



The Top Challenges, Trends and Opportunities for Combine OEMs



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Introduction

Spurred by growing populations and desires for increased efficiencies in crop yields, the agriculture industry is primed for considerable growth. Research from the European Commission has shown that the estimated value of agricultural output in 2022 rose sharply in nominal terms (+19.2 %). This represented a new peak and continued the upward trend that had started in 2010.¹

With combine harvesters often seen as the backbone of the agricultural industry, it's no surprise that these important pieces of equipment are also primed for significant growth. For farmers to get the most out of their crop harvests, these machines must be designed efficiently with increasingly advanced technologies. Per a recent study by CEMA (European Agricultural Machinery Industry Association), global agricultural equipment exports increased by 23% from 60 to almost 74 billion euros between 2020 and 2021, and when aggregated, the European Union leads global Agricultural Equipment Exports by far. Harvesting equipment makes up 11% of European agricultural machinery production at a value of €3.47billion².

This white paper will detail the challenges and trends that are currently impacting combine designs, as well as opportunities both current and on the horizon that farmers and OEMs alike can capitalise on to improve the performance of their combines.



Challenges

As combine technologies evolve, challenges both old and new threaten to limit growth in this space. Properly addressing each of the major challenges presented below will be key to ensuring that the current growth in the market continues.

Performance and system wear

Overall performance and equipment life continues to be highly sought after by farmers who are looking to use their combines to harvest more in less time. When it comes to harvesting, time is money and combine owners want to avoid costly downtime. The loss of a single day of combine use can cost thousands of euros. In addition to avoiding downtime, farmers want their combines to run at peak performance for the most efficient and effective harvesting.

With all the hose and tube connections on heavy-duty pieces of equipment, abrasion is always an issue. Abrasion refers to the wear and tear on hoses when they rub against each other or other system component and can shorten the life of various combine systems as well as cause leaks. Leakage can lower fuel efficiencies, cause mechanical issues and increase crop contamination as caustic internal fluids leak out into the soil.

System wear is also a significant problem for combines as their cutter bars and threshers reap and separate crops. These mechanical processes lead to increased levels of system wear more than other equipment such as sprayers or seeders would encounter, especially when working with more difficult crops.

Labour shortages

Ever since the great recession that occurred around a decade ago, labour shortages have been impacting the agricultural industry. Even though the market made a relatively quick recovery, the workforce is still displaced to this very day. With fully autonomous combines not yet a reality, farmers can only harvest their crops if they have someone to operate these machines, making this challenge a significant pain point. This is also putting pressure on OEMs and combine designers to move more toward automation.



Operator comfort

When working with such a large and powerful piece of equipment like a harvester, operator comfort can quickly become an issue as the machine aggressively moves through the fields. Due in part to heavy dynamic loads and unlevel surfaces, there is a strong vibration throughout a combine during operation, especially in the front header. Not only does this cause discomfort for the user, but it also reduces the lifetime of the harvester's frame and affects the working precision of the machine.³ With labour shortages already an issue, it can be an uphill battle convincing a worker to operate one of these heavy-duty machines.

Beyond the bumpy ride itself, operators are also struggling with the tools and amenities available to them inside the cabin. The typical steering column and steering wheel do not offer good ergonomics for long days out in the field. They can also obstruct the view directly in front of the combine, making an operator's job even harder. This is compounded with standard displays that are often hard to read. Even with combines that have made the switch to LED screens, glare caused by the sun can obscure read-outs. That, and having to have a separate LED screen for each Human-Machine Interface (HMI) function can take up valuable cabin space and rack up costs for OEMs.

Ground compaction

When talking about combines, their effect on ground compaction cannot be overlooked. Ground compaction is one of the biggest challenges in the agricultural industry⁴, affecting how seeds are planted and crop health. By compressing the soil and reducing pore space, ground compaction limits a crop's water supply, impairing crop emergence, root penetration and crop nutrient uptake.

