

POWERTRAIN

Have you ever pushed a loaded wheelbarrow – and then met an obstacle or encountered rough terrain? Pulling, rather than pushing on that front wheel where the weight is, makes the task easier.

The same applies if you power that wheel, turning that negative force of rolling resistance into a positive one by converting the torque of a **Black Bruin** motor (Hall 01 D127) into traction. No other motor does it as efficiently, or with such a high power-to-weight ratio, especially when combined with a high bearing load capacity and TÜV-approved brake. The Black Bruin wheel motor also features an easy and safe built-in mechanical freewheel option. With no need to supply hydraulic pressure to freewheel, you just bolt on a Black Bruin motor and you're ready to go.

Eliminate the drag of a non-powered wheel by the force generated from a Black Bruin-powered wheel, lifting the wheel over the resistance. With the addition of a Black Bruin-assisted drive to the wheel, the force is transmitted where the weight is – resulting in considerable (up to 20%) improvements in fuel economy.

Many steering axles are equipped with an adjustable track system but are undriven. To achieve an all-wheel drive, one solution is to implement two hydraulic hub motors,

one motor on each wheel. On the other hand, there are centrally driven steering axles, but these are not adjustable in width.

NAF's (01 E215) novel solution involves a centrally driven track-width-adjustable steering axle with just one hydraulic motor. The centrally located driveline provides a weight-optimised design by using a casting construction for the best use of material.

By using just one hydraulic motor, the outlay of the control and regulation system is clearly simplified. In addition, the tractive effort is nearly doubled in comparison to legacy systems using two wheel motors.

In typical driven steering axles, the hydraulic motor is vertically attached via a bevel drive. NAF's laterally installed motor drives the axle via a spur gear, increasing efficiency and saving space. The clutch provides further fuel savings, decoupling all gears and the hydraulic motor during road travel to minimise drag losses.

The adjustable track width has also been integrated into this central drive concept to ensure the highest performance in all harvesting conditions and enable the use of different tyre sizes.



Black Bruin wheel motors turn negatives into positives



The Safim S6T power brake valve stores pressurised oil to actuate hydraulic brakes

BELOW: Centrally driven steering axle with adjustable track width from NAF

NAF has also integrated a central tyre pressure control and regulation system to provide optimised ground contact: low pressure during work for best traction and reduced ground pressure in all conditions on the field; and high pressure for efficient high-speed road travel. Benefits include simplified outlay, almost doubled tractive effort, increased efficiency and the best possible all-terrain driveability.

The **Safim S6T** hydraulic brake valve is used to actuate the brakes of tractors and other off-highway vehicles that use two brake pedals. The S6T is a power brake valve that uses the pressurised oil stored in one or more accumulators to actuate hydraulic brakes, providing the required oil volume and modulated pressure at optimised pedal force and stroke for the comfort of the driver.

During road-travel mode with connected pedals, the equalisation of left and right brake pressures is obtained with patented auxiliary spools inserted in the two pressure modulation circuits. This device allows for complete separation of the brake circuits and if the valve is fed by two independent accumulators, it provides the security of an X-split dual-circuit brake system. The valve can alternatively be configured to provide a front/rear brake split if required.

During single-pedal braking, typically used to assist headland steer turning, brake pressure is supplied to just the desired rear

TECHNOLOGY TRENDS IN THE BRIC MARKETS

There is a new agricultural revolution sweeping across the farmland of the developing world. Because the world's (technologically) leading agricultural equipment OEMs are present in each of the BRIC markets, the solutions and technology offered are more dependent on market demand and the purchasing power of end customers than on the actual technological capabilities.

Meanwhile, customer structures and requirements in the BRIC states are as different as the countries themselves. STM Stieler, the author of this report, expects considerable areas of land will be brought into production in Brazil and Russia during the coming years, leading to an increased share of large-scale professional farms and a corresponding demand for high-tech equipment.

In contrast, the Indian agricultural sector seems stuck in its division into small, inefficient businesses. China is in a special situation, with an unfavourably small area of arable land per head and a historically unique urbanisation process at the same time. The central government is modernising the country's agricultural sector by attracting foreign multinationals and by boosting the development of its domestic makers of agricultural equipment.

So over the next few pages, let's take a look at how agricultural machinery technology in the main emerging markets might be influenced during the coming years...

