

Featured Articles

Global Deployment of Mining Solution Business Powered by ICT

Yoshinori Furuno
Phil Walshe
David Noble
Mutsumi Kitai

OVERVIEW: In recent years, the global operations of the mining industry have been directed toward achieving greater efficiency through use of rapidly advancing ICT. Vehicle dispatch systems have evolved from systems that merely guide dump trucks to their destinations into FMSs that provide integrated operational support encompassing blasting plans, managing the quality of the transported material, improving safety, and managing the condition of fleet vehicles. Accompanying this change has been a dramatic increase in the volume of data being handled at mine sites. In the future, the key requirement will be to draw on synergies with other parts of Hitachi to provide systems that can collect this data efficiently and accurately and contribute to the optimization of mining operations.

INTRODUCTION

THE environment in which the mining industry operates became even more difficult with the advent of the global economic recession set off by a crash in sub-prime loans in the USA. Despite the continuation of vigorous demand in emerging economies, the delayed recovery of the European economy and the slowing in China's rate of growth indicate an oversupply of iron ore and other minerals, with the slump in commodity prices continuing. The price of the coking coal used in the smelting of iron ore has also been affected by these trends. Meanwhile, the price of gold has risen steadily over the last 10 years or so, and with the associated increase in production volumes being accompanied by rising costs, the recent sudden fall in the gold price has been a major blow to mining operations. Given this background, more so than increasing production volumes, mining companies have now come to see making production safer and more efficient as being their major challenges, regardless of the type of mineral involved.

In this environment, Hitachi Construction Machinery Co., Ltd. has been making its machinery more intelligent, including through the use of electronics in mining and digging machinery to improve operating performance, and through the release of a series of mining dump trucks with alternating current (AC) drive that incorporate motors and inverters from Hitachi, Ltd. To supply mines around the world with not only mining machinery but also the fleet management systems

(FMSs) used to manage their operation, Hitachi Construction Machinery acquired Wenco International Mining Systems Ltd. in July 2009 with the aim of providing support for more efficient mining operations. Wenco has its headquarters in western Canada.

Since its acquisition, Wenco has progressively increased its market share through measures that include working with Hitachi Construction Machinery sales offices throughout the world to offer its services as a package together with mining machinery. Wenco systems are currently in use at 70 mines around the world. Amid growing awareness in the mining industry of cost and safety, Wenco not only develops its own products but is also taking advantage of synergies with other Hitachi companies including its parent, Hitachi Construction Machinery, to build a solution business based on information and communication technology (ICT).

This article looks back at the establishment and history of Wenco and describes the background and features of past products together with the current situation and future outlook for solution businesses based on IT.

EVOLUTION FROM DISPATCH SYSTEM TO FMS

The core Wenco system is a dispatch system with a primary objective of ensuring that the dump trucks at a mine site operate efficiently between the various loading sites and the unloading site or crushing and

