keeping units are usually discontinued. However, while they may have a fairly large installed base in the market, it is rarely economical for the manufacturer to maintain spare



ABOVE: Caterpillar's new facility is employing AM technologies for low-volume parts and scale models, as well as on-demand manufacturing and metal printing

LEFT: The likelihood of printing an entire tractor using AM technologies is unlikely at best (image: Samir Datta)

parts inventory for all these stock-keeping units.

Cat, therefore, has developed an online on-demand parts-ordering system, which enables its dealer network to order parts. These are ultimately printed using its AM technologies and then shipped. Thereby, the OEM is able to create alternate revenue opportunities without considerable cap-ex investments.

- Metal printing: 3D printing started off with ABS, nylon, polyetherimide, ULTEM, high-density plastics and progressively went on to printing with metals such as stainless steel. As we continue to study reliability, Cat could potentially start printing actual production parts and begin pushing them into assembly lines. This prevents the need to depend on supplier networks and minimizes cost-of-poor-quality issues.

Practical potential

But what is the ultimate potential regarding what the technology can achieve? And could it ever be a truly practical manufacturing method for production parts, whether they be low, medium or high volume?

At this juncture, unfortunately, the cost-efficiency of parts manufacture

COMPOSITE MATERIALS

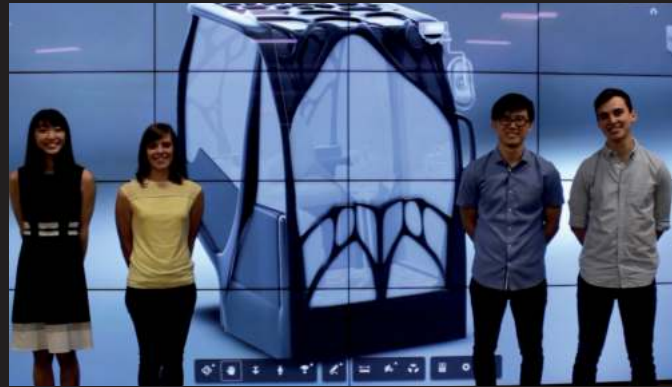
is not sufficient to bring current AM technologies into mainstream/high-volume production. Moreover, the printing process takes more time than a regular injection-molding process. There are some ongoing innovations in this area and the market will have to wait and see if they turn out to be for the betterment of the industry.

Nevertheless, all the way from brackets for earthmoving equipment to turbine blades for aircraft engines, AM technologies are being used to create intricate and complex designs to engineer 0.5% or 1% efficiency improvements. It is worth the time and investment, as it easily pays off in the long run. As mentioned above, the technology is still siloed in terms of use, but in high-risk applications such as aircraft engines, manufacturers such as GE have time and again tested the reliable use of AM technologies.

As a case in point, GE Aviation will introduce 3D-printed parts in aircraft engine platforms this year. After having fully explored various manufacturing techniques and technologies, it was ultimately decided that the only way to produce a highly efficient, low-weight fuel nozzle was through 3D printing. The company has plans to introduce 19 fuel nozzles in the combustion system of the engine.

Furthermore, GE Aviation has a deep pipe for its CFM LEAP engines,

ALL THE VIEWS THAT'S FIT TO PRINT



A student engineering team from the University of Illinois at Urbana-Champaign (UIUC) submitted the winning design for an aesthetic and functional excavator cab that will be 3D printed and on display at the Tech Experience at IFPE / ConExpo-Con/Agg in Las Vegas, Nevada next March. The excavator will be on display at the joint trade shows, bringing to life how technology is helping transform the construction industry in line with the show's 2017 theme, 'Imagine What's Next'.

Student engineering teams from all over the USA submitted their designs for a futuristic excavator cab and human machine interface. The UIUC

team will receive a US\$2,000 cash prize, donated by the National Fluid Power Association (NFPA), and have the opportunity to travel to Oak Ridge National Laboratory (ORNL) in Tennessee to observe the printing of their design.

In addition to the pre-printed excavator, show attendees will see a demonstration of the 3D-printing technology on the show floor.

"Additive manufacturing will revolutionize the way things are designed and produced in the not-so-distant future," states Mike Gust, industrial liaison officer at the Center for Compact and Efficient Fluid Power (CCEFP). "This contest

helped to raise awareness of advancements in technology to the next generation of engineers and we're excited that future engineers are bringing this newly designed machine to life."

CCEFP was awarded a grant from the National Science Foundation (NSF) to 3D print a full-scale operational excavator, to be put on display at the Las Vegas trade shows. The Oak Ridge National Laboratory's (ORNL) Manufacturing Demonstration Facility will lead the printing of the machine.

CCEFP is working with research teams from Georgia Tech and the University of Minnesota to convert the current excavator design to one that is conducive to, and takes full advantage of, 3D manufacturing.

Graduate engineering students at Georgia Tech will create a boom and bucket featuring integrated hydraulics with the ultimate goal of decreasing its weight, materials cost and maintenance, while students at the University of Minnesota are designing a hydraulic oil heat exchanger and cooling system that reduces the size and weight – and increases the efficiency – of the machine.

The Association of Equipment Manufacturers, NFPA, ORNL and NSF partnered with the CCEFP, to sponsor the nationwide cab design contest. A video of the winning design submitted by the UIUC can be seen at www.tinyurl.com/3Dexc-cab

“ADDITIVE MANUFACTURING WILL REVOLUTIONIZE THE WAY THINGS ARE DESIGNED AND PRODUCED IN THE NOT-SO-DISTANT FUTURE”

HOLD THE FLOOR

3D-printing machines would be a nice addition to the fleet of machines on the shop floor, but they are unlikely to revolutionize the appearance of off-highway equipment factories. They might be kept in a secondary production line to feed into the assembly value-chain of automotive, A&D and appliance factories. In the near future, we may not see a total replacement of CNC machines with AM/3D printing machines – only technology advancements and material innovation could possibly change the tides in the short term.



which would ultimately translate into hundreds of thousands of 3D-printed metal fabrications. Companies like this continue to push the possibilities and engineer new boundaries while challenging the status quo.

The power of using 3D printing and bringing it into mainstream manufacturing really lies with OEMs rather than end users, who can be a farmer or a company such as Etihad Airways. The biggest industry shift is the move from selling products and solutions to selling performance. The benefits may ultimately trickle down to end-user level by way of faster time-to-market and lower lead times, etc. The bulk of the manufacturing-related AM market, however, is with OEMs like those mentioned here. **ivT**



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WITH ITS ACQUISITION OF ONE OF ITALY'S MOST FAMOUS HISTORIC BRANDS, COULD CHINA'S FOTON LOVOL SOON PUT THE ARBOS NAME ON THE LIPS OF EVERY FARMER IN THE WESTERN HEMISPHERE?

▶ Most *iVT* readers will be aware of the name Foton Lovol due to its prominence among Chinese construction and agricultural equipment (and engine) makers, but it's not a name that will be on the radar of many end users of farm machinery in the West.

Having been founded as recently as 1998, and with an export focus that – farm equipment-wise – has been concerned with compact, low-horsepower tractors, that's perhaps unsurprising. But Foton Lovol Heavy Industry is China's biggest agricultural machinery OEM, producing 100,000

tractors and 50,000 combines annually for a €3.15bn turnover – and it has some very ambitious global plans. At the company's heart is a keen desire to make the Foton Lovol presence felt in farming outside of its home region, as evidenced by its announcement at Agritechnica 2015 of a new European business, Lovol Arbos Group, and the unveiling of a range of tractors designed from the ground up to feature western styling and components.

In an attempt to break out of its basic, low-hp tractor bracket and offer buyers both within and beyond China

the more technologically advanced and stylish high-hp products they demand, Foton Lovol created a new business model based around four key moves: the establishment of a European base, the recruitment of a European design team, the creation of new western-focused designs, and the launch of what could be called a 'new' brand.

Study group

Foton Lovol's strategy was to study the key European markets and base its new operation at the heart of one of the continent's largest and strongest



Agriculture

OEM REPORT



ARBOS

LEFT: New wine in new skins, or something like that – the famous name has made a comeback, but its outlook and the engineering are now very much different



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ABOVE & ABOVE LEFT: The Lovol Arbos design and engineering operation has been based at premises close to Bologna since 2011, while tractors for the western market will be made at the ex-Goldoni plant

technology and component manufacturing regions, founding its new design and engineering concern at Calderara di Reno, near Bologna, Italy, in 2011. That move more or less coincided with three significant Italian acquisitions for the business – those of the planter/drill maker MaterMacc, the compact/specialist tractor firm Goldoni and, lastly, not so much a product line as a name – the old Italian combine harvester manufacturing marque, Arbos.

Gathering dust since 1994, when the previous owners made the last Arbos combine around 40 years after the first, the firm also had links with Italian tractor maker Bubba, active from the 1890s to the 1950s. This

move has led to Lovol taking an intriguing path in re-identifying itself not through a subtle re-brand or invention of a new name, but by acquiring and revitalizing a dormant but revered – particularly in Italy – and established brand, giving it ready-made marketing traction.

Launched at Agritechnica 2015, the first product to be developed by the new concern was a line of four 100-130hp four-cylinder tractors, powered – somewhat surprisingly (see below) – by Kohler. The firm also showed some prototypes of 140-200hp and 220-260hp tractors with six-cylinder Deutz engines, although these are a little further from commercial production.

Wang Guimin, chairman and general manager of Lovol, says the intention is to target high-end international markets in Europe, North America, Middle East and Australia, as well as the emerging market for higher-tech machines in China. “While the established Lovol tractor products are primarily pitched at the Chinese market, focusing on developing countries while exploring demand in some developed markets, the new Arbos brand is targeted at more demanding western markets, although its products will also ultimately be sold in China in the next year.

“Arbos tractors must play their part in helping to improve the

STYLE AND SUBSTANCE

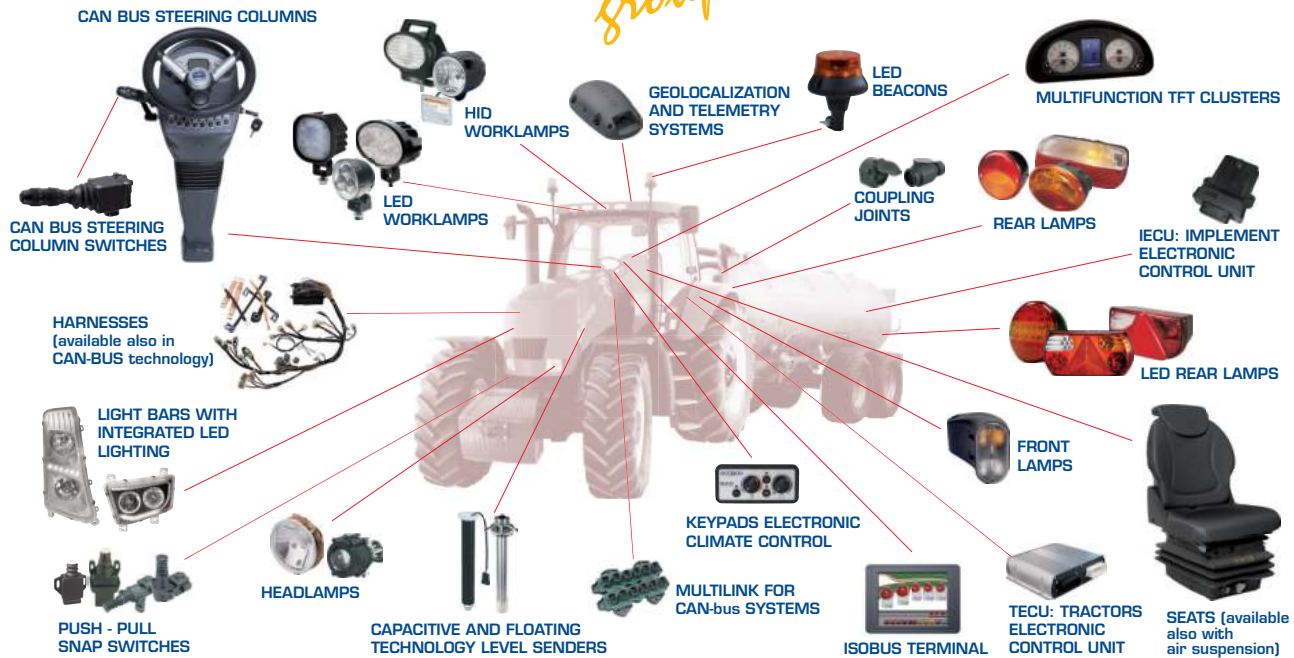
While style is of increasing importance in farm equipment, it's what's under the skin that counts. And for the 5000 series already in production, Lovol Arbos has gone down an uncommon route, agriculturally speaking, fitting a four-pot from American engine firm Kohler. The power unit might not be widely recognized in agricultural applications, aside from its association with JCB's four-cylinder telehandler powerplants, but the 3404 TCR SCR features four valves/cylinder, a pneumatic wastegate turbocharger and 2,000 bar Denso common-rail fuel system, while meeting Stage IV emissions regulations through the use of a compact SCR system with integrated DOC. The absence of an EGR system is reckoned to not only produce a cleaner burn, but also aid the creation of a compact bonnet. Maximum power of 136hp is produced at 1,900rpm, with maximum torque of 500Nm at 1,400rpm and a 30% torque rise. Specific fuel consumption is a claimed 205g/kWh.



For now, and for this range at least, the transmissions are being kept simple, with a 5-speed, three-range design in three levels, all offering 12 gears in the 4-12km/h working range.

Entry level is a fully mechanical synchronized transmission with mechanical controls for 4WD, diff lock and PTO; 'global spec' models gain a two-step powershift and mechanical synchronized shuttle; and 'advanced' versions get a three-step powershift, steering column-mounted powershuttle and electrohydraulic 4WD, diff lock and PTO with independent hydraulic wet clutch.

The latter models are also capable of 50km/h, or 40km/h at an economy 1,840rpm. Then there is an optional creeper with speeds down to 0.33km/h. PTO speeds cover 540/540E/1,000/1,000E rpm, and there is a mechanical or electronically controlled 4,400kg capacity linkage, supplied with 70 l/min of oil from a 110 l/min hydraulic system. Up to three spool valves can be specified on the 5000 series, which is among the finalists in the Best Utility category of Tractor of the Year 2016, marking the first time a Chinese OEM has reached the finals of the European competition.



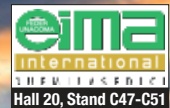
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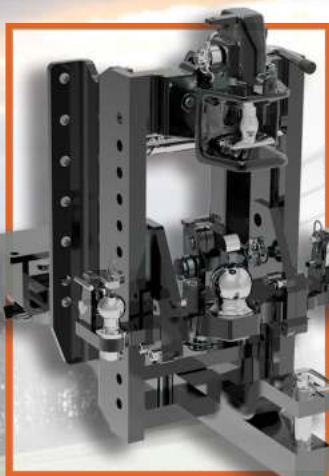
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“THE 50-STRONG TEAM OF MANAGEMENT, ENGINEERS AND DESIGNERS WE GRADUALLY FORMED AFTER THE NEW BUSINESS WAS FOUNDED IMPLEMENTED A STRUCTURED DEVELOPMENT PLAN TO CREATE MACHINES AND RECRUIT COMPONENT SUPPLIERS”

Massimo Zubelli, Lovol Arbos sales and marketing director



production of large Chinese farms to maximize their contribution to feeding a growing world population.”

Integration hurdles

According to Massimo Zubelli, Lovol Arbos sales and marketing director, bringing together engineers with different cultures, globalizing suppliers and integrating western quality standards into a product that can be ultimately built in China as well as Italy were the biggest hurdles to getting the project off the ground.

“Assembling a team of professionals in this way is a different process to what’s usually practiced by large businesses in this sector in Asia,” he explains. “But the 50-strong team of management, engineers and designers that we gradually formed after the new business was founded implemented a structured development plan to create machines and recruit component suppliers. The project met its timelines ahead of our Agritechnica launch and the entry of the 5000 series tractors into the Tractor of the Year 2016 competition.”