BRAZIL

Brazil is the world's largest exporter of sugar, coffee, soybeans orange juice and poultry, ranking third behind the USA and the EU in overall farm exports. Yet it is still one of the few places in the world where land can be put into production. From 2002 to 2012, it converted 32.5 million acres from pasture to arable, while an additional 49 million acres is expected to be brought into production by 2022.

While the majority of old farms are small, many new ones in Bahia and Mato Grosso are large, with fleets of up to 300 tractors and combines. They will provide a stable demand for large tractors (>185hp), which are able to haul wider planters and other implements so that less manpower is required.

Global players are manufacturing their state-of-the-art combine harvesters in Brazil – these machines are on the same level as products from North America or Europe, though the level of tractors produced within the country is not as advanced. However, world-class equipment is available via imports.

Due to the comparably high impact of weak infrastructure on production costs, Brazilian farmers



Tractors produced in Brazil are not as advanced as many from North America or Europe, but John Deere's 8R models are a popular import

tend to focus more on cost and performance than their counterparts from early-industrialised countries, who are willing to invest more in the latest high-end solutions. For instance, a particularly popular feature among John Deere's imported 8R tractor series is the ability to adjust the horsepower level according to the current job, which helps to reduce fuel consumption.

Nevertheless, advanced systems such as John Deere's AutoTrac (the company's autopilot system) and JDLink (its precision farming tool) are also becoming increasingly popular.

brake. For added security, the S6T can be configured with a device to electrically disable this feature at high speed or in road travel mode, ensuring full braking capability including trailer braking.

The S6T brake valve is suitable for ABS systems that use hold and dump hydraulic solenoid valves (e.g. Safim 202705/2). See more at Hall 01 D212

In the drive systems of agricultural machines, there is a definite trend towards one-part coupling solutions. Monolastic is the coupling series developed by **KTR** that is mainly used in hydrostatic drives and not only compensates for misalignment, but also allows for elastic damping of torsional vibrations.

The success of the series, which was initially available for drive performances up to 120kW, made an extension appear logical. KTR will therefore present the new size Monolastic 75 with a permissible rated torque of 1,500Nm, at Hall 01 G200g. It can be used on diesel engines up to approx 250bkw, enabling compensation of high radial and angular displacements. As a consequence, the power packs of the drive are not loaded as much, which results in a longer service life.

The pre-assembled hub can immediately be provided with the requested spline. This allows for a simple axial plug-in assembly of the hydraulic pump without the need for any further tools and devices.

Monolastic couplings are now available for torques from 40-1,500Nm and flange sizes to Ø395mm. Thanks to the simplified



Couplings from KTR provide a perfectly adjusted one-part coupling system



The WS 360 series from White Drives covers a wide application range in agricultural and other industrial vehicles

design of the coupling, special connections without complex adaptors can be realised at low cost. As a result, a perfectly adjusted, one-part coupling system is now available for the connection of engine and hydraulic pump on higher-power mobile hydrostatic drives, which can be easily assembled by the plug-and-play procedure. The vehicle manufacturer merely has to fix the coupling to the engine flywheel and push the pump shaft into the coupling.

White Drive Products will display the newly released 360 Series within the WS line of LSHT hydraulic motors at Hall 01 A107. Designed for mobile hydraulics, the new WS line excels in multiple hydraulic industries. In the agricultural market, the 360 Series covers a wide application range including combine harvesters, bale wrappers and choppers, wheel and chain drives for trailers, and many more. In the construction sector, the product delivers top-quality performance in continuous-operation applications such as sweepers, spreaders and chippers, as well as other demanding applications such as screeners and crushers.

Boasting similar performance to the other series within the WS product line, the 360 Series is a compact package like the 350 Series, with porting orientation that resembles the 355 Series. The new 360 Series allows for greater design flexibility in existing and future applications, and affords the WS line of hydraulic motors the advantage of being able to interchange with virtually all competitive medium- to heavy-duty models.

Since its founding in 1976, White Drive Products has grown into the largest independent manufacturer of gerotor-style LSHT hydraulic motors. It now offers much more – motors, brakes, pumps, steering units, flow dividers, and other hydraulic accessories – with representation in 48 countries through more than 300 channel partners selected for their complete service capabilities and hydraulic systems expertise.

