Leading Innovation in Construction Equipment with Advances in Efficiency and Productivity for Smart Skid Steer Loaders

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Contents

Introduction

The international construction market reported overall growth throughout 2019, despite the challenges of cost pressures, labor shortages and fixed-bid projects that will continue to impact construction equipment makers and owners.[1] Improvements to construction equipment can help the market take on these challenges, as well as those presented by regulations and equipment market differences, in innovative ways. Design engineers and OEMs have the opportunity to help equipment owners and end users maximize their efficiency while improving their own processes with key construction equipment such as the skid steer loader.

Skid steer loaders, referred to simply as “skid steers” for the purposes of this paper, are compact and versatile pieces of construction equipment that are used throughout the stages of most construction projects. Due to their differential steering capabilities, skid steers offer extreme maneuverability. Users have the ability to switch out traditional bucket attachments with a variety of other specialized buckets or attachments including augers, cutters, plows, forks, breakers, brooms and more. These two primary attributes allow end users to accomplish a variety of tasks on construction sites and especially in smaller spaces.

Challenges

Regulatory Issues

Regulations related to engine emissions impact operation of some diesel-powered skid steer models. Using a tiered approach to reduce emissions, the EPA limits newly produced diesel engines to near-zero levels for nitrogen oxides and particulate matter emissions. Tier 4 is the current standard impacting diesel engines for skid steers and other construction equipment. To accomplish large reductions in emissions, construction equipment manufacturers are tasked with developing technology that will produce the power and performance their customers need while adhering to the standards.[2] These standards can constrain the engine's capabilities in terms of both cost and available space.

Arguably, regulatory issues have a larger impact on bigger construction equipment, which, coupled with associated costs, drive more and more companies to invest in compact equipment like skid steers instead of larger equipment.[3]

Efficiency and Productivity

Construction managers face pressure from shrinking construction project timelines in the forms of either time-bound penalties or early completion bonuses. Demand continues to be strong for skid steers that can offer greater machine utilization and will help them avoid penalties or earn the early completion bonuses and ultimately move on to the next job more quickly. Construction companies have invested time and resources into fleetwide management in order to understand, as well as optimize, uptime and utilization for all of their equipment. Due to their use throughout the stages of construction projects, skid steers are an easy target for optimization and increasing productivity.

Skid steer designers face a myriad of customer requirements that force them to find the best balance between horsepower and attachment demands.

Shrinking Machine Footprints

For compact construction and material handling equipment, like the skid steer, contractors are trying to get more power and performance out of smaller packages.[4] The compact design of skid steers mean that they are used in the small places where larger equipment cannot fit to complete tasks like excavation, demolition, debris removal, listing and more.[5] More compact, yet powerful, equipment like skid steers are in demand for construction projects in developed areas as well as in renovation applications due to the ability to move them to, from and around jobsites without major traffic disruption, unnecessary demolition or landscape removal to gain access or cumbersome transportation to the site. Increasing the versatility of skid steers will enable construction teams to use them for more and more applications. This increases demand for skid steers that both weigh less and take up less space.

Rental Demand

Their compact size makes skid steers a popular piece of equipment in the growing construction equipment rental market. Driven by worldwide increases in construction for infrastructure development, the equipment rental market is also growing. It is expected is to reach $174.5 billion by 2026.[6] The earthmoving and road building market segment, which includes skid steers and other loaders, accounts for more than half of the revenue in construction equipment rental, driven mostly by the versatility of the equipment and range of attachments.[7] Skid steers are easier to transport to and from jobsites as well as maneuver in densely populated cities, so when a skid steer can accomplish the task, it is more likely to be selected for rental over a larger piece of equipment that could be more difficult to use onsite or may incur delivery fees. In addition to being a popular long-term rental item among professional construction crews, skid steers are also often rented by amateurs for smaller construction or larger DIY projects. Skid steer 1,300- to 1,800-pound models are most popular for short-term rentals due to ease of operation and lower rental rates and see more use by amateur renters. Model with capacities over 2,000 pounds are more likely to be rented by professionals and have additional features that would be desired by construction professionals.

