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Hitachi Construction Machinery's Dynamic Solution is Set to Change Mine Management

What is "MICT"?



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The mining business is about to change dramatically. A new operation approach using state-of-the-art technologies such as Autonomous Haulage System (AHS) and Fleet Management System (FMS) which optimizes the dispatching and operation of dump trucks and excavators is opening up the future for the mining industry. Mining Information & Communication Technology, or "MICT," is the key focus of this new trend.



Wenco is the No.1 in the number of new FMS installations between 2009 and 2014. The FMS is used in 70 mines worldwide as of January 2015.



Peter Cunningham
Operational Technology Director,
Teck Resources Ltd.

“**T**here are a wide variety of equipment and systems on mining sites. While the importance of mining ICT is growing, the coordination and integration of multiple devices and programs are critical as well. Quick upgrading, too, will be a key. Wenco’s solutions are great in any one of these aspects. What I am hoping to get from them next is a well-developed training program using ICT.”



Inside of the dispatch room. The dispatcher, who is responsible for the management of the fleet, reads a variety of data shown on multiple monitors and sends instructions on routes and speeds, among other things, to the operators in order to achieve the defined production goal. In effect it is a command and control center in the field.

Global financial crisis in fall of 2008 changed the direction of the mining industry

In 2008, the collapse of Lehman Brothers that started with the U.S. sub-prime mortgage crisis quickly threw the global economy into turmoil. The mining industry was no exception: demand from developing countries that had been driving market expansion until then came to a standstill and resource prices plunged.

“The tide in the global mining business changed at that time,” says Phil Walshe, President & CEO of Wenco International Mining Systems Ltd. (Wenco), a consolidated subsidiary of Hitachi Construction Machinery (HCM), headquartered in Canada.

“Many mining companies were on the brink of bankruptcy. Mining businesses used to focus on high-volume production in order to meet the strong demand from emerging countries, but they switched gears to focus on productivity and efficiency. That’s when they learned that information and data are crucial to improving productivity and efficiency. That was also the signal for Wenco to change our direction.”

Wenco is a mining information and communication technology (ICT) company that provides systems and solutions that support mining companies in their efforts to improve operational

Simply enter selected Key Performance Indicators in real time, and the FMS automatically dispatches your fleet and specifies transportation routes

FMS manages mainly the operation of excavators and dump trucks in the mine using analytical programs through a radio network and GPS. At a mining site, multiple dump trucks are allocated to one excavator so that they can be loaded in rotation. A dispatcher, who is responsible for the management of the fleet, provides instructions to operators based on how the fleet is working. His job is to improve productivity at the mine, managing the fleet operation in an effective and optimal manner. For example, a dump truck waiting too long for its turn to load may be sent to a different route. Wenco’s FMS provides

and management efficiency. A small company with around 100 employees, Wenco provides solutions for more than 70 mines around the world, with a strong focus on distinctive Fleet Management System (FMS), which is user-friendly and can be applied to all types of minerals and installed at any size of mine.

the dispatcher real-time information on the conditions of the fleet and equipment operation. This is the first such system in the industry to employ Microsoft Windows® as its OS, and it is highly rated for its great user interface, unique applications, and advanced technology.

Peter Cunningham, Operational Technology Director at Teck Resources Limited, a resource company in Canada that uses Wenco’s FMS, describes his experience with the Wenco product: “Its screen views are designed to offer high visibility, which is excellent, and the user interface is simple and func-

tional. You can use it intuitively.”

For example, to instruct a dump truck operator of a change of destination, the dispatcher in the office simply drags and drops the icon for that particular equipment on the monitor screen. The instruction regarding the new destination is automatically sent to the dump truck and displayed on its on-board monitor.

Wenco’s FMS also can have a function to enhance productivity and efficiency. For example, the systems can automate dispatch to increase production or control material delivery blending. The FMS formulates optional haul routes and truck to loading unit alloca-

tion to maximize production and equipment utilizations. FMS generates useful KPIs (Key Performance Indicators) that can then be applied to market conditions and management strategies to achieve success.

FMS also allows users to monitor the fuel consumption and equipment health of each vehicle, providing opportunities for failure prognostics and preventive maintenance. This can, in turn, help to minimize requirements for spare parts inventories and maintenance personnel as well as downtime.

HCM acquired Wenco in 2009 and Wenco became a member of the HCM Group.

Wenco’s expertise is indispensable for the deployment of ICT in mines

At that time, HCM was already working on ICT for its mining equipment, and had identified a particularly urgent development of an Autonomous Haulage System (AHS) for mining dump trucks. AHS can significantly reduce operating costs as a number of dump trucks work in concert with one excavator.

Makoto Yamazawa, Senior Officer and

Vice President, HCM’s Global Mining Division explains the background of the Wenco acquisition. “Dump trucks are the most numerous equipment on the mine site, and their development is essential in increasing the mine’s efficiency. HCM is a latecomer in the manufacture of dump trucks. Thus it is not easy to differentiate our product just because they are built tough and



David Noble
Product Manager

David Noble is in charge of FMS development at Wenco. “Working with HCM has allowed us access to a greater amount of technologies. This can be seen in our latest vehicle navigation system as well as proximity and collision avoidance technologies,” he smiles. “In the future we want to increase the accuracy of user decision-making with 3D and simulation technologies.”