Displayed on the **Dana** booth at Hall 01 F207, CTIS – the Spicer Central Tire Inflation System – can adjust tyre pressure to suit the prevailing conditions when travelling either on- or off-highway for greater mobility on any given terrain. Push-button operation with various setting options allows users to adjust tyre pressures to the optimum level based on load, terrain and application. The technology also makes it possible to free a stuck vehicle or take on grades and other extreme conditions that previously required assistance because CTIS enables greater functionality at extremely low tyre pressures.

When transitioning to on-highway travel, the system inflates tyres to 1.6-1.8 bar and 10-13% tread deflection, minimising tyre contact with the road surface for greater fuel efficiency up to 3.3% and reduced wear. For off-highway work, it deflates tyres to 0.6-0.8 bar and a 20-22% tread deflection, to increase contact with the ground and reduce soil compaction. When the vehicle returns to the road, the tyre inflates to on-road operating conditions, which increases overall tyre life by up to 10%.

BRIC REPORT: RUSSIA

The agricultural sector in Russia is slowly but surely recovering from the struggles of the transformation from a command economy to a market-oriented system in the early 1990s, after which the sector declined for over a decade.

Despite the favourable environmental conditions for agriculture in large parts of the country, the domestic agricultural machinery industry is relatively weak. Sales from foreign agricultural OEMs have been growing faster than those of the Russian machinery makers in recent years. It is calculated that imported products have a market share of over 90% in tractors and 60% in combine harvesters.

Energy-efficiency and productivity are becoming more important though, as the number of high-tech farms rises. Internationally active agricultural OEMs, such as John Deere, AGCO and Claas, are selling their latest big tractors and combines with GPS tracking in Russia. Most of their existing broad-acre

applications – for North America in particular – can also be applied to Russia.

Depending on the region, equipment from the high-end segment can form up to 25% of total sales. To reduce costs, foreign manufacturers are expanding the range of products assembled in Russia and increasing the degree of local content. Claas, for instance, declared an ambitious mid-term goal of 50% for its factory in Krasnodar earlier this year.

In 2009, to close the technological gap between domestic tractor OEMs and their international competitors, Minsk Tractor Works, in collaboration with Ruselprom ElectricDrive, developed its own electromechanical drivetrain for large tractors and special-purpose software for diagnosing, servicing and data analysis. Recent efforts at Kharkov Tractor Plant, Belarus Tractor Works and Kirov Plant (in collaboration with the Russian Ministry of Industry) to bring this technology towards production maturity have not yet been completed.



LEFT: Deere's W-series combines produced in Russia use more locally sourced content



RIGHT: The Belarus 3023 with electromechanical transmission won an Innovation Award at Agritechnica 2009



In the event of an air leak or other potential problems, integrated diagnostics alert the driver and automatically switch the system to emergency mode. This starts a continuous flow of air to the affected tyre to maintain a 30% tread deflection until the operator can move the vehicle to safety.

The complete system includes the front axle and final reductions that are designed with special seals, ECU plus software, a pneumatic control unit, wheel valves and quick-release valves.

In most electric and hybrid vehicles, the performance and lifetime of the batteries is very sensitive to the temperature within the battery cell. Integrated into a high- or low-temperature coolant circuit for heating up of the battery cells, the latest **Haugg** high-quality battery cooler controls the battery cell to the ideal temperature. Alternatively it can be integrated into a chiller circuit to cool the battery below ambient temperature. The ideal working temperature for batteries is that way guaranteed.

The system includes a plate heat exchanger, on which the battery cells are placed. It can be adapted to all types of batteries. The patented design provides temperature gradients below 3K. The system ensures optimal charge, longer use of stored energy and extended battery life.



Haugg's battery cooler guarantees an ideal working temperature

Installation cost is generally much lower than the savings achieved. Also important are environmental issues for green vehicles. Lengthening of the battery lifetime with a Haugg battery cooler means a reduction in the number of worn-out batteries to be processed. Find out more at Hall 01 E123.

There is currently much heated discussion over whether ABS should be introduced for vehicles with a maximum speed of over 40km/h. Such EU regulations cause many of us to put our thinking caps on – though not for **Knott**, perhaps, whose brakes can generally be combined with ABS.

"In the past we have generally come off well when having to deal with the subject of ABS. Of course this has been with large plant, where the law calls for it," Richard Hamberger, head application manager, says.