Construction companies purchasing a skid steer for their own fleet are more likely to want features, whereas a rental company may generally prefer robust models that have fewer features but are easy to operate and difficult to break.[8] Since rental skid steers may be run harder and longer than purchased models and are likely to be operated by amateurs at some point, rental companies seek to invest in features that will protect

their investment. These could include severe-duty tires and telematics systems to help track down lost or stolen skid steers. Skid steer features that add cost without adding to rental ROI are less attractive to rental companies, including enclosed heated or cooled cabs.

Innovations

Compact and Flexible Designs

Since the invention of skid steers in the 1950s, their design and application have been continually improved upon by OEMs. Even as a small piece of equipment, the skid steer is impacted by shrinking machine footprints. However, OEMs still have a wide range of design flexibility.

Driven by safety, regulations, cost, performance or other factors, a variety of design elements that are available on skid steers today include:

- Cab designs that includes side door cab entry that keeps operators from having to climb over attachments to access the cab, improving safety and operator comfort. Or forward-tilting cabs that allow for easier servicing of the skid steer.[9]
- Back up cameras and object detection systems to improve visibility for the operator which helps protect people on the jobsite as well the equipment investment.
- Moveable wheel or track bases that make fitting skid steers through narrow doorways or entry points easy, then allowing them to return to standard position.[10]
- Helical actuators that incorporate sliding spline technology which combines strength and flexibility. Parker's helical rotary hydraulic actuator features foot or flanges output with 180- or 360-degree rotation. Functioning as a rotating device, mounting bracket and load bearing structure, the actuator eliminates the need for external bearing systems, brakes or locking devices[11] lending the power and flexibility that end users need for skid steer buckets.

For skid steers, the downsizing of systems and components into a compact footprint is one of the most important innovations in design. Integrating systems is one way to make compact designs for skid steers possible. When it comes to pumps, suppliers like Parker aid OEMs and their design engineers by combining suction lines when possible or packaging tandem units in the smallest possible packages. Specifying components that directly incorporate push-to-connect technology also reduces the amount of space used and weight added for the skid steer.[12]

Also important is the minimization of human error. The more hydraulic lines on a piece of equipment, the higher your risk for a wrong connection, leakage, or contamination. OEMs can simplify connections and save time with Parker's Multi-Couplings. They provide a more streamlined and efficient connection which combines multiple couplings into a single connection point for easier connection and disconnection. With a simple, single motion using an ergonomic lever, an operator can easily connect and disconnect the multi-coupling along with:

Save Time - Single connection to couple multiple and various media lines simultaneously

Avoid Errors - Keyed configurations and unique layouts reduce human error and provide mistake-proof connections that prevent crossed lines and assure consistent proper connections.

Maintain Safety - Locking options keep the connection secure while the equipment is in operation.

Increase Productivity - Simplifying equipment operation eliminates extensive training and improves "ease of use" for the end user.

Automation, IoT and Smart Skid Steers

Skid steers are one the earliest pieces of construction equipment to benefit from advances in automation. Automation offers a solution for increasing productivity, improving efficiency, enhancing versatility and enabling safety to meet the current growth demands in construction[13]. Automation can improve productivity by reducing the amount of manual input it takes to operate skid steers and improve precision in movement to accomplish more accurate work in less time. Full automation, although once a distant future, is quickly becoming a reality for skid steers with most OEMs working to offer automated or remotely controlled skid steers.

Automation for skid steer loaders and other construction equipment cannot happen without IoT integration. Construction equipment designed with embedded sensors and internet connectivity provides value by constantly collecting and analyzing data about usage, maintenance needs, downtime and more. This benefits skid steer owners who can optimize their machine usage and overall productivity using the data, while also ensuring regulatory compliance and improving safe use. IoT also benefits rental companies who seek to provide rental equipment that integrates with their customers' existing software. Additionally, OEMs see value in IoT through the operational data that drives design improvement, collects market intelligence and enables smart maintenance contract capabilities.