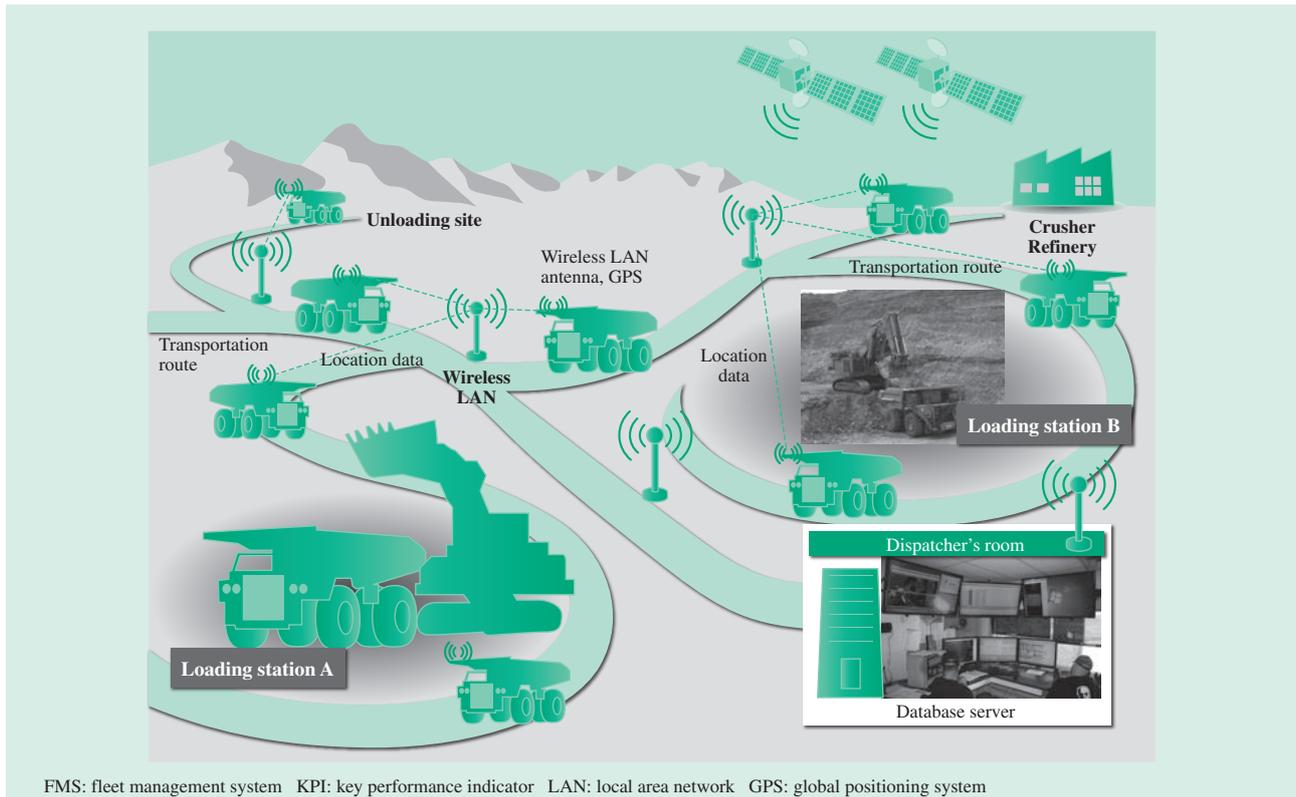


Fig. 1—Overview of FMS.

The figure shows an overview of the FMS. Dispatchers set production volume and other KPI targets in the system and issue instructions to dump trucks and loaders based on these. The system maintains the quality of ore being supplied to the crushing, refining, and other plants.

refining plant. With the performance of onboard computers having improved in recent years along with the volume of data able to be carried by wireless local-area networks (LANs), Wenco has added a variety of new functions to this system, transforming it into a mine FMS (see Fig. 1).

The following sections describe how the Wenco system has evolved from its origins to become the product it now is.

History of Wenco

Wenco's history dates back to the 1980s when it started out as part of the engineering division of Wester Mining (Kaiser Resources), a mining company that primarily operated coal mines in western Canada. One of the mining engineers working there at the time was Phil Walshe, now the President and CEO of Wenco. In 1985, the group developed a system to optimize vehicle dispatching at the company's mines. The system was made up of comparatively inexpensive personal computers (PCs) and wireless communications, and ran on a Microsoft* operating system (OS). The group was subsequently spun off,

initially as Wester Engineering Company, which was later shortened to Wenco and the company was renamed to Wenco International Mining Systems⁽¹⁾ as it is now known. The dispatch system that formed the prototype of the current system was called the production monitoring and control system (PMCS) and was created based on the actual requirements of mine operations. An approach to development that pays constant attention to the requirements of the mines has remained a feature of the company since its inception.