Since this only intensifies the bigger and heavier a piece of equipment is, combines being the behemoths that they are make them one of the worst offenders of the ground compaction problem. The more they harvest, the more they weigh and the worse this problem becomes. It can also create uneven compaction across a field since the weight of the harvesting system is changing. Even though a crop has already grown by the time a combine comes around to harvest it, the combine's compaction will impact future years' crop yields. Simply put, if crops are not growing right, then combines will have nothing to harvest.



Trends

Taking advantage of the evolving technologies and strategies in the agricultural industry, several trends are emerging in the combine space.

Lighter equipment

It's no secret that harvesters tip the scales compared to other pieces of farming equipment. Not only does their heavier nature make them worse for ground compaction, but it also means that they have comparably poor fuel economies. That's why combine designers are trying to reduce the size and weight of combines as much as possible. This is only possible by using smaller components and lighter materials.

The trick here is to be able to reduce the size of a combine without making it more susceptible to bumps and unlevel surfaces. Operator comfort is already an issue, so these efforts simply can't make those matters worse.

Changing tracks

Considering a piece of equipment can only be downsized so much before hurting its performance, there are other efforts to lessen how much combines compact the soil below them. This comes back to the physical point of contact between the combine and the soil – the tyres on the wheels.

There are two main modes of thought here: to replace the wheels with tracks or to employ a central tire inflation system (CTIS). Tracks help to displace the weight of the combine in order to reduce soil compaction. However, this can make the combine slower in certain operations. This can help with operator comfort, but slower operations mean lower efficiencies. CTIS is an automatic tire pressure adjustment system that can optimise tire inflation depending on what terrain the harvester is on.



Increasing operator comfort

OEMs and combine designers are increasingly realising that more care needs to be put into making combine operations as comfortable as possible for the end user. There's a three-pronged strategy here:

- Making the ride smoother
- Dealing with heat
- Having better amenities within the cabin

Having a smoother ride can somewhat be accomplished with the previously mentioned tracks and tyre changes, but better seat cushions, headrests and ergonomically designed controls can also help to increase operator comfort.

Parker's 285 hose was designed specifically to keep operator cabs cool and comfortable in their rugged environment. This hose leads in the industry in product service life, resisting moisture ingress and minimising refrigerant permeation with its nylon barrier.

As far as amenities go, having entertainment options like music or video capabilities can go a long way.

Opportunities

Seeing the challenges and trends ahead for the combine industry, OEMs and combine designers are working on new opportunities for farmers to better utilize their harvesters.

Hose assemblies

The mechanisation of agriculture has been a key growth driver in the hose and fitting market. Farmers rely on increasingly efficient equipment that equate to lower cost per crop tonne or lower cost per hour of operation.

Though OEMs have different growth strategies, the challenges are similar: growing competition, evolving customer demands, and shifting hose and fitting geographic markets. Specific applications require specific hoses.

Globally available product or high impulse life are two examples. Bend radius is particularly important in tight spaces. Hose weight is critical due its impact on trans- portation costs, fuel economy and ease of installation. Parker's Global Core high-performance cohesive hose and fitting system meets these needs. It was designed, built, and tested to the ISO 18752 specification. It simplifies specification for OEMs and end-users by providing a complete family of products for the most commonly used constant working pressure classes.

In cases, where a made-to-order preformed hose is too costly, an E-Z Form hose for coolant, water and oil suction/ return lines should be considered. Designed to handle extreme bends while allowing full-flow, kink-free performance, it effectively

replaces pre-formed hoses- eliminating special design, tooling, and fabrication costs.



Conversely, formed hose products can save, space, time and eliminate misalignment issues. As little as 1/8" (approximately 3mm) of misalignment to the connection can create enough issues to potentially shut down equipment. Formed hoses also eliminate the need for additional fittings/adapters, significantly reducing equipment weight. Parker's thermoplastic wire and fibre-reinforced hoses can be formed, such as the TOUGHJACKET product range, for applications requiring up to 6000 psi and an O.D. of -2 to -16. With combines averaging about 12 hours a day in the field, the thermo- plastic hydraulic fibre-reinforced pressure lines can dampen noise/ vibration out of systems decreasing control feed back to the operator which reduces operator fatigue.

