



# 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 USDA has shown that between 1948 and 2015, the United States' total agricultural output nearly tripled<sup>1</sup>.

With combine harvesters often seen as the backbone of the agriculture 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 market intelligence study, the global combine harvester market is set to surpass a valuation of \$18 billion by the end of 2026<sup>2</sup>.

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 capitalize 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 dollars. 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.

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## Labor Shortages

Ever since the great recession that occurred around a decade ago<sup>3</sup>, labor shortages have been impacting the agriculture 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<sup>4</sup>. With labor shortages already an issue, it can be an uphill battle convincing a worker to operate one of these beasts of a machine.

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 don't 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 HMI (Human-Machine Interface) function can take up valuable cabin space and rake up costs for OEMs.

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## Ground Compaction

When talking about combines, their effect on ground compaction cannot be overlooked. Ground compaction is one of the biggest challenges in the agriculture industry<sup>5</sup>, 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 aren't growing right, then combines will have nothing to harvest.



# Trends

Taking advantage of the evolving technologies and strategies in the agriculture 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 comparable horrible 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 tires 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. 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 optimize tire inflation depending on what terrain the harvester is on.



## Increasing Operator Comfort

OEMs and combine designers are increasingly realizing 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 tire changes, but better seat cushions, headrests and ergonomically designed controls can also help to increase operator comfort.

Parker's 285<sup>®</sup> 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 minimizing 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 mechanization 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 ton 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 transportation costs, fuel economy and ease of installation. Parker's GlobalCore 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 made to order preformed hose is too costly, 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" 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 fiber-reinforced hoses can be formed, such as our TOUGHJACKET products, 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 thermoplastic hydraulic fiber 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.

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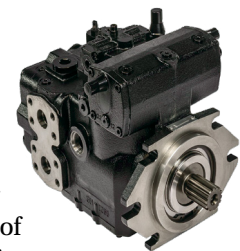
## Increased Power Management

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

Key hydraulic components such as, the Compact Electro-Hydraulic Actuator used on the combine's header, are engineered for high-power density applications and utilize 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.

Hydraulic motors and pumps found on the combine's propel circuit, can also boost reliability and equipment uptime. For example, Parker's Variable Displacement

Axial Piston Pump for Closed Circuit Applications - C Series working with the Axial Piston Variable Motors - Series V14, offer a rugged design and a wide range of controls. This premium combination 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 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.

# Central Tire Inflation Systems

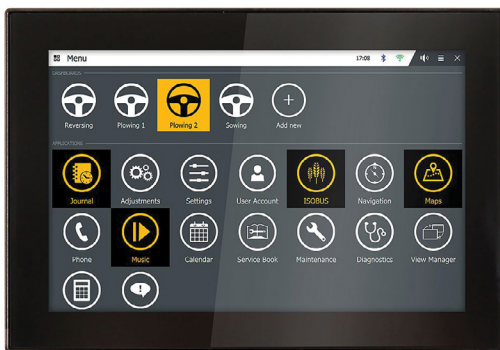
Reducing tire pressure results in a bigger tire footprint, which means less ground compaction. Central tire inflation systems also help to increase traction, increase fuel economy and extend tire life. Parker's Central Tire Inflation System (CTIS) offers improved mobility for heavy off-road equipment and is ideally suited for use on a range of agriculture 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.<sup>7</sup>

# Enhanced Software Functionality

Whether it's a 10,000-acre rice field or a 5,000-acre wheat farm, farmers rely on electronic equipment to know their position in the field and reduce operational costs and maximize profits. This is achieved by using GPS network to ascertain position, identify where to plant different seeds and efficiently harvest yields. Combine operators need a single, optimized screen that can handle all of the information that they need in one easy-to-use interface.



The Parker Pro Display 12<sup>8</sup> solves the issue of multiple, disjointed panels with a single screen that can display several HMI functions in one centralized unit. Since the Pro Display 12 uses an app-based platform, operators can view combine functionality data, diagnostics, efficiency tools and even entertainment options all on this one device. This saves on both cabin space and costs, making it a win-win for both farmers and OEMs.

With multi-touch capabilities, optimum camera connectivity and a bright screen that offers superior visibility, even in direct sunlight, the Pro Display 12 enhances operator safety and comfort. The central HMI unit is also available with Parker's ISOBUS Suite software, which contains two apps: ISOBUS Universal Terminal (UT) and Task Controller (TC). These apps allow OEMs and system developers to design a tailored, integrated HMI system. In this custom system, ISOBUS functionality can co-exist with whatever information is desired by the user end, including combine instrumentation, camera images and electronic manuals, as examples.