Business has already grown to the point where the group now has around 100 employees in China, plus 360 employees in Italy across 285,000m² of factories at the MaterMacc plant in San Vito al Tagliamento, the Goldoni factory in Migliarina di Carpi and the new Arbos design and engineering facility at Calderara di Reno.

This, says Lovol Arbos, makes it one of the three leading Italian agricultural machinery OEMs in terms of industrial surface area. In total the group is targeting a 2016 turnover of €80-90m.

Agritechnica reveal

Ahead of its unveiling to farmers at Agritechnica, the new Arbos concern was launched at a June 2015 press conference entitled ‘Arbos-Bubba: the rebirth of the Silk Road’, referring to the ancient trade route between China and Europe. A key speaker was Andrea Bedosti, recruited as managing director of Lovol Arbos Group following spells in senior management with Merlo, Same Deutz-Fahr, Volvo Trucks and Argo.

Bedosti explains, “The structure of our industrial plan is based on five pillars: engineering, production, distribution, communication/brand and the sustainability of the agronomic process. With the launch of our first tractors, we’ve completed the first stage of our strategic industrial plan. The next step will be establishing Arbos as a global trademark with a complete range of products.

“We’ve approached the European market with a lot of respect for the territory, aiming to create a cultural bridge between China and Italy, supported by numerous cooperation projects and visits by significant Chinese political figures to promote on the Chinese market the agronomic techniques and integrated systems of Italian agriculture and its agri-food industry, sharing know-how to the benefit of all parties.”

The engineering team behind the 5000 series tractors – and the 6000 and 7000 models to come – is now also working on a smaller series of specialist compact tractors (for orchards, vineyards, etc), based on the model platforms acquired in its recent purchase of Goldoni.

COMBINED STRATEGY

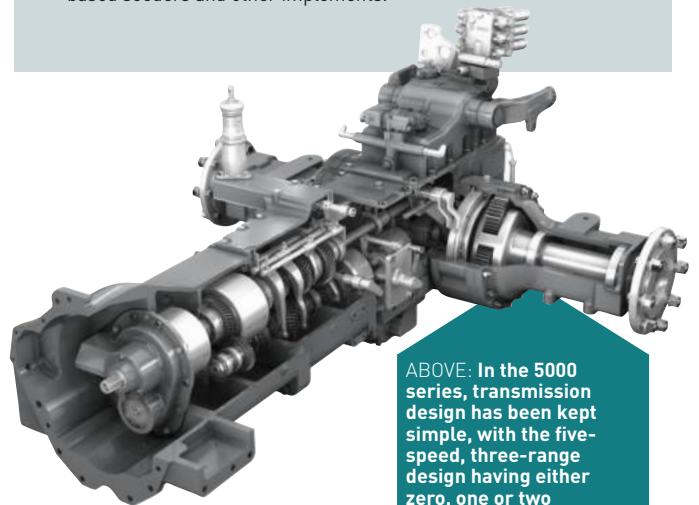
It’s not just tractors the firm has been focusing on: also of its own design is another machine that fills a big gap in the quest to become a full-line farm equipment supplier: a combine harvester.

At its July 2016 event, the first prototype of the C5200 was unveiled.



Created by a team that includes Vincenzo Perazzoli, the engineer who worked on the development of previous Arbos combines more than 20 years ago, the five straw-walker machine owes its existence to the 70,000 combine drawings acquired along with the remains of the old Arbos business, and the addition to the team of a number of other engineers with combine development experience. Like the tractors, it is produced in the new green and pearl white livery, with a reworking of the historical Arbos trademark. A production date is yet to be confirmed.

“The group’s vision is to establish Arbos as a global full-line brand,” explains Alessandro Zambelli, marketing manager. “That message will run through our marketing, with the tractor range spanning models suiting the wine-growing and producing sector right up to large field tractors, plus the combine, MaterMacc-based seeders and other implements.”



ABOVE: In the 5000 series, transmission design has been kept simple, with the five-speed, three-range design having either zero, one or two powershift steps

“THE STRUCTURE OF OUR INDUSTRIAL PLAN IS BASED ON FIVE PILLARS: ENGINEERING, PRODUCTION, DISTRIBUTION, COMMUNICATION/BRAND AND THE SUSTAINABILITY OF THE AGRONOMIC PROCESS”

Andrea Bedosti, managing director of Lovol Arbos Group



OEM REPORT



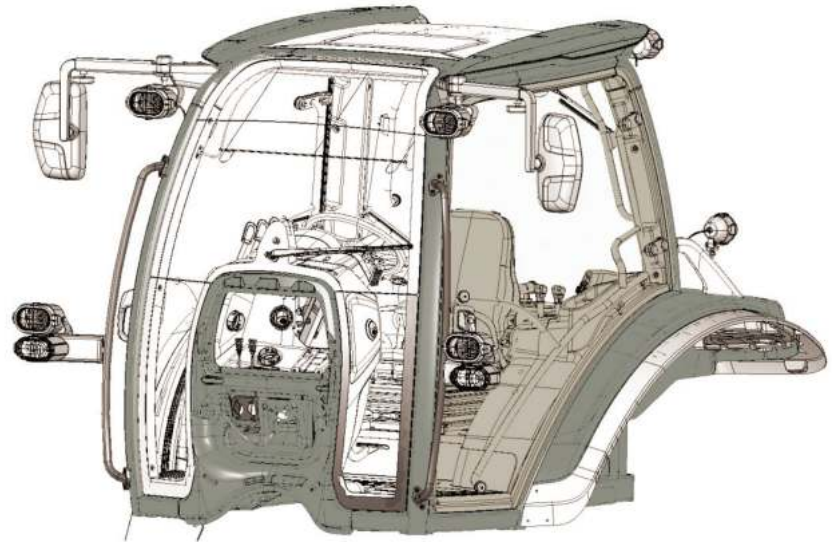
“Our aim with the 5/6/7000 series was a design encompassing performance, efficiency, reliability and value for money, using the best technology available, but without compromising the quality:price ratio,” says Gianni del Gobbo, engineering manager of Arbos Engineering.

“As we are building the tractors in both Italy and China, compliance with European process and product standards, and component assembly and quality, is paramount. But style is also important, both to compete in western markets and to impress potential buyers in the emerging Chinese market for stylish products. To that end, our European styling center focused on a fresh, original look, with rounded and tapered lines that, while also increasing structural strength, keep overall dimensions compact and make steering easy.

“Along with a curved windscreen and thin roof profile, that’s given the tractors a distinctive and modern style, along with an SMC bonnet incorporating a headlight strip that frames the new Arbos logo.

“Pearlescent white side panels incorporating shark gill slits are intended to add style and release

ABOVE: Production of 5000 series tractors for the Chinese market, where they will sit as a premium range alongside Lovol models, is already underway at the Lovol plant at Weifang, China
ABOVE RIGHT: The new ‘Hi-vision’ cab of the 5000 series – the company says every detail has been carefully studied to provide the ideal tractor/operator interface



heat, and contrast with the green Arbos livery, creating a modern take on the brand’s original colors.”

Production line

“The Arbos 5000 series tractors are already in production in the Lovol plant in Weifang, China, for the Chinese market,” explains del Gobbo. “By late 2016, production of 5000 models for Europe will have begun at the ex-Goldoni plant at Migliarina di Carpi. The 6000 and 7000 series are now at the advanced prototype stage and will be available by the end of 2017.”

In farm equipment, brand is very much identified with livery, with a tractor being not just a tool for work, but also something the owner wants to take pride in and be identified with.

“To appeal to buyers, a tractor must have not only a functional, reliable structure, but also a ‘soul,’” del Gobbo continues. “We were able to work with our Chinese colleagues on this to create something that will impress farmers around the world. Using this as a foundation, our challenge was to bring these ideas together on a global scale, blending eastern and western tastes and lines, and combining technologies that are typically automotive with those

more traditionally found in the off-road vehicle sector. From this we developed the new style, integrating design, practicality and comfort.”

The firm is already looking to establish its presence beyond its twin homes of Italy and China, he stresses. “We have opened an Arbos office in Madrid to develop our activities in Spain, Portugal and South America, and made our first official importer appointments in Romania and Turkey.”

Shen Yang, president of Lovol Arbos Group and representative of Lovol Heavy Industry, believes that in the five years since its establishment in Italy, the Lovol Arbos project has helped Lovol achieve many of its globalization objectives.

“We have connected two cultures, created an engineering excellence center, relaunched the Arbos brand, and begun mass-producing the 5000 series tractors in China to European standards. Now we are developing our sales distribution network and our international business. The Arbos brand will also be launched in China as the top-of-the-range product, a symbol of innovation and sustainable agriculture, and the first Chinese Arbos dealership will soon be inaugurated in Tianjin.” **ivT**



“WE HAVE CONNECTED TWO CULTURES, CREATED AN ENGINEERING EXCELLENCE CENTER, RELAUNCHED THE ARBOS BRAND, AND BEGUN MASS-PRODUCING THE 5000 SERIES TRACTORS IN CHINA TO EUROPEAN STANDARDS”

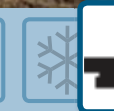
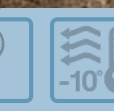
Shen Yang, president of Lovol Arbos Group

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World class

WITH A PACKED CONFERENCE PROGRAM AND A HOST OF FOREIGN DELEGATIONS AND VISITORS ARRIVING, ITALY'S EIMA EXHIBITION IS BECOMING MORE INTERNATIONAL THAN EVER

▶ Scheduled for November 9-13 in Bologna, Italy, EIMA – the international exposition of agricultural and groundskeeping machinery and equipment – is confirming its international calibre. Of the 1,900 exhibiting companies, more than 40 will be arriving from outside Italy, along with visitors from 140 countries. Moreover, the event is drawing 80 official delegations from 70 countries.

The international office of FederUnacoma – the Italian Agricultural Machinery Manufacturers Federation, part of the National Manufacturers Confederation, which is organizing the event – is collaborating with the ICE Foreign Trade Agency on special programs for foreign delegations of groups of business people from around Europe, the Americas, Africa, Asia and Australia.

The plans for these foreign delegations involve a heavy schedule of meetings with exhibiting companies organized according to the special interests of the group. The 2014 edition of EIMA International featured some 3,000 meetings set up for foreign delegations, and those scheduled for the upcoming edition will be held in a specific area and will include services provided by interpreters and commercial consultants.

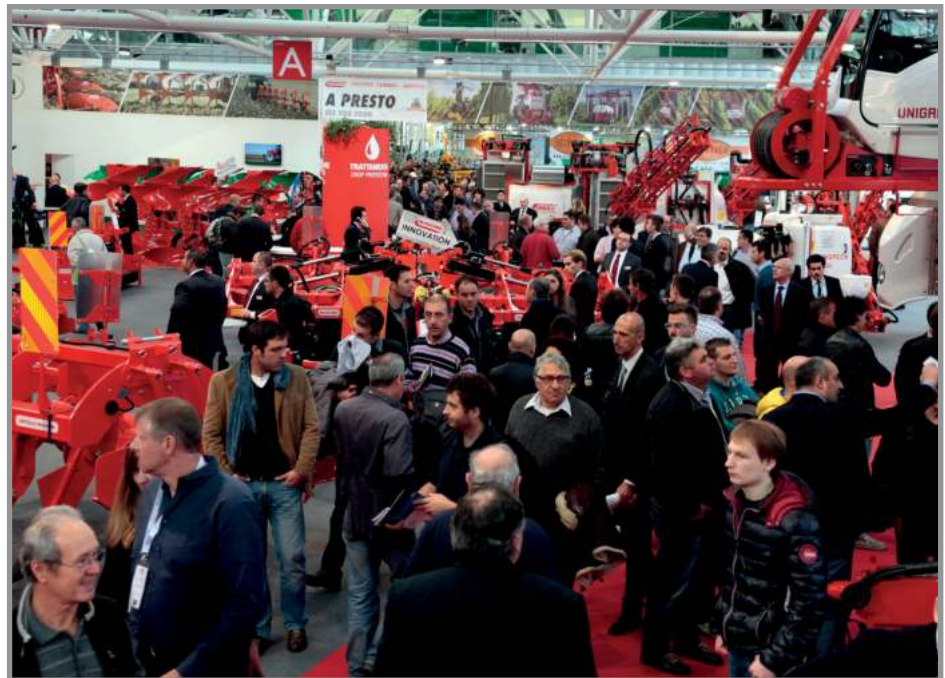
There is an even larger number of delegations arriving for this year's edition – 80 organized by ICE and 10 more outside the ICE program, compared with a total of 60 official ICE delegations in 2014 – so a further substantial increase in B2B meetings is expected to be planned for the upcoming EIMA.

Meet and greet

In addition to these meetings planned well in advance, there will be an enormous group of individual business people with their own agendas for meetings in the stands and the specialized salons – EIMA Components, EIMA Green, EIMA Energy and EIMA M.i.A. – to directly discover the technologies presented for all types of agricultural operations.

An estimated 50,000 models and components will be exhibited in the 14 merchandise categories and the specialized salons – EIMA Components, EIMA Green, EIMA Energy and EIMA M.i.A. Among the 236,000 visitors who registered for the 2014 event, 39,000 were individual business people.

In addition, many of the conferences organized for the exposition will take on an international slant,



ABOVE & RIGHT: An estimated 50,000 models and components will be on display in the 14 merchandise categories and four specialized salons



beginning with an international assembly discussing the issue 'Agricultural mechanization: the new European agenda', organized by FederUnacoma, CEMA, which represents European agricultural manufacturers' interests, and the world Agrievolution association. The conference will be held on the morning of Wednesday, November 9, with political figures and representatives from European Union institutions in attendance.

Another conference for members of the foreign delegations is planned for the evening of the same day, and will deal with the global economic picture and the new geography of the world markets. An assembly on the morning of November 11 will consist of discussions relating to Italian-African cooperation experiences in agricultural mechanization, to be

followed by a specific focus on building cooperation for Mozambique's Africa Hand Project.

In addition, a large number of meetings will be held on matters dealing with foreign markets and the development of international business relations between countries. **ivt**

Girolamo Rossi is communications and press office manager at FederUnacoma



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All talk

THE DESIRE TO BECOME A LEADING SYSTEMS AND SERVICES COMPANY – PROVIDING A COMPLETE RANGE OF IN-CAB PRODUCTS THAT ENSURE FULL CONNECTIVITY – ISN'T A GOAL THAT'S TAKEN LIGHTLY

Over recent years, one of Cobo's major objectives has been the development of the concept of a fully integrated vehicle operating system. To do so, the group shares a distinctive approach that involves every company that belongs to it.

Today, the Internet of Things (IoT) is at the core of its strategy of becoming a systems and services company that combines a worldwide leadership position in design, development and supply of global solutions for the off-highway vehicle market with a flexible and innovative approach. It therefore offers a complete range of solutions in terms of different devices and services that support and combine Bluetooth, wi-fi and GPRS/UMTS communication. Data is stored in a database and provided to customers via internet access (by computer, smartphone and tablet), whenever they need and wherever they are.

Within the next few years, the majority of businesses will be using IoT, while cloud, mobile and analytics will increasingly be conceived of and purchased together as elements of an integrated solution for off-highway vehicles.

Service solutions

The following short overview highlights some essential information regarding some of the solutions Cobo is launching in the service field. Cobo InTouch, for example, connects its devices with an attractive and dynamic multi-language web-server interface, that can be customized with colors and logos. It is ideal for applications in different fields, including agricultural, earthmoving and lifting machinery, and transport, logistics and municipal vehicles.