For combines, Parker's hydraulic and formed hoses offer innovative design, high performance, easy installation and extended hose life to enable farmers to meet the increased demand.



Efficient and reliable hydraulics

Increasing the engine power management for a key piece of agricultural equipment like a combine via electronic control, farmers can realise greater machine efficiency and productivity by reducing energy losses and redirecting energy where needed.

Parker offers a wide range of hydraulic pumps and motors to provide fluid flow in an efficient and reliable way. An optimized power to weight ratio and reduced energy losses improves farmers machine efficiency and contribute to a lower overall weight. With Gear Pumps & Motors, Torqmotors, Vane Pumps & Motors, Bent-Axis Pumps & Motors as well as Axial Piston Pumps Parker offers components for any solution and price level in high quality, short lead times and great support.

Parker Torqmotors are ideally suited for tough jobs under tough conditions, offering high starting torque and trouble-free service. Used in Harvesters to extract, transport and clean the crops from any ground, Torqmotors are the perfect choice for low speed rotation without the need of a drain line.

Hydraulic motors found on the combine's propel circuit, can also boost reliability and equipment uptime. For example, Parker's Variable Bent-Axis Motors - Series V14, offer a rugged design and a wide range of controls. This premium motor meets a wide variety of application needs and minimizes life cycle costs.

For open loop implement, fan, and auxiliary functions, Parker's P1M Mobile Open Circuit Medium Pressure Axial Piston Pump with electronic control in combination with Fixed Bent-Axis Motors Series F10, F11 and F12, offers the most effective method to maximize engine power management by enabling the pump to provide the exact amount of engine horsepower available to the actuator.



For a optimal live cycle Parker supports the cooling system with its Vane & Gear Motors to drive the cooling fan. With its application flexibility, large range of integrated valves, high efficiency and robustness the hydraulic motors are solution for any size of cooling system.

Key hydraulic components such as, the Compact Electro-Hydraulic Actuator used on the combine's header, are engineered for high-power density applications and utilise a fully self-contained DC motor-driven actuator that provides both power and control, operating only as needed. As a result, energy can be reserved for other critical functions.



Central Tire Inflation Systems (CTIS)

Reducing tire pressure results in a bigger tire footprint, which means less ground compaction. Central tire inflation systems also help to increase traction, increase fuel economy and extend tire life. Parker's Central Tire Inflation System (CTIS) offers improved mobility for heavy off-road equipment and is ideally suited for use on a range of agricultural equipment including combines. Each wheel end is equipped with a CTIS wheel valve connecting the tire to the CTIS control system whenever it is actively measuring or changing tire pressure. Otherwise, the wheel valve is closed, isolating the tire from the system, thus ensuring that the tire will not leak. This eliminates the need for manually operated shut off valves when the vehicle is inactive for extended periods of time. Parker's CTIS pneumatic control unit consists of electro-pneumatic valves and pressure sensors required to monitor and control the pneumatic system.



This bigger footprint improves traction and allows the vehicle to float across the soft terrain instead of compacting the soil and causing rutting. Its unique wheel valve design provides the best in class deflate performance while incorporating the non-piloted remote venting control strategy preferred by most vehicle manufacturers. The Parker CTIS can deflate tire pressures significantly lower than other systems while operating reliably over a wide range of temperatures and altitudes.⁵

Enhanced controls and interfaces

In the context of automated agriculture, HMIs play a pivotal role in enhancing efficiency and productivity. They facilitate intuitive control of agricultural machinery, encompassing essential input operations like start/stop and adjustments, and displaying real-time data empowering farmers to make informed decisions.