In the 1990s, the first vehicle dispatch system to use the global positioning system (GPS) to obtain machine locations was installed at a large gold mine in Western Australia. Subsequently, they added an SQL Server* database in 2000 for easier data extraction. The system uses the database for storing and managing data, and, like the OS, SQL Server is a Microsoft product. This made it comparatively easy for mine operations staff to access productivity-related data stored in the vehicle dispatch system and process it further or use it for reporting on other Microsoft products.

* Microsoft and SQL Server are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Product Evolution

In response to customer requests, the system was expanded beyond vehicle dispatch to also include managing the quality of material loaded onto dump trucks at loading sites. In 2004 they released a High Precision GPS Guidance System that checks the quality of the ore to be transported to its destination as the excavator operator loads it into a vehicle by using high-precision GPS to display each loader's excavation location on a map that shows the grade of ore in the ground and is pre-loaded into the vehicle's onboard computer (see Fig. 2). This system helps minimize variations in quality by checking the accuracy of ore composition at the loading stage as it is dumped into the crushing or refining equipment. It also improves the accuracy of recorded information by automatically sending information about the ore being loaded onto a dump truck, including its quantity, to the database server in the dispatchers' room. This ore information, which previously relied on data entered by the loader driver, is now determined from the loader's excavation position, obtained using high-precision GPS.

At this time, the number of sensors fitted on mining machinery to provide status indications was increasing significantly, leading to demand for using the outputs of these sensors to monitor machine status and provide a basis for maintenance planning. In response, Wenco developed Asset Health Management System, a new function for the realtime monitoring, display, and recording of alarm and sensor data from machines at the office. The function was first sold for

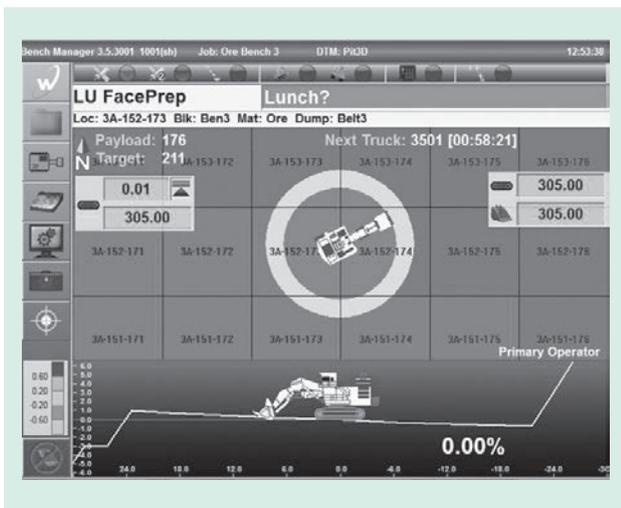


Fig. 2—Directions Using High Precision GPS Guidance System. The operator determines the grade of the ore being loaded into the dump truck while viewing the ore-specific blocks around the loader.



Fig. 3—Navigation (Tune-by-Turn Vehicle Guidance System/ Fleet Awareness).

The system encourages drivers to reach their destination on time by displaying the route on a map. It also reliably identifies any approaching machines or vehicles in the vicinity.

Hitachi Construction Machinery mining machinery with support for machines from other vendors added as needed.

To support safety, Wenco also developed the Tune-by-Turn Vehicle Guidance System, which provides map-based directions to guide dump trucks or other vehicles to their destinations safely and efficiently despite routes changing on a daily basis (unlike a typical urban situation). Sales and support of Tune-by-Turn Vehicle Guidance System commenced in 2014 (see Fig. 3).

Wenco also developed a web-based dashboard function, also released in 2014. In an environment in which data such as positions or haulage quantity per track are continually changing, this enables vehicle dispatchers and other staff involved in mine operations to perform comprehensive realtime monitoring of data in a variety of forms, not just on a dedicated dispatch computer located in the dispatchers' room.