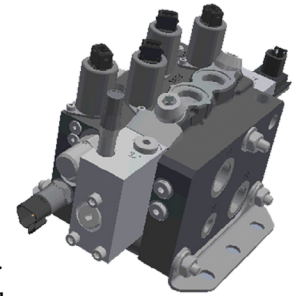


## Improved, User-Friendly Controls

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 SBW110<sup>9</sup> 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.



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## Easier and Seamless Maintenance



To increase equipment ROI, operating costs need to be lowered across standard processes. One such process that is in dire need of an overhaul is the routine oil change, where the maintenance costs behind the procedure easily exceed the price of the oil itself.

Parker's QuickFit Oil Change System<sup>10</sup> offers a novel new way of delivering a faster, cleaner and safer oil change for combine users. In three easy steps, operators can purge, extract and refill a combine's oil supply in as little as 30 minutes without ever spilling a drop. The result is less downtime, reduced consumables, lower labor costs and more productivity – all leading to increased profitability. Parker HLB remote grease hose has a proven track record of saving hundreds of

dollars in operation waste by eliminating gallons of unnecessary 'in-line' grease versus larger bore hoses and results in a 33% quicker installation time.

Beyond the oil change, combine maintenance is critical to improving performance and productivity. Maintaining connection with deployed farm equipment and ensuring the ability to get replacement parts when and where they're needed is another opportunity for OEMs. The Parker Tracking System (PTS) is a comprehensive asset management solution featuring component-tagging technology to help you stay better connected to equipment and machinery. The easy-to-use platform allows you to record, manage and retrieve product information fast and accurately. Through a global network of service partners and OEMs across more than 50 countries, PTS ensures you get the replacement parts you need to drive productivity, efficiency and reliability.<sup>11</sup>

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## 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 agriculture 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. In fact, a Russian company called Cognitive Technologies expects to already have a fully autonomous grain harvester by 2024<sup>12</sup>.

This is great news for both OEMs and farmers, as automation will not only reduce the amount of labor 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 agriculture equipment defined by Case IH<sup>13</sup>, 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 customized solutions, OEMs can help the combine sector grow and reap what the rest of the agriculture industry sows.

## References

1. <https://www.ers.usda.gov/amber-waves/2018/march/agricultural-productivity-growth-in-the-united-states-1948-2015/>
2. <https://finance.yahoo.com/news/combine-harvesters-market-cross-us-141000686.html>
3. <https://www.fb.org/viewpoints/another-year-of-farm-labor-shortages>
4. <https://www.hindawi.com/journals/amse/2019/6834269/>
5. [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex13331/\\$file/510-1.pdf?OpenElement](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex13331/$file/510-1.pdf?OpenElement)
6. <https://www.parker.com/parkerimages/Parker.com/Divisions-2011/Hose%20Products%20Division/Solutions/PDF/AC-Flyer-4480-B198.pdf>
7. <http://blog.parker.com/central-tire-inflation-system-for-off-highway-vehicles>
8. <https://www.parker.com/portal/site/PARKER/menuitem.31c35c58f54e63cb97b11b10237ad1ca/?vgnextoid=1babb17d1ea5e610VgnVCM100000e6651dacRCRD&vgnnextchannel=9383fbdc71fd7310VgnVCM100000200c1dacRCRD&vgnnextfmt=EN&newsroom=Y&vgnnextcat=News%20Release%20Details>
9. <https://www.parker.com/portal/site/PARKER/menuitem.31c35c58f54e63cb97b11b10237ad1ca/?vgnextoid=c05969dafb00a610VgnVCM100000e6651dacRCRD&vgnnextchannel=c38888b5bd16e010VgnVCM1000000308a8c0RCRD&newsroom=Y&vgnnextcat=News%20Release%20Details&vgnnextfmt=EN>
10. <http://blog.parker.com/five-ways-quickfit-oil-change-system-can-increase-your-equipment-roi>
11. [www.parker.com/PTS](http://www.parker.com/PTS)
12. <https://www.agriland.ie/farming-news/fully-driverless-combine-harvester-by-2024/>
13. <https://www.farms.com/news/case-ih-defines-categories-of-autonomy-and-announces-pilot-program-132164.aspx>

