

Automatic for the people

Rhonda Knotts from Modular Mining Systems and Caley Clinton from Komatsu Mining Corp examine how automated haulage systems are improving safety and productivity

Komatsu's Front Runner AHS combines driverless trucks and remotely managed operation to optimise the movement of materials

Throughout history, mining operations have benefitted from significant innovations in haulage. From wheelbarrows to horse-drawn carts to remote-controlled trucks the size of houses, each advancement in haulage has increased the ability and efficiency of moving material from the point of extraction to its intended destination – a fundamental goal that still exists for all mining operations, today.

MINE HAULAGE IN REVIEW

The Industrial Revolution of the 1700s and 1800s set in motion an era of powered, special-purpose machinery.

The steam engine, hailed as the most significant invention of the period, made possible mines' transition from animal-powered haulage to steam-powered rail, enabling the movement of significantly larger volumes of material than ever before.

Haulage took another step forward in the 1920s when conventional over-the-road trucks were retro-fitted with hydraulics and tipping beds for use in the mines, offering greater flexibility and significantly higher productivity over prior haulage methods.

Twenty years later, ruggedly designed, rigid body, purpose-built



off-road haul trucks began rolling off the assembly lines, giving mines a much higher degree of reliability, durability and productivity.

Enhancements such as the offset cab, twin-axle, dual-rear wheel design introduced in the 1950s, set a standard which is still used on almost all haul trucks currently in production.

The Information Age of the 1950s, '60s, and '70s had an equally dramatic impact on mining operations. As tasks such as data collection and record keeping moved from being strictly manual to computer-aided, the potential for human error

decreased, while data availability and accuracy increased.

It was during this era of emerging digital technologies that Modular Mining Systems' co-founders brought to market mining's first computer-automated dispatching application, the DISPATCH fleet management system (FMS).

Capable of optimising the haulage cycle by determining the most efficient route for trucks to follow and automatically assigning (or reassigning) trucks to shovels, the DISPATCH FMS revolutionised the way mines worked (and continue to work) in real time.

One of the most significant changes in modern-day haulage is the Front Runner Autonomous Haulage System (AHS), pioneered by Komatsu.

AHS combines driverless trucks and remotely managed operation to optimise the movement of materials – effectively removing people from harm's way while increasing production, regulating fuel usage and reducing impact on the environment.

FRONT RUNNER

The first commercial implementation of the Front Runner system occurred in January 2008 at Codelco's copper mine in Chile.

A second successful deployment followed in late 2008 at Rio Tinto's iron-ore mine in Australia. Rio Tinto ►



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► currently operates autonomous trucks in four mines in the Pilbara region of Western Australia, an operation that is efficiently and safely controlled from Rio Tinto's operations centre in Perth, roughly 1,500km from the mines.

Within an autonomous fleet, trucks are equipped with vehicle controllers, high-precision GPS, obstacle-detection technologies, and a wireless network system (jointly developed by Komatsu, Komatsu America Corp and Modular Mining), which optimises fleet management.

A remotely located supervisory computer controls the trucks' movements, enabling the unmanned fleet to operate in strict accordance with a complex plan.

Because each truck performs exactly as programmed, operational variability is essentially non-existent, enabling mines to achieve consistent, reliable and repeatable performance for every cycle, shift and day.

Front Runner customers have reported reductions in load and haul unit costs by more than 15% as compared to conventional haulage methods.

Optimised automatic controls also reduce sudden acceleration and abrupt steering, resulting in 40% improvement in tyre life compared to that of manned operations.

During its decade of commercial operation, the Front Runner system has achieved a zero-harm record of safety. The system's navigational controls work to prevent collisions between trucks, service vehicles or other equipment units.

However, should the on-board obstacle-detection systems identify another vehicle or person within an unsafe proximity, the autonomous trucks will reduce speed or stop immediately, making the system extremely safe and reliable.

With fatigue, weather extremes and hazardous road conditions no longer posing a threat to human well-being, operations can focus more on the business of mining.

BETTER FOR MINES, THE EARTH

By systematically optimising operations, autonomous haulage systems contribute to a smaller carbon footprint in the form of less energy consumption and CO₂ emissions. Additionally, the electric-drive autonomous trucks generate less waste than their traditional mechanical-drive counterparts, facilitating easier compliance with environmental regulations set forth by the government and community in which the mine operates.

The transition to AHS operation also presents an opportunity for mines to upskill and develop their workforce. Newly defined roles take people out of repetitive tasks and offer challenging alternatives, thus empowering employees to be responsible for decision-making and giving them greater control over their environment. The shift also enables mines to attract a tech-savvy generation of young miners, who bring a fresh approach and a new perspective to the industry.

ACCELERATED AHS ADOPTION

Growth in AHS is on the rise around the world, particularly with major expansions in Canada and Australia underway.

Komatsu supported Suncor Energy's 2013 AHS pilot programme, which took place in a section of Suncor's oil sands mine in Alberta, Canada. Suncor recently announced that a successful four-year trial has led to a phased implementation of the Front Runner AHS at all of Suncor's company-operated mines, starting with the North Steepbank site north of Fort McMurray.

Over the next six years, 150 driverless trucks are planned to be put into operation at Suncor, representing one of the largest investments in electric autonomous vehicles in the world. Suncor is the first oil sands operation to adopt autonomous haulage technology.

To extend the proven Front Runner benefits to operations with existing manned haulage fleets, Komatsu conducted and successfully completed trials of its retrofit kit at a Rio Tinto mine in September 2017. The retrofit kit, mounted on a standard Komatsu electric drive 830E (nominal

payload: 220t), enabled the truck to operate in autonomous mode. As a result, Rio Tinto recently placed an order for retrofit kits to equip 29 model 830E trucks operating at its Brockman 4 mine in Western Australia.

In addition to expanding the Front Runner retrofit kit to include other main models of Komatsu electric drive standard trucks, Komatsu plans to enhance Front Runner's mixed-operation functions. These enhancements will enable manned haul trucks of any make to safely interoperate with Komatsu autonomous trucks as part of a blended fleet.

Under this initiative, Komatsu has committed to providing its customers with autonomous solutions that meet the growing demand for gradual transition from an existing manned fleet to fully autonomous operation.

Komatsu recently celebrated its 10th anniversary in autonomous haulage. Today, more than 100 AHS trucks operate in Australia and the Americas, where the system runs around the clock, hauling three different commodities, in six mines, across three continents. Front Runner is fast approaching an industry-leading cumulative total of 2 billion tonnes of autonomously hauled material – a milestone achieved with zero injury incidents attributed to driverless equipment units.

INNOVATION IN ACTION

Komatsu unveiled its Innovative Autonomous Haulage Vehicle (IAHV) at MINExpo 2016 in Las Vegas, US. Unlike Komatsu's 930E and 830E autonomous models, the IAHV design lacks an operator cab, a decision that demonstrates Komatsu's belief in, and commitment to, the advantages of unmanned haulage.

The IAHV equally distributes the load to all four wheels when the vehicle is loaded and unloaded, and employs four-wheel drive, retard and steering. With this design, Komatsu aims for high-performance shuttling in both forward and reverse travel directions, thereby eliminating the need for K-turns at loading and dumping locations.

Specifically, Komatsu expects this new vehicle to considerably improve the productivity at mines where existing unmanned haulage vehicles face challenging conditions, such as slippery ground due to frequent rain or snow, as well as confined spaces for loading. ▼

The Komatsu Innovative Autonomous Haulage Vehicle at MINExpo 2016

