The evolution of dispatching

Andrew Crose examines how improved technology and the changing demands of the mining industry have transformed the role of dispatching

Early Modular Mining DISPATCH System at a Phelps Dodge mine in the US

In the December 1987 issue of *Mining Magazine*, Dr James White (then Modular's executive vice-president, now chairman) and Les Zoschke (then Modular's project supervisor, now VP, business improvement) described the cutting-edge state of 'modern' dispatching.

At the time of publication, Modular Mining Systems was the world's sole provider of computerised dispatching systems. Operating since 1979, Modular had brought 11 mines to full operation on its DISPATCH system.

Five years later, Modular announced in the November 1992 issue of *Mining Magazine* that 28 DISPATCH systems were fully deployed and operational, with an estimated 40 additional mines running some form of computer-based dispatching system.

The mining industry has changed significantly over the past 25 years. Modular is now approaching 250 installations, 18 of those at the 20 largest mines in the world. Overall, the latest statistics indicate that roughly 400 open-pit and underground mines are running one of 14 fleet management systems (FMSs) of varying levels of sophistication.

In today's world, there is rarely a mine with more than 15 trucks operating without the aid of an FMS.

"In today's world, there is rarely a mine with more than 15 trucks operating without the aid of an FMS"

THE CHALLENGE IS HARDER

The demands that 21st-century mines place on their FMSs are far more complex than those placed on early systems. The ability to optimise truck assignments no longer satisfies the increasingly sophisticated needs of current mining operations.

Advances in high-precision machine guidance, real-time maintenance data monitoring and advanced safety systems are just the beginning of a new era of fleet management technologies.

Today's mines constantly push the boundaries of technology in a search for more efficient, cost-effective and safer solutions. Mines are increasingly moving underground to reach ore deposits. Also in open pits, mines are striving for increased efficiency through non-traditional methods such as in-pit crushing and conveying.

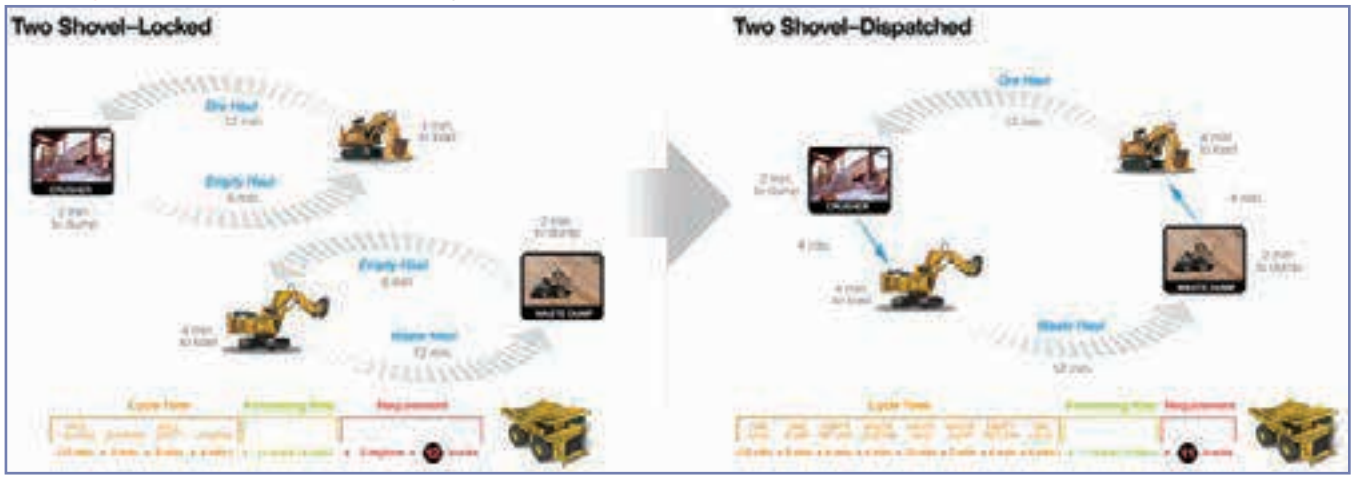
An innovative approach, such as the Komatsu Autonomous Haulage System (AHS) deployed at Rio Tinto's mines in Australia's Pilbara, illustrates what it takes to meet the needs of today and exceed the expectations of tomorrow.

OPTIMISATION AND MANAGEMENT

Since the earliest releases of the DISPATCH system, the core objectives of fleet optimisation have largely remained unchanged. Though the technology has advanced, with better hardware and improved algorithms, the goal is the same.

As Modular stated in December 1987, managers strive to achieve "large productivity increases with a given fleet of trucks and shovels, or a significant reduction in the truck and shovel fleet needed for desired production". It is still the case that more material is moved by routing trucks via the fastest route, with optimised assignments to loading equipment and dumps/crushers, than with simple truck/shovel circuits assigned to specific loading equipment and destinations.

Simple example of efficiency gains in running 'unlocked' truck assignments



BASIC FEATURES

The most basic feature of an FMS is optimising the assignments of trucks to loading units. To maximise production, the FMS needs to know, in real-time, the exact location and activity of each equipment unit. Having this up-to-the-minute data provides the basis for continuous, real-time decisions and optimal reassignments to maximise production.

For example, sending trucks at a pre-determined rate to a shovel that is experiencing hard digging could result in unnecessarily high truck idle time. By reassigning those trucks to a different shovel 'on the fly', a costly, unproductive situation could be avoided.

Managing equipment productivity and status is common to most FMSs, as doing so provides the optimisation algorithm with information it needs and data for later analysis.