But what about the annular piston system, which is used for most agricultural towing vehicles at these speeds? "These are not part of our product range, and it would not make much sense," adds Hamberger. "This system can't, in a pure sense, be as technically efficient when used in conjunction with ABS."

With Knott, OEMs profit from in-house systems that function according to the ball-and-ramp principle with external actuation. "This enables us to rely on a self-energising effect. And the entire system can be used hydraulically or adapted to compressed air for ABS," he adds.

On incorporating the system into a tractor he says: "Our 10in solid wet disc brake is going to be the practical alternative when ABS comes along. You won't find any thinking caps at Knott. What you will find are practical solutions!" Find out more at Hall 01 H220.



Knott's ball-ramp principle is ready for changes to ABS regulations



CBM's lateral stabilisers allow for infinite adjustment

New hydraulic automatic lateral stabilisers from **CBM Group** (Hall 03 B17) serve the function of limiting and/or blocking the lateral oscillation of the lower links while manoeuvring, or during transport on roads and on sloping grounds. Moreover, during transport, the stabilisers have the task of centring 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, which requires a change from the 'blocked' to the 'floating' position and vice versa. With hydraulic automatic lateral stabilisers, 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.

This system allows for infinite adjustments and can be activated at any height from the ground. During transport operations, the hydraulic stabilisers keep the implement in a central and stable position. Compared with other mechanical versions (manual or automatic), the hydraulic stabiliser allows for a gradual passage from the floating to the blocked condition, thereby avoiding the risk of accidental shocks and violent lateral oscillations that can result in damage to the three-point linkage or implement.

The benefits of this solution are even more pronounced during work on rugged or sloping terrain, when the stability of the tractor and implement are more precarious.



Even John Deere avoids complexity in its Indian-produced models

BRIC REPORT: INDIA

The professionalisation of the subcontinent's agriculture is in line with the disappointing development of the country in general over the past 20 years. Its agriculture is still dominated by a large number of small (below 2ha), unproductive farms that can neither afford nor would be able to realise the benefits of more advanced agricultural equipment and know-how.

Trapped by political overregulation, a caste system conserving a backward socio-economic order and no foreign investment allowed in this sector, the outlook for the modernisation of India's agriculture is generally gloomy.

The supply of machines in the Indian market is correspondingly dull, with over 78% of the country's tractor production

concentrating on the segment below 37kW. The most recent innovation by Mahindra, the domestic market leader, was a modest 39hp tractor with a new turbo loader and an improved hydraulic system. Why bother investing in groundbreaking innovation if there is no chance that the market will be adopting it anytime soon?

Accordingly, domestically manufacturing global OEMs such as John Deere are producing primarily small tractors (below 75kW) with a simpler cabin (or none at all) and less-sophisticated electronics compared with their western products. These machines are not only being sold in the Indian market, but also increasingly exported overseas.



Domestic manufacturers tend to confine themselves to low-power machines



FLUID POWER

The **HydraForce** booth – located at Hall 01, Stand D115 – will showcase several custom, innovative and efficient electrohydraulic control solutions for transmissions, steering, braking, hitch and ride controls, suspensions, powertrains, ploughing, harvesting, and load-handling and tow-behind functions for the agricultural equipment market.

New at the show is the HSPEC family of multifunction valves. The HSPEC is three valves in one: an electroproportional flow control valve, a post-compensator, and a load-sense valve in a single cavity. Available in three sizes with flow ranges from 34 to 132 l/min, and rated for high-pressure operation (350 bar continuous/410 bar intermittent), HSPEC valves enable more responsive, compact and efficient lifting, lowering and motion control, with their post-compensated flow-sharing capabilities. Their ability to enable ideal motion control via flow control meter-in/pressure control meter-out in a tunable package, is claimed to be a unique feature in the industry that can offer notable energy savings.

HydraForce will also feature the Integr8 engineered hydraulic control solutions for cylinders and motors. i-Design now features over 40 options of optimally paired Integr8 schematics that can easily be dragged and dropped onto a hydraulic schematic to simplify custom manifold circuit design.



Application engineers will be on hand to help visitors design a system using i-Design and, if desired, export their circuit into Automation Studio to simulate and optimise their design.

The company's latest HyPerformance and corrosion-resistant valves, for use on crop sprayers and other outdoor farm equipment, will also be displayed.