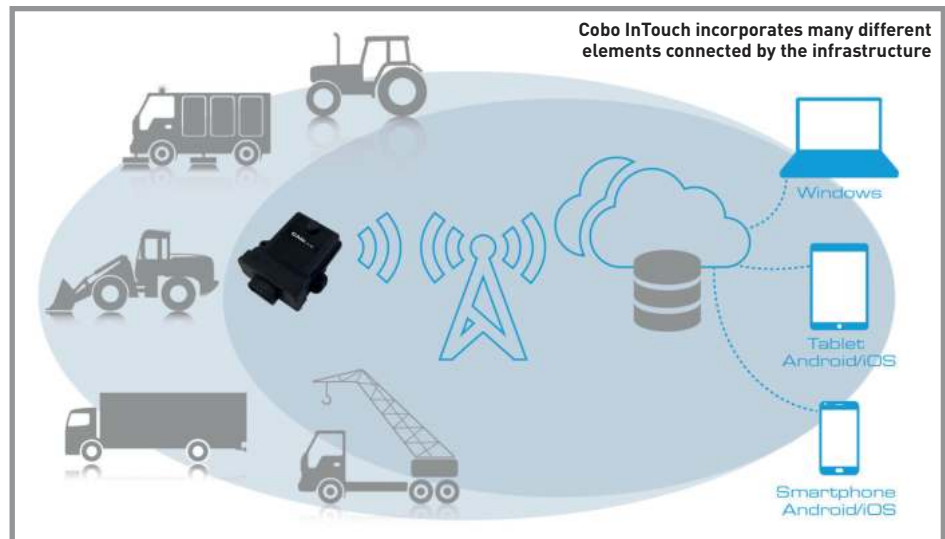
Its main functionalities include:

- Geo-localization;
- Real-time monitoring and diagnostics;
- Remote software update;
- Datalogger;
- Data analysis and statistics.

Cobo is also able to provide OEMs with telematics integration for their remote assistance services, offering them the ability to compete with the major market players.

The *i.st* steering column is the first of a new series of full CANbus plug-and-play systems that can provide the following features to any type of vehicle:

- GPS traceability;



RIGHT: Example of the Cobo InTouch website, which can be customized with colors and logos

- Bluetooth connectivity;
- Track tracer function;
- Automatic recognition of attached implements.

A simple app can be downloaded to a smartphone, with no extra costs and nothing else to add. Once the ignition is on, the app automatically establishes a bidirectional connection between the vehicle and the cloud, exchanging job tasks, info messages and operating data. Safety on the job site, progress status, performance and costs are all features available through this widely available technology.

Truckcontrol represents the first automotive-style dashboard for use in agricultural and earthmoving machinery thanks to the experience coming from Cobo's partnership with the most important players in the motorcycle market. It combines the standard functionality of a dashboard (such as indications of physical parameters and visualization of failures) with technologically advanced solutions linked to the world of connectivity.

Its reduced dimensions makes it ideal for any kind of application inside or outside the cabin (sealing to IP66). It is provided with a high-resolution 4.3in TFT display (WQVGA, 480x272), two CANbus



communication lines (with software configurable termination resistor), one serial communication line, 14 multipurpose inputs, 21 warning LEDs, one output at 5V, 128MB static memory, and one light sensor.

The above projects, together with other latest products and systems developed by Cobo, will be presented to visitors at the Eima International Show in Bologna, Italy, where Cobo staff will be available to suggest customized solutions. **ivt**

Giovanna Angiolini, business development manager for connectivity solutions, joined Cobo a year ago after long experience in the sale of automotive telematic solutions

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Cool and clever

WITH FEATURES SUCH AS AUTOMATIC ALTITUDE ADJUSTMENT, THESE NOVEL SOLUTIONS FOR COMMERCIAL AND ELECTRIC AND HYBRID VEHICLES ARE SO SMART THEY CAN ALMOST PREDICT THE WEATHER

▶ For Webasto, creating climate comfort in mobile workplaces means more than just providing powerful solutions in the driver's cab and the cargo space. As a systems supplier, the company combines heating and cooling systems into complete climate solutions that are as intelligent as they are superbly coordinated in their design.

The company's latest developments include the Thermo Top Pro 120 and the Thermo Top Pro 150, which constitute a new generation of water heaters. The market launch of these devices is scheduled for early 2017 in the performance categories of 12kW and 15kW. Each available in 12V and 24V versions, these heaters are ideally suited for use in construction vehicles, agricultural equipment and mini and midi buses. These heaters feature an innovative burner concept and an intelligent diagnosis and security system. Sensors monitoring the exhaust gases and coolant temperature continuously transmit the values to the control unit.

One of the new features in this performance class is the automatic altitude adjustment. In keeping with the Webasto motto 'Your comfort – our mission', drivers and passengers do not have to give up comfort and convenience when traveling in the mountains. On one hand, the automatic altitude compensation ensures maximum heating capacity at altitudes of up to 3,500m above sea level. On the other hand, the heater also functions at extreme temperatures as low as -40°C.

Overhaul of the Frigo range

Webasto also provides versatile, individual solutions in the area of cooling and refrigeration systems for light commercial vehicles. To this end, the entire Frigo range has been overhauled. The new Frigo Top 50 and Frigo Top 60 transport refrigeration systems provide powerful refrigeration for larger vans with a cargo capacity of up to 38m³. The system's low weight facilitates greater vehicle load capacity.

With the Frigo Top 35 Multi-Temperature, Webasto offers a flexible and expandable module with which end users can set temperatures – from -20° to +20°C – precisely in accordance with their needs. For instance, culinary establishments can now transport frozen fish at -18°C in one cargo compartment, while at the same time, they can ship wine at an appropriate



LEFT: Frigo Top 35 Multi-Temperature for transporting goods that require different types of refrigeration

BELOW: The powerful electric High-Voltage Heater for commercial vehicles



ABOVE: Thermo Top Pro 120 and 150 feature an automatic altitude compensation feature

drinking temperature of +10°C in a second, separate area of the same cargo compartment.

If a defect does occur, Webasto offers a special post-purchase benefit: the Webasto Priority Service with a 24-hour emergency hotline. The service is available all over Europe in the respective local language. The comprehensive service network consisting of over 500 qualified dealers offers fast, professional assistance.

In addition to this standard package, Webasto is now presenting an expanded version at IAA 2016: Webasto Priority Service Comfort. The functionality and operational reliability of the refrigeration system are protected and secured by annual service intervals. Furthermore, the full service option comes with coverage of all costs incurred during maintenance or repair work. Plans call for this service to be available in all of Europe during 2017.

Electromobility for commercial vehicles

There is a growing global demand for hybrid and electric vehicles – however, there is limited usable waste heat from the engine available for heating these vehicles. For this reason, Webasto launched its High-Voltage Heater (HVH), an electric heater for cars in 2015. Now it is working on a further development of the HVH, which will allow for more effective heating of the light commercial vehicles, vans and trucks – as well as agricultural equipment – that are increasingly being offered as plug-in hybrids and electric vehicles. Given the heating capacity of 10kW, this will enable heating of larger interior spaces in the future. Thanks to the efficient heating layer technology, the heater converts electricity into heat with almost no loss at a constant efficiency factor of over 95%.

Webasto is showcasing its new products and services at Hall 12, Stand B22, at the International Automobile Show (IAA Commercial Vehicles) in Hannover, Germany, September 22-29. But the systems supplier is not just presenting innovative heating and cooling systems, it is also demonstrating how it combines them into comprehensive, perfectly coordinated and – above all – intelligent climate solutions. **ivT**

Philipp van Ast and Klaus Hemmer look after the aftermarket and OE businesses respectively at Webasto Thermo & Comfort



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Cool, calm and collected

WHAT'S THE MOST EFFICIENT WAY TO ENSURE YOUR NEXT MACHINE HAS THE DESIRED HVAC PERFORMANCE WITHOUT GETTING INTO A SWEAT ABOUT IT? HOW ABOUT DESIGNING THE SYSTEM BEFORE YOU BUILD THE CAB?

OEMs can now take full advantage of Kalori's ability to develop an HVAC system even before their first cab prototype has been produced. This is a result of the supplier's high-tech development process that guarantees the optimum level of comfort to meet a vehicle manufacturer's specifications.

This innovative solution – inspired by technological developments in A/C systems for the car industry – is the result of a €1.4m (US\$1.56m) investment. In order to achieve this shift, the company has recruited a team of engineers and researchers working for a laboratory partner with car and auto part manufacturers. French customers, moreover, can benefit from a tax rebate, Kalori having become an accredited CIR laboratory.

The development of an HVAC system begins with the analysis of the cab. The use of Simulka software realizes the computer modeling of the destination cab as well as the data regarding the characteristics of the wall insulation.

The surrounding area is also specified, namely the outdoor temperature, relative humidity and sun exposure that together define the climate under which the vehicle will operate. The comfort temperature lead time of the cab can also be personalized. Simulka analyzes these criteria to ensure that the power being delivered to heat and cool the cab is sufficient – while respecting the speed of the desired changes of states.

As a result of the Simulka data, the auto parts manufacturer's engineers can define the size and characteristics of the individual components such as evaporators, condenser and compressors, while also ensuring the good working order of the A/C system.

Climatic chamber

Unless a new project absolutely requires a specific development, standard components would usually be suggested, and then tested in Kalori's 90m³ climatic chamber. This testing station has two compartments: in the first one, outdoor conditions are recreated, while in the other, the inside of the cab is simulated. The chosen HVAC system would be placed in the latter compartment.

During the testing process, the software designer is able to adjust the size and characteristics of the components and oversee the optimum working of the



A sophisticated test bench for HVAC development and simulation of A/C without the vehicle

BELOW: It all adds up to the design of the right HVAC for your vehicle

A/C system. This step is crucial as it will be the one guaranteeing the use of well-adapted subsets.

Furthermore, this means that oversized systems can be avoided. On the one hand, the cab manufacturer pays a fair price, while on the other, this specific creation enables savings at various levels: not just in weight and volume, but also in terms of handling, warehousing and transportation. It is also effectively the guarantee of a reliable system as a result of many conditions of use being tested in a short period.



This size economy can enable a 55kW vehicle – which is the critical level – to meet the manufacturing standards without any compromise on the driver's comfort. The comfort of a cab is a major criterion when purchasing a machine, which is why paying particular attention to get it right is absolutely crucial.

When a customer buys a vehicle with an A/C system, he expects it to cool. He is not interested in the explanations about the compulsory standards that may lead to reductions in cab comfort. Kalori's know-how is crucial here. The supplier currently equips small cars with A/C systems just as efficient as those of regular cars, thanks to its mastery of A/C and air diffusion. The Simulka software, plus the use of the climatic chamber, shortens the development time and backs up the 'study file' with tangible files of calculations.

Another benefit of this procedure is its educative aspect. Each step is clearly detailed, giving the manufacturer's technicians the possibility to contribute to the design of both the vehicle and the cab – and, as a result, to improve the next one! **IVT**

As Kalori's business development general manager, Olivier Bontemps has led its new testing systems implementation



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Home of the Brava

DESIGNED IN COOPERATION WITH EXPERTS AT IKTD AND USING HUMAN MODELING SOFTWARE, COULD THIS NEW MULTIFUNCTIONAL CONTROL UNIT FIND A PLACE ON YOUR NEXT MODEL?

▶ The requirements of industrial and logistics companies with regard to the functionality and ergonomics of control units on their material handling equipment are steadily increasing. Wide-ranging applications require a huge variety of functions and a high degree of adaptability. This increases the need for flexible systems that are freely configurable by the customer.

Frei has the answer: an armrest designed to guarantee the OEM a high degree of flexibility. The modularly designed Brava multifunctional control unit enables all of a vehicle's functions to be controlled with the right hand. The control unit is interchangeable and can therefore be used in a wide variety of vehicles.

During the design of the armrest, the focus was on the operator and, by extension, on ergonomics. This was achieved in cooperation with the Institute for Engineering Design and Industrial Design at the University of Stuttgart (IKTD) in Germany. The basis was an ergonomics and usability analysis with several forklift truck operators in both typical and worst-case operating scenarios. In addition, using Ramsis human modeling software, the optimum ergonomics were ascertained with regard to dimensions, adjustment ranges and positioning of the armrest and controls.

The armrest is made up of three elements: a control unit, a vertically adjustable arm support and a height adjustment unit. Three different control units are available for the armrest:

- The Actra Mono with four single-axis finger-operated joysticks;
- The Actra Xeno with two dual-axis joysticks;
- The Actra Ergo, developed in cooperation with IKTD.

All control units have been designed so that the hand rests comfortably. Due to sensitive control and ergonomic layout, the joysticks can be operated with a natural finger movement. The caps on the finger-operated joysticks are interchangeable, enabling the customer to define the color and the symbols used. The large selection of available symbols and colors enables the rapid implementation of individual customer requirements.

The use of non-contacting Hall-effect sensors guarantees a long service life. The controls remain extremely reliable, even when under extreme loading conditions, making them particularly suited for use in harsh environments due to the encapsulated



ABOVE: Brava Plus multifunctional armrest with adjusting unit



LEFT TO RIGHT: Actra Ergo control unit, Actra Xeno control unit and Actra Mono control unit

electronics that ensure protection against dust and moisture, and the laser-etched symbols.

In addition to the joysticks, the control unit also features a thumb pad. This offers three further control elements: a push button, a switch with three detent positions, and a rocker switch. The customer is able to freely configure the functions. The different shapes of the control elements help the operator to recognize the functions without actually looking at them.

Ergo, easy to operate

For the Actra Ergo control unit, which was also developed in cooperation with IKTD, the main focus was on user-friendliness, comfort and being fit for purpose. This reduces the load on the forklift truck operator's hand and arm and simplifies the complex tasks to be performed, as the control unit can be used comfortably and intuitively.

One example of this is the actuator for the primary functions of lifting and lowering the forks. This is

shaped like a fork, making it easily recognizable, and can be operated comfortably with just the index and middle fingers. The movement of the control is echoed in the movement of the truck's forks.

The shape of the armrest was specifically designed to correspond to the natural – and therefore more comfortable – angle of the operator's arm. The padded contact surface is made of hard-wearing material and is easy to clean. The armrest can be adjusted horizontally. Pulling the clearly visible handle on the arm support up with the right hand allows the armrest to be set to six different positions to enable optimal adjustment to suit the operator.

