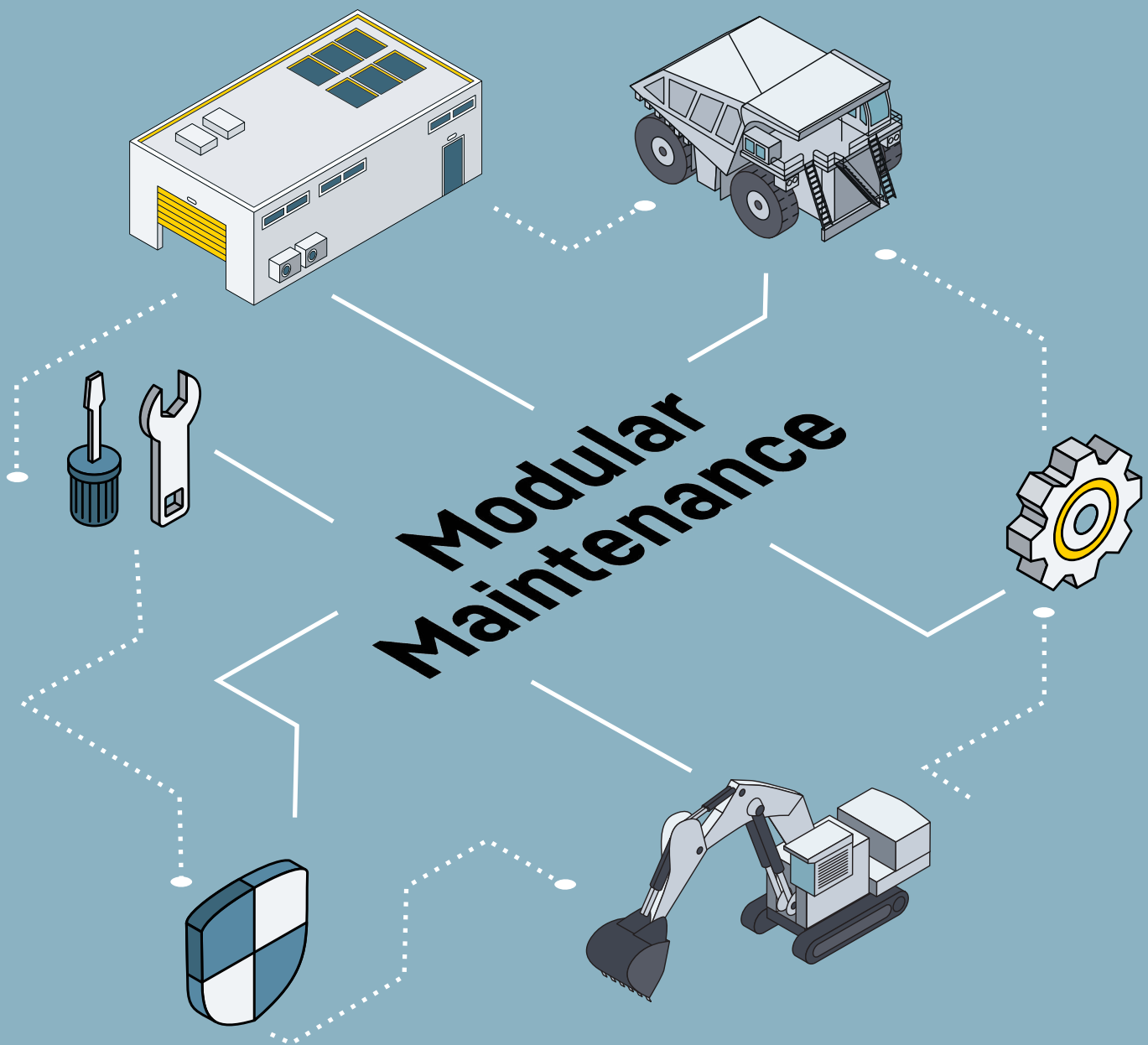
Modular maintenance

Whitepaper

LIEBHERR

Mining



How can mining operators choose the maintenance strategy that is right for them?

In the world of heavy mining equipment, failure to optimise equipment maintenance at a project's outset can lead to sudden and unscheduled downtime events.

Choosing a modular maintenance strategy – whether for minor or major assembly modules – with minimum time and expenditure is an effective alternative to traditional maintenance methods in mining. The ability to remove modules, repair them off site – while another, remanufactured and fully-functional, module is made available to the customer – then return the remanufactured module to circulation can resolve common challenges with managing equipment maintenance. Downtime becomes more predictable as scheduled, on-site risk is reduced. Further, components are refurbished rather than scrapped, minimising waste and improving operational sustainability.