HUSCO International will be showcasing a comprehensive range of remote valves and transmission-mounted, three-point hitch valve platforms designed for tractors from 20-600hp. Each platform has industry-leading features specifically targeted by horsepower range and geographical markets, as a result of the company's global engineering presence, which has enabled it to fully understand and support the requirements of OEMs in a variety of markets and on a local basis.

HSPEC multifunction valves from HydraForce combine three valves in one

Also on display will be a fully functional machine control system demonstrator incorporating industry-leading, advanced three-point hitch control and remote valve management. HUSCO's remote/hitch valve and electronics package enables an OEM to incorporate advanced features without requiring expensive and time-consuming development.

The flexible interface of the LCD-based controller means that the system is easily customisable with OEM branding and has the ability to display tractor subsystem information such as transmission and suspension diagnostics. These products complement the company's innovative range of cab and axle suspension systems, which have been developed for agricultural vehicles using patented regenerative and active technologies.

Located at 01 C204, HUSCO will have hydraulics engineering staff experienced in agricultural vehicles on hand to discuss how its components and systems can cost-



HUSCO's remote/hitch valve and electronics package makes incorporating advanced features easy

BRIC REPORT: CHINA

China is facing the tricky situation of an unfavourably small area of arable land per capita and a historically unique urbanisation process. The migration of hundreds of millions of rural workers towards China's evolving megacities is reducing the agricultural workforce while the growing urban middle classes are developing more demanding diets. To keep food prices at an acceptable level, the Chinese government is being forced to increase agricultural efficiency.

In the past, the demand for machinery in China has been primarily determined by the enormous number of small-scale operations with limited access to capital and know-how. Yet even though a system of purchase subsidies was introduced 10 years ago, promoting the acquisition of a new tractor with up to 80% off the purchase cost, the most popular products were cheap and simple tractors made by local manufacturers.

However, with a growing number of large-scale modernisation projects, in particular in the northern provinces (Heilongjiang, Inner Mongolia, Xinjiang),

this situation is changing. Earlier this year, for example, the State Council initiated a pilot project in Heilongjiang, which is supposed to set the starting point for a comprehensive reform of the country's agricultural industry. Major goals are to put additional land into production as well as increase productivity. In particular, the large-scale cultivation of grain and other crops is supposed to be promoted by fostering farmers to join forces and establish co-operatives.

For the first time, farmers moving to cities will be able to transfer their land-use rights to active farmers (the private acquisition of arable land in communal ownership will stay restricted, though). Furthermore, farmers will also receive easier access to financial support and technological innovations, while soil improvement measurements will be promoted more strongly.

This will certainly increase demand for high-tech equipment of Western standards. Foreign companies such as AGCO, CNH and John Deere are already producing high-horsepower tractors and combines in the north of China –

a consequence of the fact that, bar a few exceptions, only equipment produced in China is eligible for purchase subsidies.

The machines produced in China are adapted to the domestic technology platform: components such as axles, drivelines, steering units and electrics are partly being purchased from local suppliers. The localised equipment usually has a reduced set of functions and a lower price – John Deere's motto in China is translated as "Keep up with the China beat."

Additionally, the stream of foreign makers of agricultural equipment into China continues. In July, Claas announced it was to take over Chinese combine maker Jinyee to benefit from domestic market opportunities.



effectively improve the performance and efficiency of applications.

When dealing with hydraulic fluids, increasingly more focus is being placed on ecological awareness. Oil spills should be a thing of the past – but their prevention shouldn't cost you a fortune. In Hall 01 D132, **Parker Hannifin** will therefore present a cost-effective alternative to its well-known TIA-series: the compact, single-handed RSD series couplers.

Geared towards agricultural use, its ISO 7241-1-A profile enables it to be used in many applications where a third hand just isn't available. Compatible with standard couplings and plugs, it is very easy to use, and perfect as a replacement or to retrofit existing applications. Its integrated pull-off function disconnects the system automatically when pulled too hard. A mechanical lock prevents the valve from closing in case of a backflow of oil (>190 l/min). This coupler can take a punch and still keeps the environment clean.