COLLABORATION WITH HITACHI GROUP

Vehicle Safety Support

As further functions are added to its FMS, Wenco is seeking to collaborate with other Hitachi companies through an active policy of incorporating Hitachi technology while also remaining attentive to what customers have to say. Wenco's vision is to strive to undertake system development in a way that integrates the "machines" that operate at a mine, the

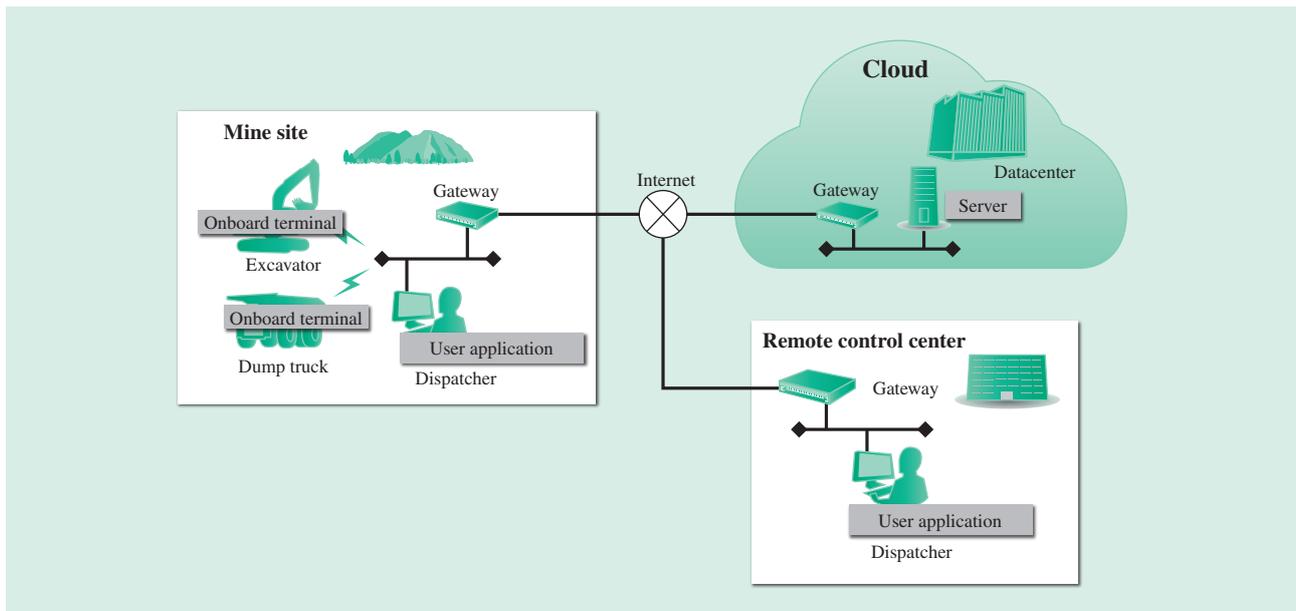


Fig. 4—Concept for Remote Control Center Using Cloud.
This runs the FMS in the cloud to control the FMS of the mine site remotely.

“ICT” that represents information and communication technologies, and the “humans” (people) who use both of these. As part of this, and to ensure that machines and people can work more safely at mine sites, Wenco is extending its Tune-by-Turn Vehicle Guidance System using technology for monitoring the surrounding area based on vehicle-to-vehicle communication technology built up by the Research & Development Group at Hitachi, Ltd. through its involvement in the automotive industry. In addition to wireless links via the mine office where the dispatchers’ room is housed, the technology is able to establish direct communications between nearby vehicles or other machines and to use this to determine each one’s position and direction of movement more reliably. It can also implement systems that reduce false reports to a bare minimum through the use of logic that can utilize maps and other information for the accurate prediction of potential collisions in various different situations. This technology is scheduled to go on sale during FY2015.

With the aim of combining its FMS with driverless dump trucks, Wenco has been developing its autonomous haulage system for driverless dump truck operation in collaboration with Hitachi Construction Machinery since 2012. It also plans to spin off functions and other technology developed for this purpose and progressively deploy it on current Hitachi Construction Machinery machines to provide functions for improving things like safety and productivity.