This is how Liebherr's modular solution for maintenance in the mining industry works. Once a module – such as an engine or radiator – reaches its maintenance schedule, that module is replaced with a refurbished one straight from one of Liebherr's service centres. This circular process cuts downtime and expedites the entire maintenance cycle. Many mining operators are seeing the benefits of adopting this modular maintenance approach.

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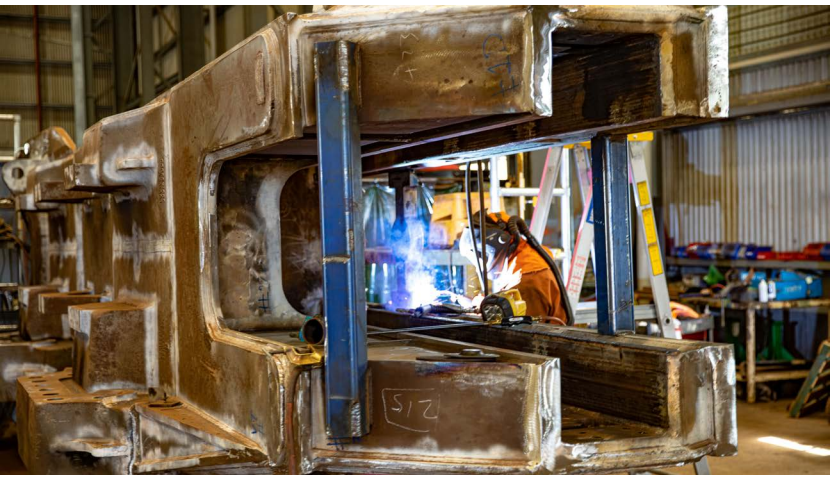

Modularity as an enabler

Liebherr's modular approach to its equipment is an integral part of the company's design philosophy. In the early stages of development, equipment is manufactured from small, self-contained units – or modules – that can be easily assembled, disassembled and replaced as needed. This part of the machine design and engineering process stems from the need to have smaller transportable machine modules to comply with international transport regulations. It also ensures that technology adaptations and innovations can be built into upgrades throughout the Liebherr equipment life cycle.

With a foundation of modular design, it is possible to upgrade components and convert diesel machines to electric.

Liebherr's modular design philosophy provides mining machine owners with equipment that is efficient, adaptable, easy to maintain, sustainable, and technologically advanced, thereby enhancing overall operational effectiveness.

Simplified maintenance and serviceability: modular component design offers numerous benefits to Liebherr machine owners, including increased efficiency, reduced downtime and improved safety. Instead of performing detailed maintenance on every individual part, entire modules—such as powerpacks—can be removed and swapped with pre-refurbished units. This approach significantly shortens maintenance time and helps keep machines in operation longer.

Flexibility and adaptability: Liebherr's modular design for large excavators and off-highway trucks streamlines the repowering process, making powertrain upgrades on existing machines highly efficient. So for example, converting an R 9400 from an internal combustion engine to an electric power system can be completed within weeks.

Approximately 60 % of an electric-powered Liebherr mining excavator shares the same components as its internal combusion engine counterpart, significantly simplifying the repowering process. Liebherr recommends scheduling repowering during major service intervals or component exchanges. In fact, the very first repower of a Liebherr excavator from internal combustion engine to electric drive took place when the key components of the excavator – an R 9400 in Australia – reached the end of their service life. Completing both processes side by side not only optimised maintenance efficiency but also enhanced cost-effectiveness.[1]

Commitment to sustainability: Liebherr's modular design provides machine owners with a sustainable upgrade option when needed. This modular approach allows mining operators to upgrade existing equipment rather than replace entire fleets, offering a cost-effective path to environmental compliance. In November 2024, Liebherr-Australia successfully repowered two R 9800 excavators for Yancoal, a leading Australian coal producer and exporter, at the Mount Thorley Warkworth coal mine in New South Wales' Hunter Valley region. The repowering process involved replacing the existing engines with Liebherr's D9812 12-cylinder engines, specifically engineered for the demands of the mining industry.

The D98 series engine, known for its low fuel consumption and reduced emissions, is also compatible with hydrotreated vegetable oil (HVO), which can further cut CO_2 emissions.

Advanced technological integration: Liebherr's modular design approach allows for seamless integration of advanced technologies into their machines, enhancing flexibility and adaptability in the mining sector. This conception of machines enables easy retrofit of various automation solutions, such as the Autonomy Ready Kit for off-highway trucks, semi-automatic Bucket Filling Assistant for excavators and teleoperation systems like LiReCon.