The IQAN-MD5 is a family of master display units, fully compliant with the IQANdesign platform system. These units serve as programmable master controllers allowing users to tailor HMI systems to diverse machine applications, offering comprehensive graphical, diagnostic, and CAN

gateway functionalities. Their user-friendly interface, paired with IQAN programming tools, simplifies HMI design through predefined building blocks and guided development with templates and libraries. This user-friendly drag-and-drop interface enables rapid and efficient HMI creation.

These master displays support IP cameras, eliminating the need for separate monitors and allowing multiple cameras to be connected via an IP switch. Installation is hassle-free, with options for flush mounting using steel clips or a standalone mount compatible with RAM™ mount components, in both landscape and portrait orientations.

Crucially, these HMI products and solutions are engineered for reliability, ensuring a long service life despite intensive and regular use. The IQAN-MD5 units feature a rugged mechanical design with no moving parts and are completely sealed, incorporating optically bonded display glass to enhance readability, prevent light refraction, and eliminate condensation risks.

Improved, user-friendly controls

Because the standard steering wheel and steering column can cause operator discomfort and impair a user's sight in front of the combine, companies are working on ways to change how combines are operated. One way to navigate around the issue is by using Parker's joystick steering solutions for harvester combines. By allowing users to steer their combines by using joysticks instead of a steering wheel, operator comfort is enhanced. The area directly in front of the combine also remains unobstructed so that users can have an enhanced field of vision.

Making the switch to steer-by-wire systems can also help by removing the need for a heavy, complex steering column. Parker's new SBW110⁶ proportional, load sensing, pre-compensated mobile valve was made for heavy-duty mobile machinery like the combine harvester. With only a pump oil supply, tank connection and an electric signal, the flow from the SBW110 valve work ports can control the combine's steering. It also offers easier installation for OEMs and reduced noise levels for drivers, making the cab safer and more ergonomic.



Easier and seamless maintenance

To increase equipment ROI, maintenance and process costs need to be minimized. The Hydraulic Push-Pull Quick Coupling Series RSD⁷ is especially designed to protect hydraulic hoses from destruction and to prevent leakages by automatically disconnect in case of accidental traction on the hose. To save oil and other liquids as well as protecting the environment, the ISO 7241-1 Series A profile quick couplings, allow for connections under full system pressure.



Maintaining connection with deployed farm equipment and ensuring the ability to get replacement parts when and where they're needed in another opportunity for OEMs. The Parker Tracking System (PTS) is a comprehensive asset management solution featuring component-tagging technology to help users stay better connected to equipment and machinery. The easy-to-use platform enables fast and accurate recording, management and retrieval of product information. Through a global network of service partners and OEMs across more than 50 countries, PTS ensures that users get the replacement parts required to drive productivity, efficiency and reliability.⁸

Beyond the oil change, combine maintenance is critical to improving performance and productivity.

Moving toward autonomy

Since combine operators face higher levels of discomfort than the users of other farming equipment, the need for autonomy is even greater in the combine space. Fortunately, the agricultural industry is one of the most advanced industries in the world when it comes to developing and deploying automation technologies. With advanced sensors and IoT-enabled technology, combines are already on the path to full autonomy with the roll-out testing of autonomous driving system for combine harvesters, tractors and sprayers.

This is great news for both OEMs and farmers, as automation will not only reduce the amount of labour needed for combine operations, but it will also make processes faster and more efficient. That means higher crop yields and less required capital. However, looking at the five distinct stages of autonomy for agricultural equipment defined by Case IH⁹, the promise of a fully autonomous fleet of combines is likely years away. That's why OEMs need to take advantage of the trends and opportunities of today to drive growth in the combine market.

Conclusion

Combine OEMs face a great deal of challenges that they must overcome in order to continue to improve harvester designs. By taking advantage of the emerging trends and evolving technologies presented in this white paper and partnering with experienced manufacturers for parts, services and customised solutions, OEMs can help the combine sector grow and reap what the rest of the agricultural industry sows.

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