Possible glimpse into the future of diverse mining techniques

INTERMEDIATE FEATURES

Equipment

Common intermediate features of FMSs are focused on fleet and material management. This process takes several forms – from including refuelling needs into the optimisation calculations to tracking tyre wear and tear.

Another simple, yet highly effective, tool in many FMSs is computerising the operator's log of the pre-start checklist. Instead of keeping a physical checklist on a clipboard in the unit's cab, the operator can complete the checklist electronically on a mobile device. This enables the system to store the pass/fail results in a permanent, reportable database.

More advanced FMSs also include modules that interface with truck sensors to track haul road conditions and automatically dispatch auxiliary equipment to fix road issues. These types of enhancements tend to quickly improve production and reduce long-term maintenance costs, as they help solve small problems that, if left unresolved, can result in lost time and significant costs.

Operator safety tools

More and more, operator safety tools are becoming a key element of FMSs. For example, an operator's qualifications and training records can be stored in a central database, and automatically checked when the operator logs in at the start of a shift. If the system detects that the operator is not qualified to operate the equipment, an exception notification is sent to the dispatcher, enabling immediate mitigation of the situation.

Given the importance of safety in powered haulage, many advanced features are available, such as providing the operator with real-time feedback to reinforce adherence to operational best practices. When paired with a speed-monitoring application, the positive reinforcement is even more effective. In this case, the operator's speed is monitored and the feedback is displayed in the cab, which allows the operator to self-correct. The feedback may also be sent to the dispatcher or supervisor, giving them the opportunity to reinforce the correct behaviour.

Another increasingly common component of safety programmes is fatigue monitoring and management. Several technologies are available to help mines reduce fatigue risk. Modular's FatigueAlert system uses sleep patterns and circadian rhythms, paired with advanced sensors that detect driving performance indicative of tiredness to calculate a fatigue score.

Dispatchers are increasingly taking operator fatigue levels into consideration when scheduling breaks. As a result, operators have more time and opportunities to reinvigorate before resuming their shifts.

Finally, proximity detection has become a common safety tool of the more advanced FMSs. Through the use of multiple synergistic technologies, the system can evaluate the risks and hazards in the operating area. By alerting operators of hazards, they have a better chance of avoiding collisions or other proximity-related accidents. Proximity detection systems have become commonplace in mines that value a comprehensive approach to safety.

Grade tracking, material movement and blending

One of the more frequent enhancements to an FMS is the ability to improve the quality of the material being extracted. On a basic level, tracking the grade of the ore being mined enables more accurate reporting of mine production. However, automating the blending downstream to produce the desired ore grades is what really creates significant value for many operations. Used effectively, blending can improve ore recovery, increase final product quality and increase profitability.

ADVANCED FEATURES

Equipment capacity assurance

'Capacity assurance' is an increasingly popular buzzword in the mining industry. The concept of capacity assurance means that the fleet equipment is operational and available to meet the needs of the production schedule.

This may sound simple, but if you spend any amount of time in a mine, it quickly becomes apparent that unplanned maintenance issues happen frequently, and almost always at inopportune times. When the down events involve a critical piece of equipment such as a shovel, or when they occur in an inconvenient location such as the middle of a ramp, the results can prove catastrophic in terms of production and cost.

Reactive maintenance approaches such as run-to-failure and preventative maintenance have been used almost exclusively in mining. These reactive approaches have not been sufficient to achieve a satisfactory level of availability or control costs.

"It quickly becomes apparent that unplanned maintenance issues happen frequently, and almost always at inopportune times"

As with most things in modern mining, technology has taken equipment maintenance to new levels. Predictive approaches are becoming an indispensable component of the maintenance strategy.

Today, maintenance and reliability engineers now have a robust set of software tools to assist them in maintaining equipment to meet operations' needs. Those tools include remote, real-time monitoring of OEM data, notification of OEM alarms or user-defined events, and trending analysis for specific equipment units or across the entire fleet.

Stylised representation of proximity detection zones

Autonomous and manned fleet

With the recent announcement of large orders of autonomous truck fleets, a new reality has begun to set in. Leading mining companies across the globe are now planning for mines to operate fully autonomously, or with combinations of autonomous and manned trucks.

Partially autonomous fleets are becoming more common, creating a number of planning challenges. These challenges include defining and implementing an optimal operational strategy, and supporting policies and procedures. This is critical for the effective and safe interaction between manned and unmanned vehicles. Autonomous truck suppliers have to consider these diverse fleet management situations, as well as other issues and obstacles, as they work to satisfy the needs of the market.

CONCLUSION

Modern fleet management has evolved greatly since the early systems of the 1980s. At the same time, basic fleet management has become a standard part of most medium and large mines. Advanced features have helped leading mines maintain a position of lower cost and higher productivity.

The number of vendors in the entry-level fleet management space has greatly increased, and the competition has spurred leading fleet management providers to bring even more value-added functionality to market.

Safety features have become equally important to the production benefits typically associated with fleet management. In addition, maintenance engineers and managers now have access to the data required to satisfy operations' needs for increased up-time and capacity assurance.

The reality of autonomous haulage fleets, and mines operating with both driverless and manned vehicles, still presents challenges, but none that cannot be overcome with a holistic approach that integrates procedures, technology and an educated engaged workforce.

After 35 years, fleet management has clearly evolved to solve the needs of mines throughout the world. The next wave of innovation will surely be just as interesting to witness.

Andrew Crose is manager of marketing at Modular Mining Systems. See: www.mmsi.com