A further advantage of this approach is that it facilitates modular maintenance, which is particularly advantageous during the later stages of the equipment's life cycle. When modules are refurbished to as-new quality, integrating product updates and optimisations is part of the process. This ensures that Liebherr machines can benefit from technological advancements that help to maintain their effectiveness and efficiency over time.

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The benefits of modularity

How is modularity making a difference for its existing users? Breaking down its benefits across key business priorities can offer some insights.

Parts ordering: with a modular approach to heavy machinery it is possible to order hundreds of individual parts with a single item number. With approximately 1,300 line items for a single powerpack, the ability to consolidate parts to build a module massively boosts the efficiency of the ordering process. Once the purchase order for the module (using the module part number) is sent to the regional Liebherr Service office, the Liebherr team consolidates the required parts for assembly. This approach to parts ordering also reduces logistics complexity by allowing for a single freight load, minimising the need for multiple trailers and shipments of separate components.

Safety: modularity can reduce occupational hazards, which is especially important in mining as it is one of the more hazardous heavy industries. A 2015 case study conducted by Liebherr-Australia Pty. Ltd. illustrates the significant safety benefits of adopting modular replacement strategies over in-situ component replacement for the powerpacks of R 996B excavators. In-situ replacement required 14 days of shutdown, whereas modular replacement reduced this to just 6 – a 68 % decrease in task duration. Furthermore, the number of shifts where cranes were used was also reduced. During modular replacement, Liebherr-Australia only required an 80-tonnes crane for 5 shifts, rather than the usual 14 – a 65 % reduction. Similarly, a 20-tonne crane was only needed for 12 shifts, rather than 28, which was a 58 % reduction.[2] These reductions in time and crane usage both lowered labour demands and enhanced safety by minimising technicians' exposure to critical hazards such as extended lifts and working at heights. And, by using a modular replacement strategy, refurbishment of the powerpack was completed in the controlled environment of a regional workshop facility rather than the unpredictable environment of a mine site, optimising safety. This also helped to improve contamination control by removing potential adverse environmental factors from the module's assembly.

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Comparative analysis of modular vs. in-situ replacement for a Liebherr R 996B hydraulic excavator powerpack

Aspect	In-situ replacement	Modular replacement	Outcome
Task duration	14 days	6 days	68 % fewer days
80-tonne crane usage	14 shifts	5 shifts	65 % fewer shifts
20-tonne crane usage	28 shifts	12 shifts	58 % fewer shifts
Technicians' exposure to risk	High (extended lifts, heights)	Minimal	Enhanced safety
Powerpack refurbishment location	Mine site	Regional workshop facility	Improved safety and control
Contamination control	Prone to environmental factors	Controlled environment	Optimised

Labour market pressures: recruiting and retaining skilled workers is a growing concern among leaders in heavy industries. For example, 86 % of respondents to a 2022 McKinsey survey of mining executives said recruitment had become more challenging compared to two years previously, with 71 % reporting that delivery of production targets was falling behind as a result.[3] And, in PwC's 2023 annual global chief executive survey, just under two-thirds of mining CEOs said they expected their profits would take a large or very large hit from skills shortages over the coming decade.[4] Notable human capital gaps are set to worsen in critical roles, including mechanical maintainers, mobile equipment operators and fixed equipment operators. Recent data highlights the severity of the issue. In Australia, the mining sector's vacancy rate reached 5.2 % in late 2023, an increase from 3.3 % just three years earlier. The global mining industry is reported to need an estimated 24,000 new workers by 2026. The supply of skilled workers, however, is expected to fall short, with only around 16,000 likely to be available.[5] Modular maintenance solutions, such as Liebherr's, offer a practical answer by streamlining maintenance processes to reduce shutdown times and optimise labour usage. For example, replacing the engine module of an R 9400 excavator with a modular approach reduced shutdown times from seven to four days and halved labour hours compared to conventional maintenance techniques.[6] This demonstrates modularity's potential for alleviating workforce pressures while improving operational efficiency. With recruitment such a concern for mining leaders, and modularity a proven solution, modular maintenance could be a source of much-needed stability against a backdrop of uncertainty.