Use of Cloud Technology

Along with the integration of machines and ICT, work on research and development of systems that combine ICT with people, who supervise its operations, has been in progress with the Information & Telecommunication Systems Company of Hitachi, Ltd. since 2012. With a view to handling operations at distant mine sites from a city-based remote control center, Hitachi is working with mining companies on the west coast of Canada to trial the cloud-based operation of Wenco’s FMS (see Fig. 4). This trial has demonstrated that the use of Hitachi, Ltd. wide-area network (WAN) accelerator technology can dramatically improve operation response times, which are a factor in ease of operation and, by clarifying operational issues, has taken a major step forward toward commercialization⁽²⁾.

FUTURE DEPLOYMENT AS MINE OPTIMIZATION SYSTEM

The system design put together by a group of engineers at a division of a mining company more than 30 years ago was more than just a simple vehicle dispatch system. Also present at the time was the idea of a system that performs optimization across all aspects of mine operations, an idea that has existed since that time. While the operating costs of crushing, refining, and other plants used in the downstream production processes at mine sites like that shown in Fig. 1 tend to be much higher than those for the excavation, loading,

and transportation processes, these costs are strongly influenced by the purity (quality) and quantity of the ore supplied to the plants by the upstream processes. Even when the system was first being developed, they envisaged performing optimization through a system designed for accurate, realtime detection of these parameters that could provide them as feed-forward inputs to the downstream processes.

One example is the use of chemical solvents to extract the metal at gold and copper mines, with the quantity of solvent being determined based on the purity (quality) of the ore that is fed into the plant. If the quantity of chemical solvent is too low for the purity of the ore, not all of the gold or copper will be extracted, resulting in a large loss. In the opposite case, using too much of the expensive solvent is wasteful. Similarly, if the quantity of feedstock supplied to the plant is less than its processing capacity, it will adversely affect the plant’s productivity. The initial concept for the optimization system was to dynamically synchronize the large variations in the upstream and downstream processes.

The main forms of radio communications used when the system was first envisaged were ultra-high frequency (UHF) and very-high frequency (VHF), neither of which was suited to handling large amounts of data in realtime. Furthermore, as data on the position of loaders, dump trucks, and other vehicles was limited, with few sensors for monitoring machine status, the optimization system was not able to be implemented as intended.

In recent years, wireless technologies such as IEEE802.11x have emerged that are able to handle large volumes of data at high speed. There have also been notable advances in technology such as more precise GPS for better positioning accuracy, and machines have started to incorporate a large number of sensors for monitoring their status and output (how many tons of material have been transported). Along with this, Wenco developed High Precision GPS Guidance System (described above) for monitoring load quality, and subsequently the Asset Health Management System for monitoring machines to prevent sudden faults. It also developed Tune-by-Turn Vehicle Guidance System to enable mines to operate safely by maintaining an accurate view of mine environments, which change dynamically on a daily basis. Wenco has also collaborated with Hitachi, Ltd. on testing cloud-based systems that extend beyond on-site communications to manage mines remotely. Through this work, it is moving a step at a time toward a mine optimization system.

Next, tools are needed that can analyze large amounts of data from multiple perspectives to synchronize the upstream and downstream processes by analyzing the constantly changing data associated with mine operation. In 2015, Wenco started developing an analysis system based on business intelligence (BI) tools in collaboration with the Information & Telecommunication Systems Company of Hitachi, Ltd. (see Fig. 5). These BI tools will be adapted for mining companies that increasingly