Integrating smart systems in skid steers can include a total electronic control approach for controlling and monitoring hydraulic systems through a state-of-the-art IQAN system that gives OEMs and end users the freedom to customize software without advanced programming. Parker's IQAN control units have built-in diagnostics that will reduce downtime and master modules have powerful computing capacity with extreme adaptability for use with a wide range of hydraulic components and input devices ranging from sensors to joysticks.[14]

By keeping smart skid steers running at peak performance, designers can reduce or eliminate unexpected downtime for their customers and help enable safer operation. IoT solutions for skid steers and other construction equipment is a highly customized processes. Working in tandem with the primary supplier of sensors, systems and displays to customize an IoT solution makes it easier to integrate and create actionable data usage to optimize skid steer uptime performance.

Efficiency and Electrification

Skid steers are one of the most important machines available to the construction and related industries today. Their flexibility to support a wide variety of attachments is critical to the efficient performance of the multiple tasks demanded of them in the execution of their work. The introduction by OEMs of electric or electric hybrid technology to all types of compact equipment, including skid steers, is allowing machines to operate in environments where noise or emissions would traditionally have been a barrier. Whether it is the reduction of noise or the zero emissions associated with electrification of these machines, their application will continue to grow exponentially particularly where previously their use would be unacceptable. Meeting these needs will continue to expand the range of use for these critical machines.

Parker's Global Vehicle Motor (GVM) range of electric motors offers OEMs and end users the appropriate solution for all machines. High power density, compact design combined with the highest efficiencies in the market provides the key. Introduction of electric solutions allows the efficiency recovery and storage of energy which would previously be wasted. Parker offers a wide range of motors with up to over 400kW of power. With a variety of sizes, lengths and voltages up to 650V each application can be uniquely engineered to maximize your machines performance.

The design of the GVM means that is can be used as a motor or a generator. This feature facilitates efficient system energy recovery whether from smart system design or braking solutions. This can provide a means of reducing expensive battery costs, extend the range between charges reduce overall machine operation costs.

With proven performance in a wide range of applications the GVM should be considered for application when looking for improvements in system efficiency, noise free operations and compact design.[15]

Conclusion

Compact, versatile equipment like skid steers are an opportunity to offer customers in the construction industry new innovations that can help them face their daily challenges and improve productivity. Those innovations can be incorporated in a variety of ways ranging from new standard components to completely customized systems. Working with an engineering and technology partner who has experts on-hand can help to optimize not only each component or system, but can also ensure that specifications integrate effectively.

References

1. https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/engineering-and-construction-industry-trends.html
2. https://www.constructconnect.com/blog/electric-dreams-will-heavy-construction-equipment-go-electric
3. https://www.constructionequipmentguide.com/skid-steer-manufacturers-sound-off-on-technology-trends/39840
4. Interview with Parker Hannifin subject matter experts
5. https://www.equipmentandcontracting.com/10-must-have-skid-steer-attachments/
6. https://www.mordorintelligence.com/industry-reports/construction-equipment-rental-market
7. https://www.openpr.com/news/1979559/construction-equipment-rental-market-trends-2020-by-top-players
8. https://www.forconstructionpros.com/rental/article/10364068/must-have-skid-steer-options-for-rental-businesses
9. Interview with Parker Hannifin subject matter experts
10. Interview with Parker Hannifin subject matter experts
11. http://blog.parker.com/central-tire-inflation-system-for-off-highway-vehicles
12. https://ph.parker.com/de/en/helical-hydraulic-rotary-actuator-l30-series/helac-l30-series?cm_re=Search-_-Flyout-_-Part&se=Helac%20L30%20Series&sr=1?cm_re=Search-_-Flyout-_-Part&se=Helac%20L30%20Series&sr=1
13. Interview with Parker Hannifin subject matter experts
14. Interview with Parker Hannifin subject matter experts
15. https://www.parker.com/Literature/Electronic%20Controls%20Division/Literature%20files/IQAN_Electronic_control_made_easy.pdf

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