The height adjustment unit is bolted to the vehicle's seat. Using a push button, the height adjustment can be unlocked and steplessly adjusted to the desired height. The integrated gas strut enables the armrest to be adjusted with a minimum of effort. **ivt**

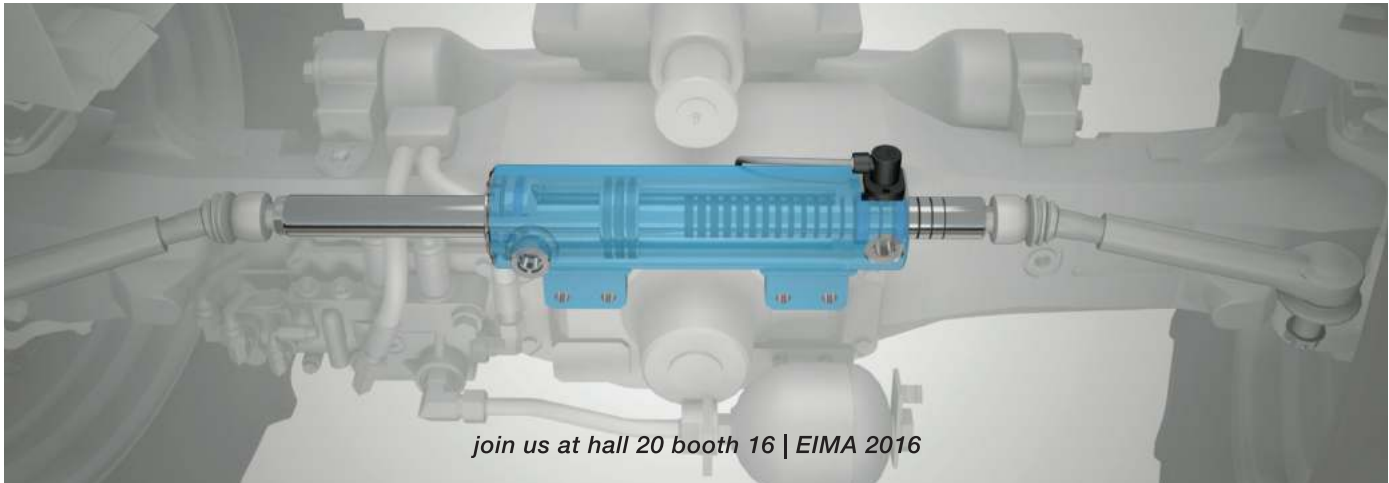
Jürgen Schwarz is head of Frei's Control Systems division



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A good year

WE'RE ONLY TWO-THIRDS OF THE WAY THROUGH 2016, YET ONE ENGINE MANUFACTURER HAS ALREADY LAUNCHED NEW MODELS, IMPROVED ITS STOP/START FUNCTION, APPROVED THE USE OF AN ALTERNATIVE FUEL AND ENSURED READINESS FOR STAGE V

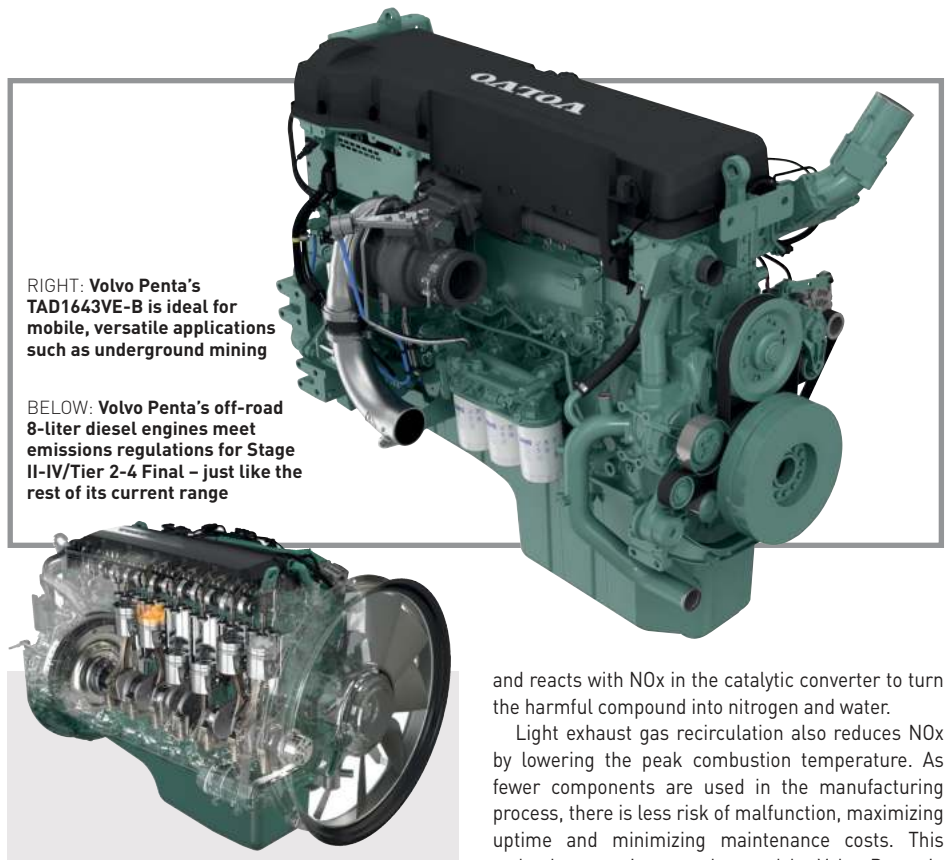
▶ During the course of 2016, industrial engine manufacturer Volvo Penta has continued to introduce products that optimize machine performance for its customers, while at the same time offering lower fuel consumption and reduced emissions. The company is attracting a growing following of OEMs – applications that now use its engines include heavy-duty underground trucks, drills, trenchers and stringers, wood chippers, shredders, crushing and screening machines, and high-pressure pumps.

Earlier this year, Volvo Penta added to its industrial off-road engine range by launching a Stage II 16-liter diesel engine that is suitable for mobile, versatile applications. With the benefit of new fuel injectors and more efficient combustion, the new engine delivers improved fuel consumption and lower operating costs. Equipped with the Volvo Group's patented engine brake technology, the new engine delivers 250kW performance and 10x higher engine brake capacity, as well as increased torque and torque curve. Thanks to the turbocharger, the extended torque curve allows for better performance at a wider range of RPM, making it more powerful, particularly at the lower end of the engine speed range.

The company has also released the second generation of its innovative fuel-saving stop/start function for industrial engines. First introduced in 2013, the feature is now available for Stage IV/Tier 4 Final D5, D8 and D11 engines, as well as Stage III/Tier 3 D11 engines. The stop/start feature works by shutting down the engine during extended idle periods and turning it back on when the equipment needs to resume operations. These features are increasingly common in automobiles, and Volvo Penta was one of the first companies to integrate the function into industrial off-road engines.

Emission reduction

This year has also seen Volvo Penta approve the use of hydrotreated vegetable oil (HVO) in all diesel engines, globally, enabling a reduction of fossil CO₂ emissions by up to 90%. HVO can be used neat, or blended with conventional diesel, and is designed to help customers reduce the environmental impact of their products. The approval is based on extensive field testing and endorsement of HVO for on-road use by its sister company Volvo Trucks, part of the Volvo Group. Volvo



RIGHT: Volvo Penta's TAD1643VE-B is ideal for mobile, versatile applications such as underground mining

BELOW: Volvo Penta's off-road 8-liter diesel engines meet emissions regulations for Stage II-IV/Tier 2-4 Final – just like the rest of its current range

Penta engines do not need any type approval or specific certification for HVO usage.

HVO is a renewable, paraffinic fuel, also known as synthetic diesel, and can be produced from a variety of vegetable and animal sources. It follows the preliminary CEN standard, prEN 15940, for use in diesel engines. Unlike most conventional diesel fuels, it also results in a substantial reduction of soot and is sulfur-free.

Volvo Penta has always strived to offer the most straightforward methods of operation for the end user. Prior to the Stage IV/Tier 4F emissions standards being introduced in 2014, the company launched engines with selective catalytic reduction (SCR) technology and AdBlue (diesel exhaust fluid), as the simplest way to comply with regulations. With SCR technology, AdBlue is injected into the exhaust line

and reacts with NOx in the catalytic converter to turn the harmful compound into nitrogen and water.

Light exhaust gas recirculation also reduces NOx by lowering the peak combustion temperature. As fewer components are used in the manufacturing process, there is less risk of malfunction, maximizing uptime and minimizing maintenance costs. This technology continues to be used by Volvo Penta in both off-road industrial and marine engines.

With Stage V legislation set to be introduced in 2019, Volvo Penta will adopt further solutions to limit gaseous and soot discharge. As part of the Volvo Group, the division has a wide range of knowledge and experience upon which to draw for its applications. The standard range of engines from 5-16 liters, from 105-565kW, will stay the same. New solutions on how to adapt existing engines to conform to Stage V regulations will use the latest technology prior to implementation in 2019. This means the engine program will be consistent, from Stage II to Stage V, offering substantial investment and convenience benefits to OEMs. **IVT**

With 30 years at the company, Peter Karlsson is vice president of industrial sales for Volvo Penta in Europe



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Hose to the grindstone

FORCED TO WORK IN COMPLEX AND TIGHT INSTALLATIONS, DELIVERING WATER AND LUBRICANT IN EXTREME TEMPERATURES, HOSES THAT SUPPLY TURBOCHARGERS ARE PERHAPS SOME OF THE HARDEST-WORKING LINES AROUND

▶ Automotive supplier and industrial partner ContiTech is expanding its product portfolio for turbochargers to include a lighter, extremely flexible high-temperature hose. With its rigorous lightweight design, this solution offers a clear weight advantage over the PTFE pipes with a stainless-steel braid that have been used until now for these applications. The hose therefore contributes to reducing fuel consumption and CO₂ emissions.

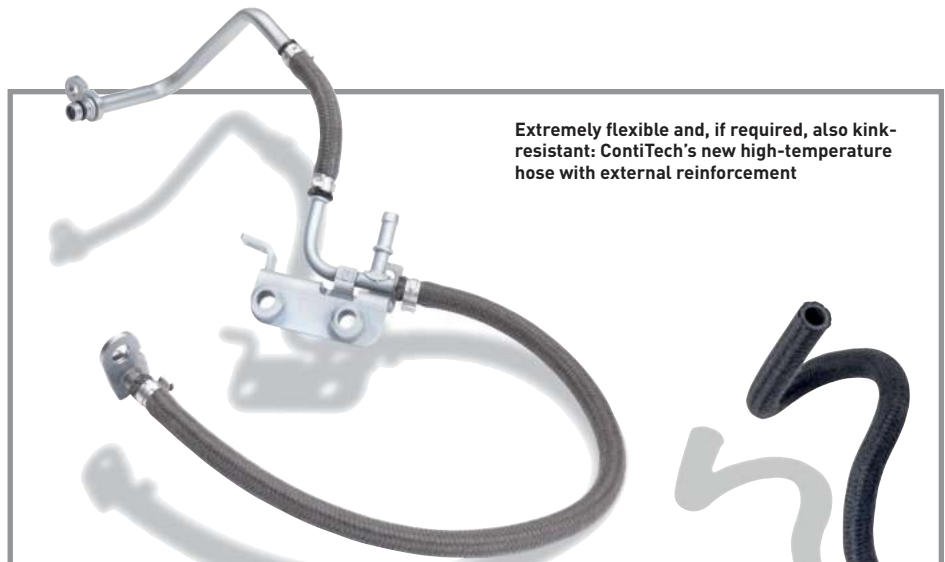
For customers, the turbocharger 'toolbox' will in future enable global one-stop sourcing of all oil and water lines relating to the turbocharger. The high flexibility of the hoses means they can be used even in especially tight and complex installation situations, not to mention the extremely high temperatures they invariably encounter. Some hoses with a particular finish can withstand temperatures of 250°C.

The hose is able to supply the turbocharger with either cooling water or lubricant, depending on the particular application. It gets its flexibility from a special braid made from a synthetic textile that is resistant to high temperatures and chemicals. This encloses an inner lining made of a highly stretchable rubber specially adapted for the application. The tight bending radii that are possible as a result are an ideal response to the trend toward downsizing and the associated ever-tighter installation spaces.

Tailored solutions

The bandwidth of turbocharger applications therefore now extends from the aluminum water-cooling line to the stainless-steel corrugated tube and right through to the high-end hose with external reinforcement. The application spectrum encompasses both feed and return lines for the lubrication system and the water-cooling system connected with the normal cooling circuit. The developers are faced with different media and varying pressure and temperature requirements. This explains why ContiTech maintains such a great diversity of lines made of different materials – it's the only way it can meet all the customer requirements with tailored solutions for the particular application.

The possible options cover all the various hose materials, together with the ability to connect the hoses with all the available tube materials – whether polyamide, aluminum, steel or stainless steel – to form lines.



Extremely flexible and, if required, also kink-resistant: ContiTech's new high-temperature hose with external reinforcement

This all-in-one package is then rounded off with extensive process engineering expertise, encompassing brazing, hydroforming, bending and cleanroom production. "We can therefore always offer customers the optimal design for the overall system," emphasizes head of the Engine and Drivetrain segment, Joel Ripamonti.

Working in conjunction with their customers, the developers at ContiTech identify tailored solutions.

BELOW: The bandwidth of turbocharger applications extends from both feed and return lines for the lubrication system to the water-cooling system connected with the normal cooling circuit



They simulate the required line on the computer, using the specified data such as heat load, installation and manufacturing tolerances for the unit, thermal expansion in operation and using dynamic data such as the movement of the connections relative to each other. Their comprehensive calculations enable, for example, the permissible tensions to be calculated, from which suggestions for improving the design can be derived.

In addition to the feed lines relating to the turbocharger, ContiTech also offers automotive and commercial vehicle manufacturers an extensive range of charge-air hoses and hose assemblies. These are also expected to withstand ever-higher pressures and temperatures. ContiTech develops and manufactures solutions that meet the most stringent requirements even for products where installation presents difficulties.

Furthermore, Continental supplies highly efficient, robust turbochargers worldwide. Engines charged by Continental turbochargers have, for example, won the prestigious Engine of the Year award four times in a row since 2012. The turbochargers come in two versions – that is, with the turbo housing made of either steel or aluminum. **ivT**

Christof Kirsch is head of R&D in ContiTech Mobile Fluid Systems' Engine and Drivetrain segment

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Roadside assistance

ADOPTING ELECTRIFICATION AND DRIVER-ASSIST TECHNOLOGIES FROM THE AUTOMOTIVE AND COMMERCIAL VEHICLE SEGMENTS, THE INNOVATION TRACTOR MAKES OPERATIONS FASTER AND SAFER



The Innovation Tractor includes a groundbreaking feature: it can be maneuvered from outside the driver's cab using a tablet

ZF Friedrichshafen has revealed the Innovation Tractor, demonstrating how safety, comfort and efficiency can be enhanced by applying intelligent systems used in the passenger car and commercial vehicle segments to off-highway vehicles. ZF is one of the few companies to introduce autonomous driver assist systems (DAS) across all vehicle segments. Its expertise in networking sensors, intelligent electronics and mechatronic systems is key to giving industrial vehicles the ability to see, think and act. This enables end-customers in the construction, agricultural and other off-highway segments to take advantage of entirely new automation approaches.

The Innovation Tractor is a standard tractor that has been upgraded with some groundbreaking ZF components and assistance functions. "Our systems expertise has enabled us to combine established

standalone systems to create a network so we can make vehicles see, think and act," says Dr Harald Naunheimer, head of R&D at ZF Friedrichshafen.

The tractor is equipped with environmental cameras to monitor its surroundings, with six mounted on the driver's cab and the hood acting as the vehicle's 'senses'. A computer analyzes the images from the camera and generates a surround-view image of the tractor's spatial environment. The driver can view this image on a tablet from various perspectives, including a bird's-eye view. The driver can also see an overview of the tractor's movements. The data from these cameras is then used to enable semi-autonomous maneuvering or via mobile devices operated from outside the cab, making it easier to hitch implements.

Additional cameras are available at the rear of the tractor, with a separate data processing unit, and are

used during automatic hitching and for pedestrian detection while changing implements. These systems can considerably reduce the risk of accidents – particularly in narrow depots.

Optimum maneuverability

Drivetrain electrification is provided by the powerful ZF Terra+ generator module, an electric single-wheel drive for trailers and implements. Coupled with specially developed traction management, it provides optimum off-highway maneuverability.

The all-wheel-drive function of the ZF tractor and the electrical boost function from the single-wheel drive on the trailer interact and complement each other, delivering optimum traction management. The tractor/trailer combination can negotiate muddy or loose ground, and with electrical assistance from the



trailer, the tractor can successfully tackle uphill gradients of up to 30% – terrain that is normally off-limits for a conventional tractor/trailer setup.

The additional power provided by the trailer allows a higher payload to be transported with a downsized tractor, which is ideal for users who tow a fully laden trailer only occasionally.

An electric steering system, required for automatic driving functions, has been built into the control network, while the driveline includes ZF's TerraMatic transmission and Terra+ generator module. This system generation can provide 60kW of continuous electrical power and serves as the power source for the electrical consumers in the trailer.

The trailer features another key innovation developed by ZF specifically for use in off-highway machinery – namely, a pair of liquid-cooled, high-power, three-phase asynchronous motors, with a downstream transmission stage, that are used to drive its axle. The electric motors are integrated into the wheel heads, saving space. The nominal voltage is 400V, and the system can also be fitted with a wheel brake. Forces can be transferred to the field more carefully with the tailor-made drive concept, while trailers of the future could even be able to move autonomously.