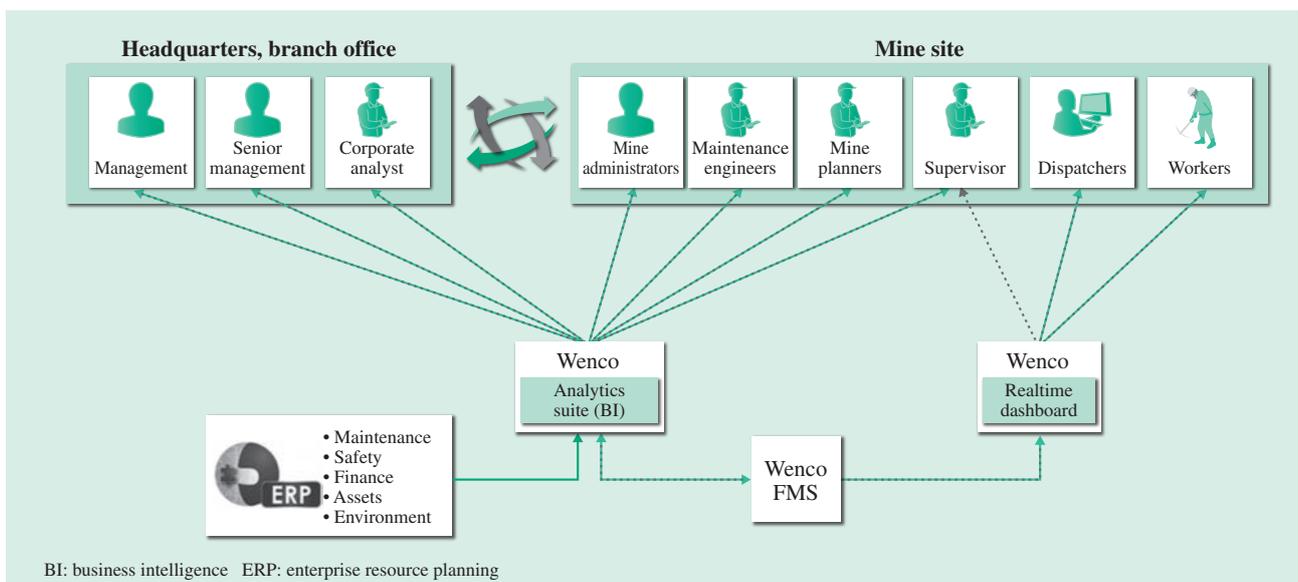


Fig. 5—Overview of BI Tools.

Production information output by the Wenco FMS can be analyzed not only by dispatchers, but also by a variety of other stakeholders.

operate as oligopolies, with a view to shifting them to the cloud for monitoring the status of production processes across a number of mine sites, instead of just one site at a time.

Meanwhile, Hitachi is utilizing its information technology (IT), operation technology, mining machinery technology, and consulting capabilities and experience in a wide variety of industries to improve productivity and perform other optimizations all the way from excavation to the railway and port, and undertaking mine operation support from equipment to operation, maintenance, and management support as part of its Social Innovation Business⁽³⁾. Wenco intends to take part in this work in ways that include solution development and the use of equipment information in its role at the core of the mining sector.

CONCLUSIONS

Having started in the 1980s as a vehicle dispatch system, the Wenco FMS has now become vital to the optimization of mine operations. The challenge

for the future is to provide total support for reliable production by minimizing the factors that cause production to vary at mines that have complex ore bodies and that tend to change more dynamically than other types of industrial plants. The next major step will be to integrate FMSs and other types of ICT into machines to make them smarter and to implement control systems that support “humans” (people) in terms of production, safety, and other considerations. Given the demand for optimization of the entire mining process from pit to port, Hitachi aims to deploy its comprehensive capabilities and go beyond its organizational structure as a mining machinery vendor to become a broad-based solutions company.

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ABOUT THE AUTHORS



Yoshinori Furuno

Mining ICT Development Center, Mining & Heavy Equipment Division, Hitachi Construction Machinery Co., Ltd. He is responsible for FMS & predictive maintenance development.



Phil Walshe

Wenco International Mining Systems Ltd. He is currently President and CEO of Wenco International Mining Systems Ltd.



David Noble

Wenco International Mining Systems Ltd. He is currently engaged in managing FMS development in his role as Product Manager.



Mutsumi Kitai

Hitachi Construction Machinery (Australia) Pty Ltd. He is Deputy Managing Director of Hitachi Construction Machinery (Australia) Pty Ltd.