This can be combined with a new Euro 6-compliant heated hose designed for SCR systems to keep your diesel exhaust clean at all temperatures. The Parflex heated SCR hose is designed for heating and transferring DEF throughout SCR systems. Available as suction/throttle and pressure lines, these



Go green with Parker's RSD series couplers: a cost-effective alternative

hoses combine consistent thaw with low power usage. Parflex heated SCR hoses feature an over-moulded fitting, which provides excellent protection from the ingress of water, salt and dirt, as well as high impact resistance and all-around robustness. Customised layouts to suit individual requirements, such as length, hose size, W/m, or connectors are available.

In agricultural applications, it has become necessary to develop innovative solutions for several problems that may commonly occur in a variety of situations.

As a consequence, the solutions adopted for developing and manufacturing the new **Faster** FHV series quick-release coupling



Faster's FHV quick-release couplings guarantee no spillages or air inclusion

must meet the highest standards, as quick-release couplings represent the interface between the machine (power source) and the hydraulic attachment. Homologation tests have confirmed the best performance of FHV screw-on couplers:

- User-friendly, with Rd thread and safety sleeve;
- Female adaptor free in rotation;
- Excellent corrosion resistance;
- Polyurethane sealing technology;
- Maximum working pressure up to 46MPa, and minimum pressure drop;
- High burst resistance.

Faster's FHV screw-on couplings are characterised by the perfect flatness of the shut-off valves adopting the flat-face valve technology. This product concept guarantees no spillage or air inclusion during line disconnection due to the flat-face valves. Cleaning is simpler, due to the flatness of the mating surfaces, while the female valve is blocked within the coupling by using a pair of patented sintered steel semi-guides, which grants a greater flow cross-section.

To be seen in Hall 01 B106, FHV screw-on couplings are available with a wide range of threaded adaptors such as BSP, metric, NPT, SAE, flange and flange head. They can also be equipped with dust protection caps (on request) in two different choices: aluminium screw-on caps, and PVC rubber plug.

BRIC REPORT: CHINA (CONTINUED)

So does this mean that Chinese tractor manufacturers might soon lose their leading position in their own market due to changing requirements? The central government, as well as the leading Chinese agricultural machinery makers, YTO and Foton Lovol, have ambitious development goals for the 12th Five Year Plan (2011-2016) to close the technological gap.

Satellite-based auto pilot systems and precision farming software: Together with South China Agricultural University, YTO applied an RTK-DGPS system to an X-804 tractor in 2010. Foton Lovol then revealed a prototype of its M904-D tractor equipped with a GPS navigation and automation system for automatic precision seeding and fertilising in September 2012. However, due to a lack of market demand, neither has made it towards serial production, according to both companies.

Powershift transmissions (PST): In 2011, YTO took over ARGO McCormick's transmission factory in France. Those powershift transmissions will be deployed in three new tractor lines in the second half of 2013: the LA series (200-300hp), LF series (90-200hp) and the LZ series featuring electrohydraulic control technology. Whereas the LA and LZ series will first be introduced in

the northern provinces, the smaller LF series will be available all over the country.

Continuously variable transmissions (CVT): Based on its experience gained from the development of the PST, YTO is currently working on a CVT, which is intended for introduction in a 400hp tractor by 2015. Foton Lovol also named the development of an inhouse CVT among its major goals for the 12th Five Year Plan period, although it did not elaborate further.

Higher horsepower: YTO declared it would put particular emphasis on the development of tractors between 200-300hp with government support. Foton Lovol now covers the range up to 320hp and will benefit from the increased purchase subsidies for tractors over 150hp.

Electrical tractors: In May 2012, YTO signed a co-operation agreement with General Electric for the development of electrical tractors for garden and light agricultural operations.

Chinese makers of agricultural machinery have the clear directive to seize the tractor segment for small-scale and semi-professional applications in South-East Asia, Africa and the BRIC regions. By 2015, YTO wants to sell the first Chinese tractors in Europe. But given the country's backwardness in regard to aspects

THE ABILITY OF CHINESE COMPANIES TO SUCCESSFULLY CONQUER THE MID-MARKET SEGMENTS SHOULD BY NO MEANS BE UNDERESTIMATED!

such as engine vibration, noise, emissions, experience with powershift transmissions, electronic control and load-sensing hydraulic systems, this sounds like an ambitious goal.

However, experience from other industries show that the ability of Chinese companies to successfully conquer the mid-market segments should by no means be underestimated! **iVT**



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