Automated driving functions

The SafeRange function allows the driver to leave the vehicle and then remotely control the tractor/trailer combination from a safe distance. The Innovation Tractor and trailer are outlined as a bird's-eye view on

BELOW: Traction management enables vehicles to set off with perfect traction control on uphill gradients of up to 30% – all thanks to electrically powered wheel heads installed on the trailer to provide additional power



a tablet display, from where all the relevant driving and steering commands are managed. The vehicle components can be moved intuitively on the screen. Dragging the tractor or trailer to the right or left on the screen with a finger causes the actual tractor/trailer combination to maneuver in the chosen direction. When it comes to complicated reversing, the user simply needs to specify the direction in which to steer the trailer and the system calculates and executes all the necessary steering movements. The speed is set by swiping the screen from the center to the edge, across the tractor model or the trailer. The further toward the edge, the faster the tractor/trailer combination moves.

The maximum forward speed is 4km/h, with the top reversing speed limited to 2km/h. When contact with the screen is removed, the vehicle stops automatically. The same happens if radio contact is lost between the tablet and the Innovation Tractor. SafeRange also works when maneuvering the tractor without a trailer.

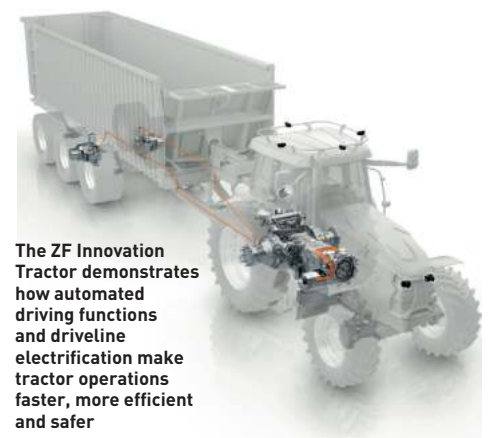
Maneuvering using the tablet may become more taxing while hitching implements, however, so ZF engineers have addressed this issue by introducing the Hitch Detection function to automate the process. The system uses a camera to detect the exact position and angle of the relevant agricultural implement in relation to the tractor by using special targets installed on the trailer or implement. The position is continuously measured during the hitching process and the angle of the steered wheels corrected. The Innovation Tractor maneuvers automatically until it reaches the optimum position for hitching, which is then done by hand.

The Pedestrian Detection function helps ensure the Innovation Tractor works as safely as possible while using the tablet for maneuvering and hitching.

The cameras detect pedestrians between the vehicle and trailer and this information, along with the individual's location, is displayed on the tablet. If the person controlling the tractor fails to respond, the system stops the vehicle. The interrupted hitching process can only be restarted once there is no one between the tractor and trailer.

"True to the ZF innovation concept, the Innovation Tractor brings together in a test prototype all the new functions we believe are practical for agricultural and construction applications," concludes Naunheimer. "The focus was on demonstrating what is already possible and technically feasible today, but sets a benchmark on future innovation." **IVT**

Alexander Eisner has been head of off-highway product communication at ZF since 2007. He is responsible for construction, agricultural and material handling machinery systems marketing operations



The ZF Innovation Tractor demonstrates how automated driving functions and driveline electrification make tractor operations faster, more efficient and safer

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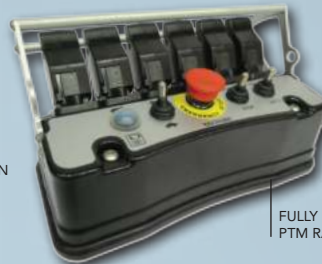
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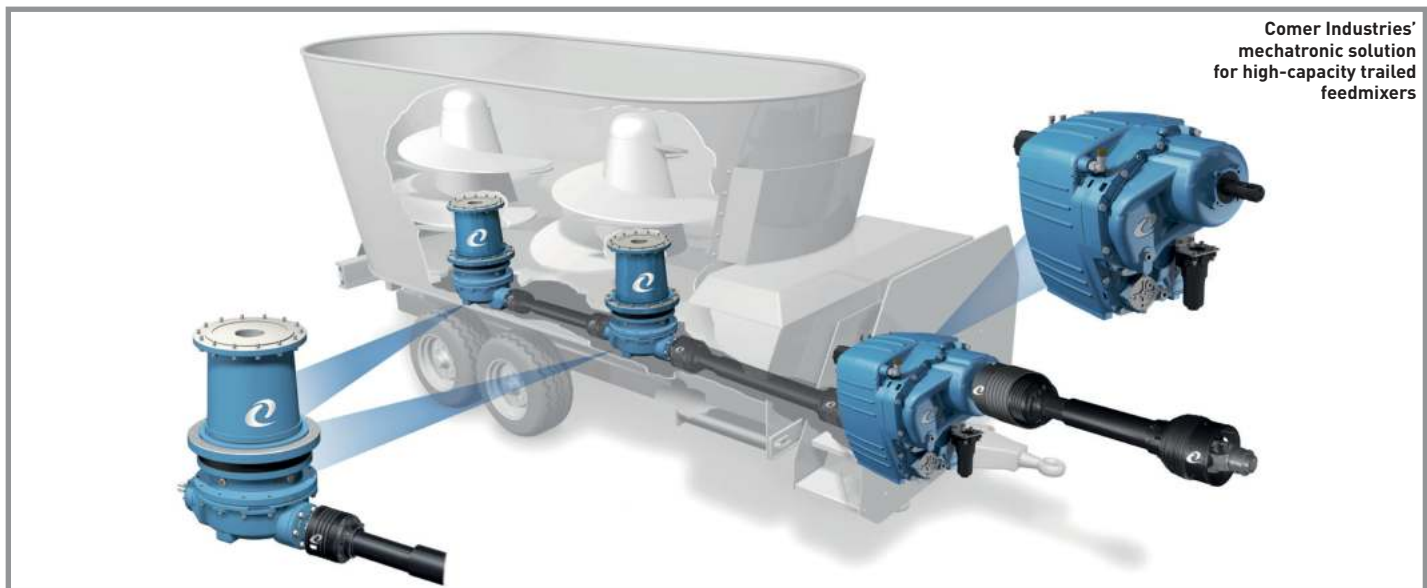
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Mixed signals

WITH ITS ECU CONTROL ENABLING COMPLETELY UNINTERRUPTED OPERATION, THERE'S NO DOUBT THIS NEW POWERSHIFT TRANSMISSION FOR FEEDMIXERS WILL BE ATTRACTING KEEN OEM INTEREST



Comer Industries' mechatronic solution for high-capacity trailed feedmixers

▶ The agricultural feed mixer market is in continuous evolution: OEMs and farmers alike are calling for ever-higher efficiency, reduced fuel consumption and increased automation in daily farming operations, while maintaining the ideal balance between cost and benefit. As a designer and manufacturer of advanced engineering systems and mechatronic solutions for power transmission for agricultural and industrial machinery worldwide, Comer Industries has therefore launched its new Powershift solution for high-capacity feed mixers. This 2- or 3-speed gearbox for feed mixers ensures optimum machine performance by allowing shifting while the machine is operating.

The brains of the outfit

The new Powershift A-614 transmission enables gears to shift while the machine is running, without any interruption of working operation. The end user is therefore able to change the final speed of augers without stopping the tractor's PTO, thereby avoiding any waste of time and also obtaining considerable fuel savings.

The A-614 model is a complete mechatronic package, available in 2- or 3-speed versions, and is integrated with a hydraulic system to manage the clutches. The Powershift gearbox also works in

combination with an electronic control unit (ECU) – the brains of the product – that manages multiple components and functions of the machine, while making it possible to control the shift gear in a modulated way to allow for continuous operation.

Sensors are installed in the gearbox to monitor temperature, input and output speed, and pressure. The ECU also protects the unit from improper shifting. Additionally, it provides simple analogic signals and, via the CANbus interface, submits sophisticated feedback to the main feed mixer control unit.

The main feed mixer control can also dialog with Comer Industries' ECU to set different work cycles depending on the various combinations of mixing, time and volumes.

"The ECU has the task of optimizing the whole system for the highest functionality at the greatest efficiency and lowest fuel consumption," explains Morgan Motta, application sales manager.

Specifically, the 3-speed Powershift features a high reduction ratio of 3.2:1, allowing for the use of a lower PTO horsepower tractor – thereby delivering a further reduction in investments for the farmer.

The 2-speed Powershift is available with ratios of 1:1 and 1.8:1; the 3-speed model is available with ratios 1:1, 1.8:1 and 3.2:1. Both solutions can perform at power outputs of up to 250hp and are designed for

10,000 hours of life to meet demands for intensive utilization from the end user.

The Powershift, combined with the company's professional series of driveshafts and high range torque planetary drives for final augers, represents the complete package for high-capacity feed mixers.

Comer Industries' offer includes:

- Parallel-axis speed-change gears, suitable for transmitting power between 40-180kW, with ratios from 1:1.5 in multiplication to 3.3:1 in reduction;
- Planetary drives with high transmission ratios, suitable for transmitting torque moments between 900-4,200 DaNm;
- Configurations for hydrostatic transmissions, for electric motors and for remote controls;
- PTO driveshafts in various sizes, with safety devices;
- Rigid and steering axles;
- Planetary wheel drives.

In the forage harvesting and distributing machinery sector, the company has become a worldwide leader in the production of transmission systems for feed mixers with vertical or horizontal augers, whether stationary for feeding and biogas purposes, self-propelled or truck-mounted. **IVT**

Sara Bernardelli is press office and communication manager at Comer Industries



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Line of sight

WORKING FROM MARKINGS ON THE ROD OF A CYLINDER, OPTICAL SENSORS ARE IDEAL FOR PROVIDING COST-EFFECTIVE AND RELIABLE POSITION DETECTION – EVEN IN THE TOUGHEST ENVIRONMENTS

▶ Optoi Microelectronics and Giuliani Cilindri are celebrating 15 years of the manufacturing and installation of optical sensors for position detection of hydraulic cylinders. The core technology is patented and based around the reflection of light emitted by the sensor and reflected by the rod, which has been specifically imprinted using the laser-marking process. The rod therefore provides reflective and opaque surfaces that are recognized by the sensor. Special gaskets protect it, and keep the observed area free from hydraulic fluid.

The optical technology for the detection of a single position of the rod was invented in 2001. OIS21 is a single-position sensor that, by recognizing a thin mark on the rod's chromium surface, lets the operator know when the wheels are aligned for road driving. Compared with magnetic solutions, OIS21 is resistant to external electromagnetic fields and can be applied on iron cylinders, providing cost savings over more expensive materials. Over those 15 years, 300,000 sensors have been produced, providing full customer satisfaction – proving that the optical technology is reliable even in dirty and aggressive environments.

Since the beginning, single-position sensors have been mounted on Dana's steering axles, effectively meaning that the most important manufacturers of telehandlers and construction machinery have been testing its functioning for over a decade.

Today, a wide range of single-position sensors, such as a model with improved internal diagnostics (OIS25) and the fully redundant OIS27, can satisfy new applications and needs. Specific positions and the direction of a cylinder can be detected in a simpler way compared with absolute position devices such as

Patented OIS21 position sensor detects a specific position of the rod



MAIN IMAGE: Giuliani Cilindri manufacture smart hydraulic cylinders that make use of Optoi optical position sensors
BELOW: Patented OIS22 optical sensor looks to the barcode marked on the chromium rod to detect its absolute position

magnetostrictive sensors, potentiometers or string pots. Moreover, optical sensors also provide smaller hindrance and are tamper-proof, as they are fully integrated inside the hydraulic cylinder.

Some beneficial applications include the detection of open and closure positions of a stabilizer, detection of open and closure positions and movement direction of a lifting cylinder (redundant sensor), and the detection of closure position of a telescopic cylinder (redundant sensor).

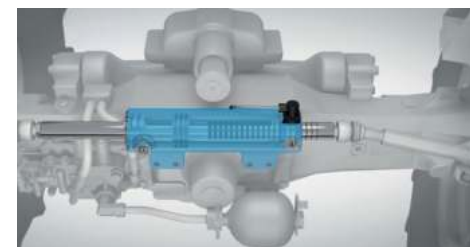
Optoi Microelectronics and Giuliani Cilindri look forward to receiving new customers' requirements and offering them smarter and cheaper solutions.

Absolute position sensors

Optical technology for position measurement has now progressed, and new sensors for determining the absolute position of a cylinder stroke are available.

OIS22 is the first model designed for the continuous position measurement of a steering cylinder. The sensor is integrated in the double-effect cylinder and measures the direct position of the rod, which is marked by exploiting laser-marking processes. The barcode is marked along the whole curved surface in order to prevent errors in the event of rod rotation.

Its simple design always guarantees a reliable measurement and enables the system to reach a very high accuracy (0.05mm). Moreover OIS22 is highly robust to electromagnetic noise due to the optical



core of the system, and it is also immune to external agents as the electronic components are completely integrated inside the hydraulic cylinder.

The maximum measurable stroke is 300mm, thereby making OIS22 ideal for steering cylinders. The main applications are currently telehandlers, harvesters, crop sprayers and trailers, although more applications are feasible.

Compared with the standard solutions on the market, the OIS22 absolute sensor presents some major advantages and is covered by patent. Unlike magnetostrictive sensors, no rod drilling is required because the sensor is interfaced to the rod and there are no parts in it. And unlike angular sensors, no external devices or assembling operations are required, so the user can save time and money. **ivT**

Working at Optoi Microelectronics since 2009, Jacopo Brunelli is now sales and application engineer

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Pole position

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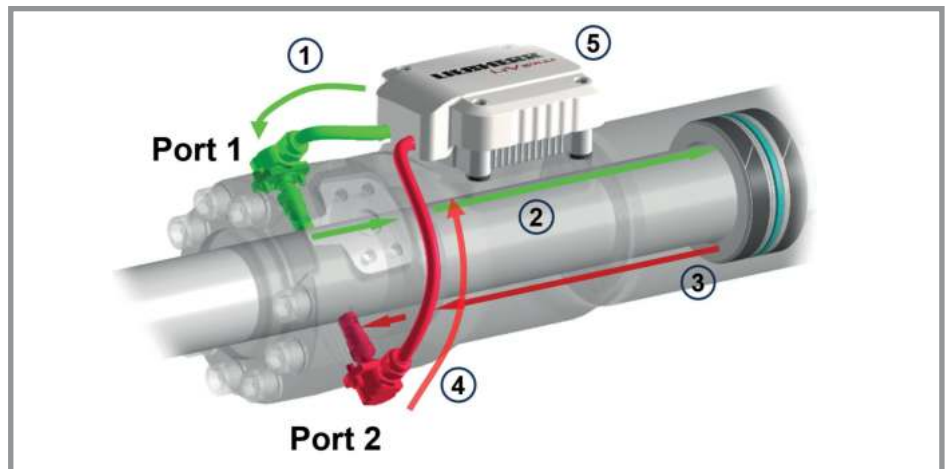
In order to increase the productivity of mobile machinery, more and more OEMs are focusing on automation. In many industries, rough operating conditions challenge automation systems every day. Robust high-performance systems are therefore required to ensure precise and solid automation.

Meanwhile, the end users must steadily improve productivity to maintain their competitiveness. For that reason, automation is becoming increasingly important across a variety of sectors, including construction and agriculture. The level of automation ranges from semi-automatic movements to fully autonomous machines, while the challenges for automation systems are plentiful – for instance, vibration, dust or extreme temperatures.

For the automation of mobile machinery, precise automatic movements of their hydraulic cylinders is crucial. This requires a smooth interaction of sensor technology and electronics. In order to sense the piston position inside a hydraulic cylinder by exploiting the electric characteristics of the mechanics, different methods have been tested. In particular, resonance and microwave techniques inside the cylinder cavity are advantageous due to the availability of integrated circuits. Generally, a main challenge for the sensor is the stability of the measured signal, as the sensing element is the mechanics of the cylinder itself. As the hydraulic cylinder is subject to extreme mechanical stress and high temperature gradients, the sensor itself needs to be able to perform in harsh environmental conditions.