Reduced downtime: modularity enables the completion of projects ahead of schedule as well as on budget. Mine owners can efficiently deploy components that are easy to replace at regular intervals, enabling them to meet and exceed strict deadlines. As a planned maintenance strategy, a modular approach to machine maintenance is critical for keeping downtime to a minimum. Unplanned maintenance costs three to nine times more than planned maintenance as sudden and unexpected failures of critical machinery can require a business to shut down entirely while repairs are undertaken.[7] Even small repairs can impact productivity. Planned, routine maintenance can prevent these failures and be scheduled to take place at times where little or no downtime will be incurred. Since the inception of Liebherr Mining's modular maintenance programme in Australia in 2015, the company has seen customers reduce their machine downtime during scheduled maintenance by up to 50 %. With modular maintenance, overrunning timelines on mining projects can become a thing of the past.

Technological advancement: modular maintenance isn't just about optimising the mines of today – it can help sites prepare for the innovations of tomorrow. In a recent joint effort by Liebherr Mining and Fortescue, an R 9400 excavator was converted from an internal combustion engine to an electric powertrain, marking a significant milestone in mining decarbonisation efforts. This is the first time Liebherr has repowered one of its excavators to electric configuration during the machine's standard service life. Liebherr's modular equipment design facilitated the repowering process, demonstrating the potential to futureproof existing fleets.[8]

Up to

50 %

reduced downtime*

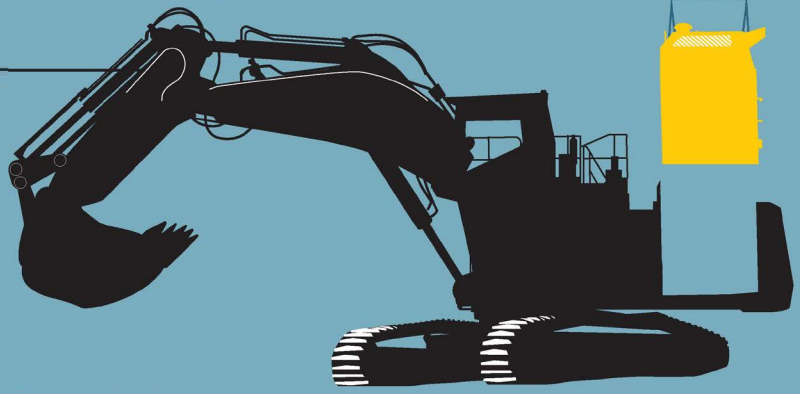
Up to

70 %

reduction in high risk tasks*

500+

modules delivered by Liebherr-Australia since 2015



50+

modules delivered by Liebherr-Africa since 2018

*The figures are calculated based on the average results derived from all internal case studies conducted and may be different for individual machine modules.

Modular maintenance, mining and Liebherr

Liebherr is an expert in providing heavy equipment and assets to customers globally. Since introducing modular maintenance to its service offering, Liebherr-Australia Pty. Ltd. has delivered over 500 modules nationwide. In 2025, specialised teams in Perth, Mackay, and Mount Thorley are expected to collectively deliver more than 100 modules. Meanwhile, Liebherr-Africa (Pty) Ltd launched its modular maintenance programme in 2018. Since then, it has delivered over 50 modules, supporting a fleet of Liebherr mining excavators, including R 996s and R 9800s.

Liebherr's experience in supporting its mining customers has enabled it to develop tailored, proven programmes that are increasing industry productivity. These programmes are also flexible, with Liebherr providing scaled-down mini modules and additional maintenance during major changeout periods, according to client needs. For customers whose site requirements are not compatible with Liebherr's full modular maintenance programme, mini modules offer reductions in cost and machine downtime when compared to traditional in-situ component changeout.

The benefits of Liebherr's modular solutions are undeniable. By shifting work to controlled Liebherr workshops, safety risks are significantly mitigated, on-site tasks are streamlined and efficiency is dramatically improved. Customers get the benefits of reduced downtime, enhanced machine availability and lower operational costs – all while aligning with sustainable practices to meet evolving environmental standards. By working with an OEM partner like Liebherr, mining operators can access all the tools they need to deploy a market-leading modular maintenance solution – and the high-tech benefits on offer guarantee that these tools are futureproof too.

Investing in a Liebherr machine means choosing a futureproof asset designed to adapt and evolve. Liebherr's modular design approach ensures that each machine is both built for the present and is ready for the future. This strategic design facilitates easier upgrades and maintenance, enhancing long-term performance and efficiency. Whether you are a current owner or considering your first Liebherr purchase, Liebherr mining machines offer a smart, sustainable solution that grows with your needs.

Scan the QR codes to see Liebherr's modular maintenance programme in action:

Liebherr Mining's modular maintenance programme: from start, to finish

Witness the power of Liebherr Mining's modular maintenance programme

For enquiries

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