Integrated approach

Accordingly, Liebherr-Elektronik has developed and patented LiView, an integrated sensor approach for the measurement of the piston position of a hydraulic



ABOVE: The functionality of Liebherr's position transducer for hydraulic cylinders

BELOW: Designed for off-road use, LiView measures the piston position fast and precisely

cylinder based on radio frequency. The cylinder is electrically sensed through elements that are directly integrated into the piston rod. Thanks to its robust design, LiView measures the piston position precisely, even in tough off-highway applications. Additionally, the innovative system is easy to integrate in hydraulic cylinders without any special design modifications.

Liebherr's position transducer exploits the cylinder itself as a sensing element. Two sensing probes (Port 1 and Port 2) are integrated in the high-pressure part of the cylinder rod bearing. LiView injects a stimulus via Port 1. The signal travels toward the piston and is reflected. Port 2 then measures the reflected signal and the system calculates piston position and speed.

LiView has been extensively tested both under laboratory conditions and in the field. The repeatability is typically 250µm. High-precision measurement is performed in cycles within a period of 200µs and has been successfully tested for dynamic piston speeds up to 1m/s. However, there are no limitations in terms of velocity.

LiView is easy to install and is even retrofittable. The cylinder is sensed through elements that are

directly integrated into the piston rod bearing. Extra modifications of the basic cylinder are not required. Consequently, the costs for integration are low as there is no need for drilling the piston rod to embed conventional sensors.

The design concept of the position transducer ensures that any part of the system is easily accessible. The compact dimensions allow for installation even in small-sized cylinders and the system is independent of the piston diameter. LiView is suitable for all cylinder lengths.

Suitable for heavy-duty operation

The position transducer has been developed to withstand the highest stresses and strains. LiView has also successfully proved its robustness in temperatures ranging between -40° and +100°C and pressure variations of up to 400 bar.

Due to its robustness, performance and flexibility in terms of integration, LiView is ideal for the automation of mobile machinery. The performance of the system is on a par with leading state-of-the-art stroke transducers based on conventional methods (e.g. magnetostrictive or optical sensors). In addition, LiView excels in three core areas: high dynamics, low integration costs and an ultra-ruggedized design, without any moving parts in oil. **IVT**

Roman Hofmann is head of sales at Liebherr-Elektronik



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Industrial (vehicle) complex

WITH THE NEED TO COORDINATE BOTH HYDRAULIC AND NON-HYDRAULIC PROCESSES, MOBILE MACHINES REQUIRE A CREATIVE – AND ADVANCED – APPROACH TO CONTROL SOLUTIONS

In industrial applications, a superordinate PLC often takes on the coordination of processes and controls the components that are involved. If hydraulic functions are present – for example the position control of a hydraulic cylinder or the pressure control of a clamping or pressing function – these are also controlled by the PLC, by monitoring the corresponding electronics. In this case, the electronics only regulate this one function.

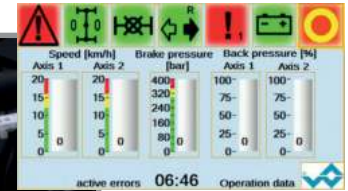
The requirements of mobile machines are much more complex. Their controls should both coordinate the processes and directly control the hydraulic valves, in addition to taking on other electric, non-hydraulic functions. This also requires a change in thinking in the design of such machinery, while cooperation between specialists in the fields of systems, hydraulics and electronics needs to be intensified. For instance, function is no longer limited to individual pressure controls – instead, several functions of the machine should be coordinated and controlled, additional sensors should be read, and actuators directly controlled.

With the new generation of Programmable Mobile Electronics (PME) control devices, Switzerland-based Wandfluh is able to close this gap and connect its extensive know-how in the field of hydraulics with mobile machine technical control requirements. The new family of devices consists of various electronic modules for operation and control as well as for graphically displaying machine data.

As a result of the modular design of these PME devices and simple networking via a CANbus, the control structure can be built in a decentralized fashion, greatly simplifying assembly and reducing its cost. Extensions and additional functions can be easily integrated, and the free programmability of the modules leads to great flexibility – although it requires creative solution approaches. With the flexible I/O devices, displays and keypads, many applications can be covered. In addition, the telemetry devices allow remote access via GSM or wi-fi, and enable remote diagnostics, vehicle tracking and control interventions.

Hydraulic drive support

As a real application, Wandfluh has been able to implement the hydraulic-electric control of a trailer for forestry work. Fully loaded, these have a high



LEFT: Electronically controlled hydraulic drive and brake support

INSET: Online diagnostics and operation by means of a display of the Wandfluh PME devices family

BELOW LEFT: Application example in a forest trailer with payload up to 12t



weight which, using conventional technology, requires a very powerful and therefore large towing vehicle that is not suitable for narrow roads or rough terrain. In addition, the mechanical brakes of the trailer are not generally designed for high and long-term braking forces – normally, these would overheat, and the engine brake of the tractor cannot brake the weight of the trailer sufficiently on its own.

Using its own hydraulic valves and an intelligent control system built with PME products, Wandfluh has now developed a hydraulic drive support and a hydraulic brake. The flexibility of the different PME devices family has therefore been exploited: the free programmability of the modules has allowed for the software to be adapted to match the desired functions, and a graphic display reads the status of the operating elements and allows the adjustment and diagnostics of important data. It was possible to wire the

decentralised input/output modules for sensors and hydraulic valves simply via the CANbus, and to easily integrate standard Wandfluh electronics.

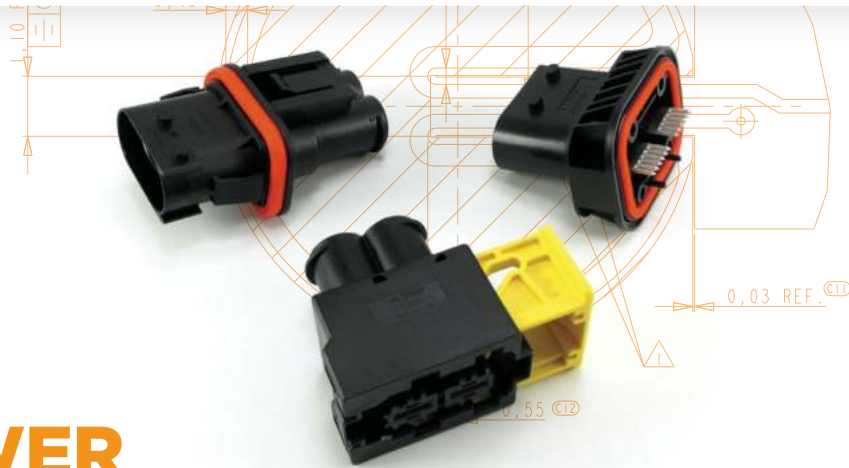
The Cardan shaft drives two hydraulic pumps, which provide the necessary oil pressure uphill for the drive support. By means of electronically regulated proportional pressure-relief valves, it is possible to easily adjust the additional power needed on the display in the towing vehicle. Downhill, the axles of the trailer are hydraulically braked, whereby the same valves indirectly limit the revolution speed of the axles. The hydraulic motor now pumps the oil, the valves produce the desired backpressure and in doing so, they brake the trailer. The hydraulic oil is then cooled again by the built-in fans.

The transmission of the two axles can be individually engaged or released in order to drive at a higher speed on flat terrain. Additional sensors, for example in the Cardan shaft or the transmission, allow functional analysis and error monitoring in the software. Operation by means of switches and display in the towing vehicle allows the driver to constantly keep track of all the important data such as speed, hydraulic pressures and the system status of the functions. **ivt**

Working at the headquarters of Wandfluh AG, Hydraulics + Electronics in Frutigen, Switzerland, since 1997, Adrian Feuz is responsible for the Electronics division



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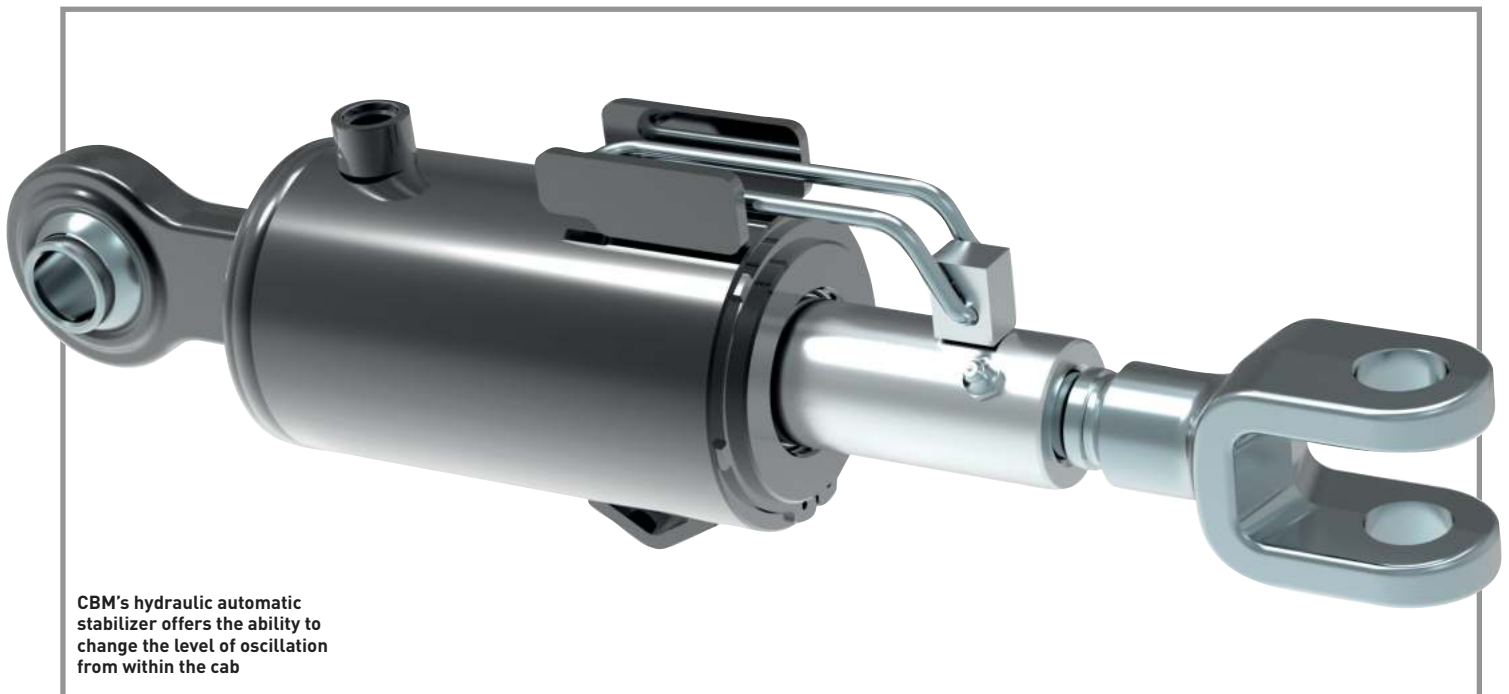
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Lateral thinking

PROVIDING THE THREE-POINT LINKAGE WITH MAXIMUM FLEXIBILITY –
WHILE ALSO PREVENTING DAMAGING OSCILLATIONS WHEN NECESSARY
– REQUIRED A CREATIVE APPROACH TO PROBLEM SOLVING



CBM's hydraulic automatic stabilizer offers the ability to change the level of oscillation from within the cab

▶ With every passing day, suppliers involved in the agricultural sector must deal with the demand for ever-increasing loads, while tractor horsepower is continuously rising. Mechanical tractor parts, especially the components of the three-point linkage, are subject to high loads and therefore need to be specifically designed using special raw materials and heat treatments to guarantee the safe working conditions of the tractor operators.

With almost 50 years of experience in the design and manufacture of systems for coupling, towing and lifting implements for agricultural tractors, CBM supplies these systems to all of the principal tractor manufacturers worldwide.

Safety and stability

The company's new automatic lateral stabilizers serve the function of limiting and/or blocking the lateral oscillation of the lower links while maneuvering or during transport on roads and sloping terrain. Moreover, during transport, the stabilizers have the task of centering and blocking the implement in relation to the tractor for safety and stability reasons.

In several working conditions, however, the lower links need to be free to oscillate sideways, requiring the change from the blocked to the floating position and vice versa. With the CBM hydraulic automatic lateral stabilizers, these two operating conditions can be obtained autonomously and in total safety, directly from the driver's seat, without requiring any user intervention between the tractor and the implement.

When compared with other mechanical versions (manual or automatic), the CBM hydraulic stabilizer allows for infinite adjustments and a gradual passage from the floating to the blocked condition. It therefore avoids the risk of accidental shocks and violent lateral oscillations that could result in damages to the three-point linkage or to the implement. The benefits of this solution are even more remarkable while working on rugged or sloping ground, where the stability of the tractor and the implement are more precarious.

The CBM hydraulic stabilizers are also available as a retrofit kit, which includes hydraulic hoses, a lift height sensor, wiring and a control box. Replacing mechanical CBM stabilizers with this version is very simple, and it will fit other models using the appropriate adapters.

Retrofitting the hydraulic stabilizers is very simple. Removing the original mechanical units and fitting the new ones is actually a fairly straightforward operation as all the necessary parts are supplied by CBM, including the hydraulic connectors. The sensor that detects the position of the lift arms has to be installed in the middle of the pivot point of the rockshaft arms and connected with wires to the control box that is in the cab. The extremely easy and step-by-step instructions provided by CBM will guide the operator to calibrate the system.

Using the control box, the operator can lock or release the stabilizers directly from the cab; the current status of the stabilizers is shown by a small LED. Another LED indicates if the manual or auto mode is selected. The kit is available from all the main spare-parts distributors.

CBM Group has always been focused on technology and innovation, and continues to invest substantial resources in R&D to ensure its production remains up-to-date with leading-edge technology. **ivm**

Enrico Cornia is managing director of CBM Group



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Face facts

IF YOU'RE STILL PRODUCING HIGH-PERFORMANCE AGRICULTURAL EQUIPMENT WITH POPPET VALVE QUICK-RELEASE COUPLINGS, ISN'T IT TIME YOU STARTED OFFERING CUSTOMERS A BETTER OPTION?

▶ The agricultural sector is continually evolving and in response OEMs are constantly focused on designing and producing their machines to offer higher levels of performance, efficiency and safety. Hand in hand with this, each individual component of these machines must be able to perform at the highest level. It is well known that the hydraulic circuit is a vital part of agricultural machinery, because it is only as a result of fluid power that most of the equipment working in the field, such as plows, cultivators and trailers, is able to operate.

A key component of the hydraulic circuit is the quick-release coupling, which has the function of quickly connecting the hydraulic circuit of the operating machine to the hydraulic circuit of the equipment, and then conducting the pressurized fluid through the circuit.

Improved couplings

The quick-release coupling is very often considered to be a component of low importance – one that simply has to carry out its main function of connection and fluid transfer. For this reason, a traditional poppet valve coupling has been widely used. However, given the agricultural sector's trend toward more powerful and sophisticated machines, the need to use quick couplings with better characteristics – and that are able to give benefits in line with the increased value of the machine – is created.

Quick-coupling flat-face technology is certainly something that can offer considerable benefits in comparison with the traditional poppet valve coupling. The main benefit is the reduced natural fluid loss that occurs during the disconnection of a quick-release coupling. For example, for size 1/2, which is the one most commonly used, the typical loss is 2.5ml for a traditional poppet valve coupling and just 0.02ml for a flat-face coupling.

A loss of 2.5ml may seem minimal, but once you take into consideration the number of disconnections that are carried out during a year of work, multiply the loss, and then multiply that by the number of hydraulic lines present on different machines, it is clear that many liters of hydraulic oil are wasted. Aside from the cost of the oil, there is also the matter of the considerable damage to the environment. In fact, even though many machines are provided with an oil



ABOVE: Neptune casting block with flat-face female couplings installed at the rear of the tractor

collector, whether because the collector is broken or because the operator is not so sensitive to the correct disposal, the oil can still end up in the environment.

An additional benefit given by the flat-face coupling over the poppet coupling is that during the connection process, there is only a very limited quantity of air and contaminant introduced in the circuit. This feature is very important because it ensures the hydraulic circuit is maintained in optimum conditions of cleanliness, and therefore efficiency, greatly reducing the risk of damage to the hydraulic components that are normally sensitive to the presence of air and contaminant.

All of this can be translated into a reduction in costs due to unexpected downtime and extraordinary repairs, as well as a useful reduction in ordinary maintenance. Other advantages of flat-face couplings over poppet valve couplings are the higher operating pressures, reduced pressure losses, and availability of solutions for connection with residual pressure – all characteristics in line with the new trends of an increasingly demanding market.

Neptune casting block

For these reasons, recent years have seen a rapid growth in the use of flat-face couplings in agriculture – just think of the multicouplings applied on tractors with a front loader, the multicouplings used on combine harvesters and the many individual flat-face couplings installed on various other machines.

Last but not least, many market-leading OEMs are now installing manifold blocks equipped with flat-face couplings on the back of the tractor – for which Stucchi has developed the Neptune casting block. This innovative product offers the possibility to attach to the same casting female cartridge couplings of different models (flat-face or poppet valve) and different sizes (1/2, 5/8, 3/4).

Stucchi, a company that has always stood out for its dedication to the development of flat-face quick couplings, is willing to listen to the needs of manufacturers in order to provide them with the best solution and to accept the challenge to further develop a technology that is already present in the agriculture market – and in the future will be more and more widely adopted. **ivT**

Gianmarco Gatti is a product specialist at Stucchi SpA



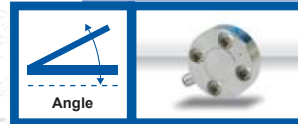
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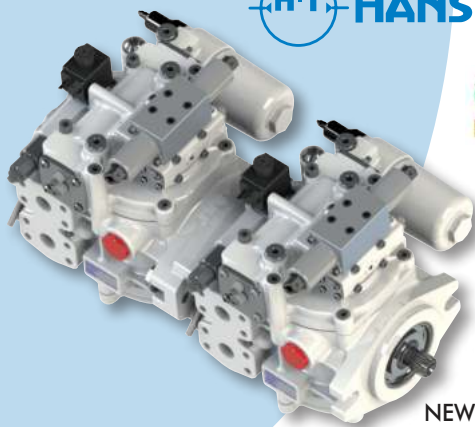
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Linked in

▶ The LHLink pivoting front linkage was introduced at Agritechnica 2007, attracting enormous attention internationally and being awarded the DLG Silver Medal. At the launch the LHLink was attached to a Valtra N Series, but it can be retrofitted to any brand of tractor. OEM deliveries are also available to tractor manufacturers. The LHLink pivoting front linkage has already been retrofitted to John Deere, Fendt, New Holland, Steyer and Case IH tractors.

Customers love this linkage, as LHLink can improve productivity by 25-30%, for example when mowing, snow plowing and sweeping roads. The pivoting front linkage can turn either in relation to the front tires or independently, as the driver chooses. It can turn up to 35° in both directions and carry loads of up to 3.5 metric tons.

Specializing in the design and manufacture of couplings for tractors and other machinery, the manufacturer



of the LHLink, **LH Lift**, is a 40-year-old family-owned company operating factories in Finland and China. It is a proud supplier to Valtra.

Its factory in Ningbo, China, purchases, machines and assembles components with a workforce of 25 employees. Another 40 work at the factory in Laukaa, Finland, designing, manufacturing and marketing components. Both factories deliver components directly to their OEM

customers, including the AGCO factories in China and Finland.

LH Lift supplies a wide range of components, including top links and lift rods, lower link arms, lower link arm stabilizers, quick coupling hooks, rear hitches and drawbars, front linkages and accessories.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm
Quote Ref: **515**

Rugged and reliable

▶ ASM Sensors has launched the PosiHall PH58 non-contact analog/digital (CANopen, CAN J1939) multiturn angle sensor for harsh environmental and heavy-duty applications. The sensor measures angular positions over multiple revolutions using the non-contact magnetic 'multiHall technology'.

The rugged aluminum housing with completely encapsulated electronics protects the sensor against shocks and vibration, extreme temperatures and humidity. PosiHall PH58 is suited for rotating assemblies in harsh and aggressive environmental applications such as industrial vehicles or wind power stations.

The non-contact magnetic multiHall technology is able to reliably detect measuring data even if the machine housing becomes filled with water or oil – for example, as a result of leaks in seals, bearings or any other connecting devices in the surrounding system. The PH58 has a sealing capability protection class of IP67/69K, which makes it perfectly suited for heavy-duty and harsh environmental applications.

The sensor measures up to 255 revolutions (255x360°). The sensor housing is made from aluminum and has a diameter of 58mm. The stainless steel shaft is available in diameters of 6mm, 10mm or 12mm. The PH58 has an operational temperature range of -40° to +85°C, and its protection class is IP67/69K. Outputs are available either in voltage of 0.5-10V, 0.5-4.5V or in current of 4-20mA, 3-wire. Redundant versions are available for all output types. The sensor has a resolution of up to 16 bit.

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Quote Ref: **517**

A shock-resistant window on the world

▶ With the future firmly in mind, **Orlaco** is introducing a shock-resistant Ethernet camera: the EMOS. The images it produces are for all intents and purposes displayed in real time, making it perfect for use on trucks, cranes, heavy construction and mining equipment, semi-automatic or remote-controlled vehicles, and more.

This compact, lightweight camera (55x60x24mm, weighing 150g) was specially developed for integration into onboard computer systems. Via the RTP and AVB protocols, the camera is able to stream MJPEG or H.264 to practically any type of monitor. The ISO17215 protocol, which is standard in the automotive industry, is used to communicate with the camera.

Orlaco's newest camera is up and completely operational within two seconds and in combination with common hardware processing platforms, the total latency of the camera-monitor system is less than



100ms. CMOS chip technology and a sensor with a high degree of light sensitivity (0.05 lux) provide superb vision, night and day.

The EMOS is designed to perform under the most challenging conditions. This ethernet camera is watertight (IP68/IP69k), vibration-resistant

(15G_{rms} at a frequency of 24-2,000Hz), shock-resistant (50g), and can handle temperatures from -40° to +85°C.

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Quote Ref: **516**

Torquing Italian



FPT Industrial, one of the world's leading players in industrial engines from 2.2-20 liters, offers a full range of sustainable products for on- and off-road vehicles and marine and power-generation applications.

Responding to the needs of the customer, FPT develops its diesel and alternative fuel products to deliver outstanding performance, efficiency and adherence with the appropriate emissions regulations, while having low fuel consumption and reduced total cost of ownership.

To comply with Euro 6 and Tier 4 Final emissions regulations, its EGR-free patented HI-eSCR aftertreatment solution maximizes combustion efficiency. The solution uses clean air – rather than EGR – before the aftertreatment HI-eSCR converts NOx to diatomic nitrogen and water, and does not need a DPf.

To comply with Stage V emissions standards, FPT Industrial developed HI-eSCR2, the second generation of its renowned and patented High Efficiency Selective Catalytic

Reduction (HI-eSCR) aftertreatment technology.

And, as one of the few engine manufacturers with 25 years of experience in natural gas, compressed and liquefied (CNG and LNG) in on-road applications, FPT Industrial also offers engines for light, medium and heavy applications. The available range goes up to 400hp, creating a valid alternative to diesel, even for long-haul missions.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm Quote Ref: **518**



The best seat in the house



Within the scope of the Cab Concept Cluster (CCC), at Bauma 2016

Grammer presented a complete system consisting of an innovative, ergonomically optimized driver seat with electrically adjustable features, plus a multifunctional armrest and 12in multitouch display designed for controlling all vehicle and seat comfort functions.

The Cab Concept Cluster counts 13 participating partners, including global players, innovative OEM suppliers, prominent scientific institutes, designers, industry associations, rental companies, and vehicle users, all of whom teamed up to pool their expertise and decades of practical experience for developing the Genius Cab.

As the cluster partner responsible for the aspect of interior HMI/ assistance, it was important for Grammer to work with the other partners to ergonomically gear the interface used to control all vehicle functions to the operator. The



company delivered a complete system comprising a seat, multifunctional armrest, display, and graphical user interface.

The development work under the theme of 'human-centered design' has focused exclusively on meeting the needs of vehicle drivers by enabling them to intuitively and ergonomically control and operate all vehicle and comfort functions using a multifunctional armrest and multitouch display.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm Quote Ref: **519**

Making high-power connections



TE Connectivity's high-power AMP MCP 9.5 two-position connectors are designed for harsh environment wire-to-wire and wire-to-circuit board connections.

Part of TE Industrial & Commercial Transportation's extensive portfolio of rugged electrical connector solutions, AMP MCP 9.5 two-position connectors are designed to withstand the typically extreme conditions encountered in the agricultural industry.

The rugged thermoplastic connectors utilize TE's field-proven AMP MCP 9.5 contacts and have a

current rating of 78A for 10mm² wire. AMP MCP 9.5 two-position connectors are IP67 and IP69K rated (with a backshell) and protect connections from dust, dirt and moisture. Several mounting options are available, including in-line, flange, sealed flange and PCB mount, making the connectors suitable for several types of applications. No tools are required for mounting.

For harsh environment applications that require a high-power, environmentally sealed two-position electrical connector, the AMP MCP 9.5 two-position connectors are a reliable solution.

AMP MCP 9.5 two-position connectors, and the entire TE Industrial & Commercial Transportation product portfolio, deliver highly reliable connectivity solutions for applications where failure is not an option.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm Quote Ref: **520**



Paddle your own industrial vehicle



Curtiss-Wright has launched the JC1200, a next-generation, cost-effective paddle joystick from its brand family of **Penny & Giles**.

By using a long-life bearing system and non-contacting Hall-effect sensing technology, the JC1200 has achieved a long operating life of 25 million cycles while providing functionality that is smooth and easy to operate.

Key features of the JC1200 include:

- An under-panel depth of 9mm, requiring minimal installation space;
- A spring-loaded return-to-center or return-to-end paddle movement;
- Integrated panel seal and IP67 protection – suitable for outside use;
- A choice of nine colored paddle 'Tabs', which can be factory fitted or supplied separately and added as part of the final customer installation process.

The JC1200 launches with a 5V DC supply voltage and the option for factory-programmable electronics configured to one of two analog

voltage output ranges (0.5-4.5V or 1.0-4.0V). The joystick also provides safety functionality via dual outputs, which can be set to positive or negative ramps, or a combination of both. This offers system designers the option to compare the output signals for error checking.


The JC1200 paddle joystick builds on the success of the potentiometric-based JC120 and is ideal for use in control panels and armrests found in industrial trucks, and agricultural and construction machinery, where cost-effective, long-life operator controls are essential.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm Quote Ref: **521**



TriMark's open-door policy

 As **TriMark's** newest innovation in rotary latches, the 050-1900 8mm single rotary latch features a robust modular design that offers extensive actuation locations and options providing application flexibility in a compact design. Designed for medium- to heavy-duty applications for on- or off-highway personnel, compartment door and door hold-open applications, this single rotor latch is available in both FMVSS 206 (UNECE Regulation 11) and non FMVSS 206 (UNECE Regulation 11) configurations.

Its modular case construction has been preconfigured with multiple actuation points on the front case allowing top/bottom actuation, including stacked actuators as well as combinations of actuation points, providing the most configurable rotary latch ever designed.

Its compact size and shape allows for maximum use of door space and minimizes visibility issues without compromising either strength or robustness. The rotor provides for vertical clearance of strike, allowing for door sag, misalignment and ease of installation.

Two-position rotor versions for personnel doors and single-position versions for compartment and door hold-open applications are available.


System kits include handles, latches, accessories and keyless entry e-ASK systems to provide a comprehensive electromechanical access solution.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm
Quote Ref: **522**



CAN-do attitude

 **Ametek Vehicular Instrumentation Systems (VIS)** has added the new CAN I/O X expander module to its family of CAN interface modules that are used to enhance vehicle instrumentation systems.

The versatile CAN I/O X can convert switched, analog or pulsed input into a standard or proprietary J1939 CAN databus message for any device on a vehicle instrumentation system. It provides both manual transmissions and mechanical engines with a means to connect with electronic instrumentation by converting pulsed inputs to digital information. It also allows switched and analog inputs to be converted to digital data and converts pulsed input into a J1939 CAN databus message. The module features 10 switched and analog inputs and a minimal footprint of 18.7in².

The CAN I/O X module is environmentally sealed against dust and moisture penetration to IP67 specifications and can be mounted onto a vehicle chassis. The module




is designed to withstand harsh conditions and rugged off-highway environments. It meets all SAE J1455 and J1113 requirements for vehicular instrumentation.

Information about the company's full line of CAN Communicator and next-generation instrument systems is available at www.ametekvis.com.

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To learn more about this advertiser, visit www.ukipme.com/info/ivm
Quote Ref: **523**

Carry that weight a long time

 Supporting the evolution of underground mining vehicles as the industry demands reduced fuel consumption and improved productivity, **Dana** recently introduced a new rigid planetary axle for medium-sized load haul dumpers (LHDs) and ADTs. The Spicer 20D axle supports LHDs with bucket capacities from 10-12 tons and mining trucks with payloads from 22-36 tons.

Delivering 25-35% more load capacity over previous models, the Spicer 20D axle provides superior productivity and high power density. Compatible with a wide range of powershift transmissions designed for heavy-duty, rough-terrain applications, this axle is part of Dana's complete drivetrain solution for mid-sized underground mining vehicles, which allows OEMs to increase bucket size and carrying capacity while minimizing the size of powertrain components. There is also 30% more brake power to ensure reliability under full load conditions on all operating grades.

The Spicer 20D axle has been designed to accommodate Dana's optional Spicer Smart Suite technology, a platform of fully integrated, connected-vehicle features that converts operating data from the drivetrain into actionable insights. Machine-learning algorithms built into the software optimize productivity by measuring performance, predicting maintenance issues, and enabling more precise maneuvering in tight, subterranean work areas.


This axle is currently undergoing verification testing, with OEM field testing to begin in Q1 of 2017.

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Quote Ref: **524**



Pump action

 The innovative TPV 3600 axial piston pump series launched this year by **Hansa-TMP** now contains a compact double version. The TPV 3600 is a high power-density pump with a displacement of 25-38 cc/rev per single pump and peak pressure of 450 bar. The highlight of the pump is its complete modularity: one body for all versions.

With the standard body it's possible to integrate a multitude of controls, such as manual, hydraulic, electric, with or without feedback and automotive and pressure cut-off. Moreover, there is a full range of built-in electronic sensors such as pressure sensor, speed/RPM sensor, swash plate angle sensors and man-on-board (MOB).

The pump has been designed to be assembled with the ports on the left and on the right side. This feature is extremely valuable for applications with space constraints, such as forestry machines, skid-steer loaders, dumpers, paving machines and both wheeled and



tracked applications. Hansa-TMP works directly with the OEM to supply the overall electronics and programming for the machine functions and controls.


This new offering, along with its investments in the manufacturing process, demonstrates Hansa-TMP's huge commitment to the R&D of new products that deliver smart solutions to meet customers' needs.

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Quote Ref: **525**



Stay in the loop

 With **Bauser's** latest in-cab display solutions, extensive data connectivity can now be enabled via CAN 2.0B, USB, Ethernet or PAL/NTSC video (in response to customer requests), while J1939, CANopen, TCP/IP, and OEM proprietary protocols are also available. To enhance Stage IIIB/IV and Tier 4 emission standards compliance, compatible DPF and SCR functions can be incorporated.

Installation can be achieved with a surface-mounted or integrated jointed arm, while up to 12 tactile buttons and an optional rotary encoder can be incorporated.

Bauser offers a wide range of display sizes, i.e. 3.5in (320x240) to 7in (1024x600) color-transmissive TFT displays with LED backlight between 350-1,000cd/m² over a lifetime of up to 50,000 hours. The displays can be incorporated in a panel/cockpit, or even mounted on a surface by using the jointed arm. The displays are compatible with CAN J1939 engine data and can even be used as virtual terminals in



an ISObus application to control the accessory equipment of machines. The optional rotary encoder enables the easy setting of a wide variety of machine and accessory equipment parameters.

Standard displays include up to 21 warning lamps (LED) and up to 26 pins for several I/Os, such as analog, digital or frequency inputs, as well as FET outputs (switching capacity 24V, 500mA). Finally, a rugged design means applications can withstand rough environments with high levels of shock and vibration over a wide ambient range.

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Steering a path to success

 **Hydraulic Nord Fluidtechnik** and **M+S Hydraulic** have signed a contract for cooperation for the next five years. The two companies are very well-positioned in the field of hydraulic applications in agricultural machinery, construction vehicles and other industrial and municipal vehicles, all around the world. The former is a technology leader in the field of hydrostatic steering units, while M+S Hydraulic is becoming famous for the production of orbital motors, brakes and accessories. It also produces steering units on a smaller scale.

Innovative steering systems offer the optimal conditions to meet the challenges of a globalized world of agriculture. The practice-orientated and diversely deployable steering systems from M+S enable the highest-possible steering precision. Its solutions guarantee precision, speed and durability, giving OEMs the decisive upper hand in around-the-clock competition. Its steering units are used in the hydraulic steering circuits of motor vehicles and mobile machines with high axle loads and driving speeds of up to 60km/h. Priority valves are used in

hydrostatic steering units where additional consuming units are combined, while its steering columns provide the ideal connecting element between steering wheel and steering unit.

The new relationship will offer OEM customers the best of both companies. The cooperation will cover preliminary technological development, production and a joint approach to OEM markets. About 1,200 employees are now producing more than 700,000 units of hydraulic products in the **Hydraulik Nord Fluidtechnik** and **M+S Hydraulic** factories; these are then sold in more than 100 countries.

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An affordable upgrade

 The new KL2001 LED work light from **Nordic Lights** matches the basic introduction-level needs for heavy-duty work lighting and is the ideal light when replacing halogen work lights.

The KL2001 LED is available with wide flood and flood light patterns and has an operational light output of 1,200 lm. It also features a sturdy aluminum housing (104x94x59mm) and a weight of 0.5kg. Among the other features, the lamp has an optically-even distribution of light pattern, demands minimum maintenance in its heavy-duty

construction and has a long lifetime, being 12-24V multivoltage, waterproof, with extensive EMC, and is protected against load dumps, over-voltage, reverse voltage and overheating.

The light's IP rating covers IP68 and IP6K9K as well as SAE J1455, and it withstands salt mist according to ISO 9227 for over 240 hours. It fulfills the EMC standards of ISO 13766, ISO 14982 and ISO 7637-2 and CISPR 25 Class 5.

Nordic Lights is a company based in western Finland developing and manufacturing LED, HID (Xenon) and halogen work lights for the heavy-duty on- and off-highway industry for harsh working environments. The use of Nordic Lights products ensures that darkness, vibration, shock, dust and humidity will not affect visibility when the results of your work and safety depend on effective lighting.

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Extra efficiency for wheeled loaders

 **Kawasaki** has launched the KLV control valve, a variation of the KLSV range of valves developed specifically for use in construction machinery and industrial vehicles. The KLV provides superior performance and efficiency particularly in wheeled loader applications, due to its low hysteresis and excellent pressure-drop characteristics.

The benefits of the KLV valve are a result of Kawasaki's extensive experience in the development of control valves and in-depth CFD analysis, which allows the fluid path to be optimized.

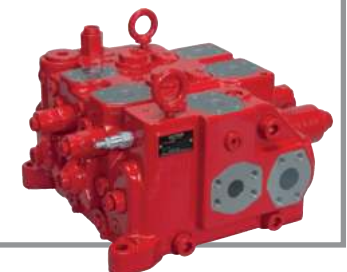
The KLV boasts a flow rate of up to 450 l/min and comes complete with a variety of features that are applicable to wheeled loaders. This includes regeneration to maximize efficiency and reduce energy wastage, a lock valve to minimize boom drift, and a ride control valve to improve

performance. The KLV features flow-sharing technology, hydraulic and electrohydraulic control, and it can be neatly combined with Kawasaki's new K3VLS load-sensing axial piston pumps.


This product continues to reinforce Kawasaki's reputation for developing extremely reliable and efficient products to give maximum controllability to the end user.

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Office in the sky

 At the Port of Hamburg, Germany, almost nine million containers are handled every year, with about 8,000 of them on average being loaded onto each ship. To ensure this loading goes smoothly, a lone man sits in a red-painted cabin high above the containers, adjusting the load in accordance with the packing lists. His activity area resembles an ultra-modern office, containing picture windows, computer displays, a desk and a body-contoured seat with an operator console. There is even an air conditioner.

This special cabin was designed and manufactured by **KML Miller**, situated in Lahr, Germany. Miller ranks among the technological leaders in the area of specialist cabin construction. It is known for highly innovative system solutions concerning high-tech cabins across a wide range of application areas.

The company develops and manufactures cabins in accordance with the individual and demanding specifications of its customers,

employing the highest of quality standards and extensive innovations. KML Miller offers turnkey solutions made in Germany and produced in-house. All cabins are designed with a plug and play system which allows for fast and smart installation.

The company's cabins are sent all over the world, destined for a wide range of machinery, including container cranes, special vehicles, machine or power station control centers, mining operations, cabins for airport, communal and forestry vehicles, and industrial trucks.

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Quote Ref: **530**



Robust and versatile

 EC-MMS-1521 is a new electronic controller from **Tecnord's** successful MMS series for driving hydraulic manifolds and performing complex machine management logic. Together with its fully potted electronics and automotive connectors, its robust aluminum housing offers an advanced hardware design suitable for harsh environments and heavy machines.

EC-MMS-1521 is often used as the main control unit of machines in a variety of applications such as AWP's, cranes, forklifts and earthmoving equipment. The electronic circuits are designed to cover demands for implementation of security features up to Performance Level d, in mobile sector applications. They feature a dual microprocessor, a dual CANbus interface, as well as redundancy and diagnostics capability for the outputs.

Use of state-of-the-art technologies – such as a CANbus interface for data communication and solid state switches for the power outputs – allows effective cost reduction on the entire system, along

with increased reliability and reduced wiring complexity.

EC-MMS-1521 features various types of inputs to interface with different devices: 10-bits standard and high-resolution 16-bits analog inputs, digital inputs and frequency inputs for the measurement of speed. Furthermore, up to 12 PWM outputs with independent current feedback are available, together with two low-side outputs and separate power pins for safety.

As options, the EC-MMS-1521 may include an inclinometer, mainly used in automatic leveling applications, and can provide datalogger functions, thanks to a real-time clock.

The software is developed on the basis of customer applications and can be easily updated in the field.

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Quote Ref: **531**



What is IP69K testing?



15 / A1

 Products rated to IP69K, the highest ingress protection rating available, must primarily be impervious to dust, but they must also be capable of withstanding close-range, high-pressure, high-temperature spray downs. IP69K was initially developed for construction vehicles, especially those requiring regular intensive wash downs, but it is also becoming increasingly important in industries

such as food processing, medical and marine.

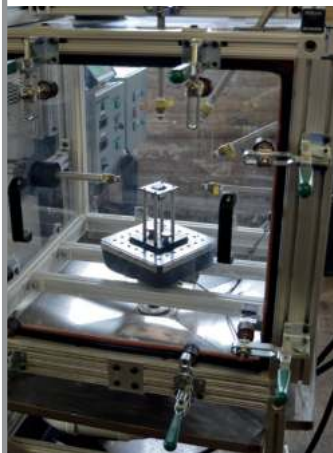
Specific equipment is required to ensure that products meet the test specifications. The test centers around four spray nozzles which are positioned at angles of 0°, 30°, 60° and 90° to the product and held at a distance of 10-15cm from it.

Products are placed inside the test chamber on a turntable that rotates once every 12 seconds and, when the water temperature reaches 80°C (176°F), the first spray nozzle is activated. Each nozzle is activated individually for 30 seconds at a flow rate of 14-16 l/min.

To meet market demands and to ensure that its products are suitable for the most demanding applications, **Otto Engineering** has built its own fully certified test equipment. To learn more, visit the company's YouTube page by searching ottoexcellence or IPX9K.

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Quote Ref: **532**



Make smart trucks? You'll need these

 It is impossible to imagine the industrial truck sector today without the use of intelligent sensors. **Siko** recently introduced redundant wire-actuated encoders that will meet the safety requirements in the whole system in line with SIL 2 and Performance Level d. The newly redundant wire actuated encoders SG32, SG42 and SG62 have been introduced in the forklifts and AGV systems to make them more reliable in measuring the height of the lift mast.

They offer this improved safety by means of a special and complete redundant sensor technology, which is employed to measure the absolute position. Two completely separate sensor systems measure the absolute position and give it out separately as

analog signals. With a measuring range between 3-6m, these wire-actuated encoders are best suited for measuring the absolute height of the lift mast on driverless transport systems. For forklifts, versions for up to 15m are available. All sensors are available with the redundant interface, potentiometer, analog current or voltage, as well as CANopen.

For vehicles that cannot be fitted with a wire-actuated encoder, Siko offers the innovative incremental IG-O encoder. Integrated in a toothed belt wheel, it can be installed within a very small space. The existing gear belt can be used in combination with the IG-O encoder on the lift mast, to cost-effectively measure its height. Extensive mechanical adaptations are completely eliminated.

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Quote Ref: **533**



Putting the brakes on

eima
18 / B53

Thanks to the RVBR regulation, the braking performances and safety conditions of agricultural vehicles are set to be greatly improved. Hydraulic trailer braking systems will see shifts from single to dual lines, consequently increasing their complexity. As a result, **Safim's** braking valve for tractors – the TBU (trailer brake unit) – can be fed by gear or piston pump, and an LS port is embedded, should it be required. The TBU, in addition to the hydraulic control head, can be controlled by mechanical cable or by the pressure of the SAHR brake when the tractor driver applies the secondary brake. It can therefore be used for tractors running above 40km/h.

For tractors with a manual mechanical parking brake used as the secondary brake, Safim has now developed a special handbrake lever that allows the tractor to be parked with the TBU unloaded.

For trailers, in addition to a simpler coupling device, the company will be offering an automatic trailer braking

valve that, using an accumulator, applies automatic braking. The same operation will be possible with a device that applies the spring force for the parking and automatic braking of the trailer. This is a new function that was developed to overcome the connections limitation of the recent regulation.

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Quote Ref: **534**



At the hub of invention

In recent years **Knott** has invested heavily in the development and production of ball-ramp wet multi-disc brakes. It is able to offer all common actuation principles and is equipped to produce any size of actuation disc from 4.7 to 16in using fully automated machinery.

For more than 24 years, the company has produced oil-cooled wet multi-disc brakes which are virtually maintenance- and wear-free. In 1992 the company designed its first wet multi-disc brakes for agricultural tractors based on the ball-ramp principle and actuated by a push wedge. The first sizes were 8.75in and 6.5in in diameter, and applications in forest and harvesting machines soon followed. Additionally, Knott offered special solutions based on the ring piston principle in cases where specific brake design capabilities were required.

In 2012, Knott took the strategic decision to broaden its capabilities of design and production of wet multi-disc brakes to obtain new

markets. It has therefore invested and enhanced its know-how, adding actuation systems based on the pull wedge and the pull rod principle to its portfolio. Knott has also invested in state-of-the-art fully automated production of actuation discs. This will shortly be complemented by a fully automated assembly and testing facility.

The actuation discs can be combined with external Knott hydraulic, SAHR or pneumatic cylinders or with mechanical or hydro-mechanical actuators. This allows for either service or parking brake or combined functions.

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M+S HYDRAULIC

HYDRAULIK NORD
FLUIDTECHNIK



Hydraulik Nord
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Hydraulic announce
strategic partnership
agreement...

See bulletin board section
for more information

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IN LIGHT OF THE EVER-EXPANDING (IN SEVERAL SENSES OF THE WORD) POPULATION, IS DESIGNING FOR THE 95TH PERCENTILE STILL THE BEST WAY OF ENSURING CABS ARE FITTING THE BILL?

▷ These days, I don't make the trip from my home to the *iVT* office quite as frequently as I used to. However, having recently been summoned to the sparkling edifice that is our publishing house to attend an audience with the editor, I felt somewhat obliged.

He squinted in my direction as I entered. "If it's about my new car I'm having the cream X5 with the red leather seats," he barked. "No, sir," I intoned, "it's me, about the column."

"Ah, yes." Recognition had finally dawned. "The *Insider* chappie?" (We'd been on first-name terms for years.) "The thing is," he continued, "we're looking into this thing on ergonomics for the old and obese."

I must have looked confused. "What are you gawping for? You're obviously the man for this job so step to it! I've a hell of a lot to do before I jump on the next flight to Shanghai," he mumbled, batting a hand in the direction of the door.

And that was, as they say, that. Meeting over. Although I resented his broad implication, it was true that over the last few years I had increased somewhat in girth – and age, obviously – but to assume my automatic compliance was, well frankly a bit 'off', I thought.

"Losing a bit of weight yourself wouldn't hurt either, by the way," he shouted down the corridor after me as I hurried from his presence.

I checked with a pal of mine who works in HR. He looked askance. "You're not serious about this are you?" he asked. "Industrial vehicles are built for young fit people, not old fatties like you." This was all getting a bit much now. Despite his rather jaundiced opinion, however, he told me that as far as the law is concerned, a company cannot refuse a job applicant on the basis of age or, well, let's call it 'stature'.

It seems that on age, there is no real basis for concern as most official bodies stress fitness and competency above age and apart from a suggested medical examination schedule there is no restriction, nor apparently any encumbrance, on the part of the



Illustration: Julie Welby

employer to modify machines to accommodate aging employees.

However, on the subject of body size, the need for OEMs to consider it when designing a workspace for their potential customers could become more of an issue. Ergonomic experts will know that designers work on a statistical factor where a sample of body sizes are averaged, and then defined as a percentile. So, if we are designing for the 95th percentile, then statistically 5% of the sampled body sizes will fall outside of our target design size. Meaning that most of the people are happy, most of the time.

Now, this works with automobile design (which is, after all, where the concept was originally developed) as there seems to be an acceptance of some compromises should a driver's size fall outside of these values. But off-highway vehicles come under the heading of equipment – and are technically a work environment – so the effect of recent legislation can therefore affect end users when it comes to vehicle selection. Sensibly, one expects operators to monitor their own fitness, but of course in today's workplace expectations can be stretched a tad.

For example, obesity is not (yet) considered a disability and, as such, to employ a clinically obese person to operate an off-highway vehicle is fine – such an operator could not expect the machine to be modified to accommodate them. However,

should their obesity increase or lead to other conditions which then prevent them from safely operating the machine, those conditions, along with the morbidity, could then be considered a disability and therefore discriminatory if the employer refused to modify the machine – or replaced the operator with a slimmer model.

And if, for instance, a routine machine replacement meant that the current operator would not fit the new machine (even if 95% of the average population would), this may result in some conflict.

So what does that mean for us? Well, not a lot really. Many operator spaces are dictated by machine design functionality – for example, one could hold a hoedown in the cabin of a combine harvester, but for those vehicles working in tight spaces, such as reach trucks or mining vehicles, the operator space is defined by the nature of the vehicle operation.

And in reality it is unreasonable to expect OEMs to accommodate these anomalies at a manufacturing level, so I guess that the only way it could be done is by a willing and capable dealer. It's also a question of cost and appropriateness.

Must we then consider shorter operators that fall into that 5% percentile figure, or gender-related issues? We'll find out in the fullness of time – meanwhile, it seems I'm going on a diet... *iVT*

Comments: theinsider@ukipme.com

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