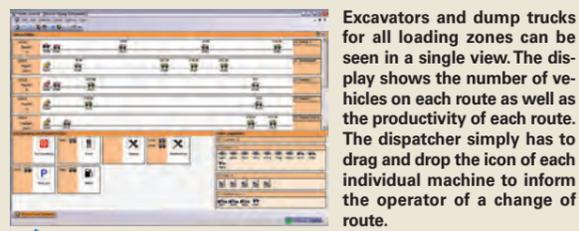


Glen Trainor
Vice President, Sales and Marketing

“**O**ur products offer high usability and versatility and are compatible with any IT environment. They accommodate any ore type and are scalable to any mine size. We now have an advantage called AHS. Our next challenge is to strengthen our sales force to accommodate the more diversified lineup of products. For this, we think the dealers of HCM will help expand our channels. The collaboration with the Hitachi Group benefits us this way too.”

Fleet Management System = FMS

Data such as weight, mineral species, and positions are fed to the on-board computer by sensors loaded into the equipment. The data is then sent to the server through a wireless radio network and GPS. The data is analyzed in real time and displayed on the monitor screen in the dispatcher's office. The Wenco FMS has an advanced automatic dispatch feature that provides efficient vehicle positions and haul routes based on KPIs taken from the data of the system.



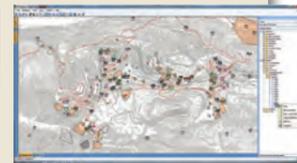
Excavators and dump trucks for all loading zones can be seen in a single view. The display shows the number of vehicles on each route as well as the productivity of each route. The dispatcher simply has to drag and drop the icon of each individual machine to inform the operator of a change of route.



A screen of bucket position, current toe, ore boundaries and crest zone. Visual confirmation of ore quality and material type promotes ore quality control at the loading point.



MDT (Mobile Data Terminal) Basic hauling unit screen showing load count, assigned dump truck location, unit tag, load amount, speed and status of unit.



A map view with equipment positions and routes. Setting up and changing hauling routes and restricted areas are done with a single click.



A screen displaying the wear status of tires, which are among the most expensive equipment parts. Tire wear is calculated based on mileage and load on the axle along with ambient temperature. The information is used for predicting and managing the remaining life of tires.



Safety comes first in a mine site where lots of vehicles are presented. Other vehicles in the vicinity are displayed on the screen, and when one comes within a defined distance, a proximity alarm is triggered, assisting the vehicles to avoid collision.



Dave Hewlett
CIO (Chief Information Officer)

Chief information officer (CIO) is a new position that was created last year in order to strengthen the Information Department. Dave Hewlett, a Data Engineer, has been working on building a system that will provide information to facilitate decision-making at all levels in the mining company, from top management to frontline operator. "Providing the right information to the right people, at the right time will dramatically improve operations and planning across the mining industry," says Hewlett.

functional. Naturally we set our eyes on the development of AHS because it would reduce operating cost and enhance safety dramatically. To do that, you must become thoroughly familiar with everything about mines. Under such circumstances, Wenco, with its unique FMS, looked very attractive to HCM."

"I highly valued the acquisition proposal by HCM," says Phil Walshe, President and CEO of Wenco. "After the collapse of Lehman Brothers, the industry finally started to understand the

A "Retrofit" approach: a perfect match with the ICT environment of mining companies

Success flowed from the good fit between the development philosophies of Wenco and HCM.

The integration of IT in the mining industry actually started in the late

role of data-based mining management solutions in improving efficiency and optimization. Yet due to the market downturn, mining companies did not make such investments. HCM offered equity participation right at that time. I thought they were extremely brave making the move when nobody was talking about new investments."

In fact the marriage of the two companies is positively reflected in the numbers: between 2009 and 2014 Wenco led its sector in the number of new FMS installations.

eighties. However, each company had an array of hardware, software, and systems from different vendors installed at different times. With virtually no compatibility among these parts, it

was impossible to implement changes to a dynamic system. Furthermore, system providers often monopolized the data collected from the site, meaning that mining companies sometimes did not have free use of their own data.

"In contrast, Wenco's system uses an open database, and it is therefore easy for us to share issues in customization," says Peter Cunningham of Teck Resources Limited. "It is great for customization as well. Their FMS uses versatile Microsoft Windows as its platform, making it easy to integrate with systems built by other companies and off-the-shelf programs. Software updates or matching do not require a lot of time."

This type of approach is similar to "Retrofit" HCM's policy in technology development. Through Retrofit, HCM aims to allow existing equipment to be upgraded and tuned up to the latest specifications by adding new features so that customers do not need to replace their fleet. In the case of AHS, even dump trucks that already exist can become AHS by installing AHS func-

tionality. Such retrofitting means mining companies can save on their existing assets and will have an easier time justifying proactive capital investment in heavy equipment.

Katsuaki Tanaka of HCM, currently at Wenco to oversee the development of AHS, confides, "Wenco's presence is extremely valuable in AHS development."

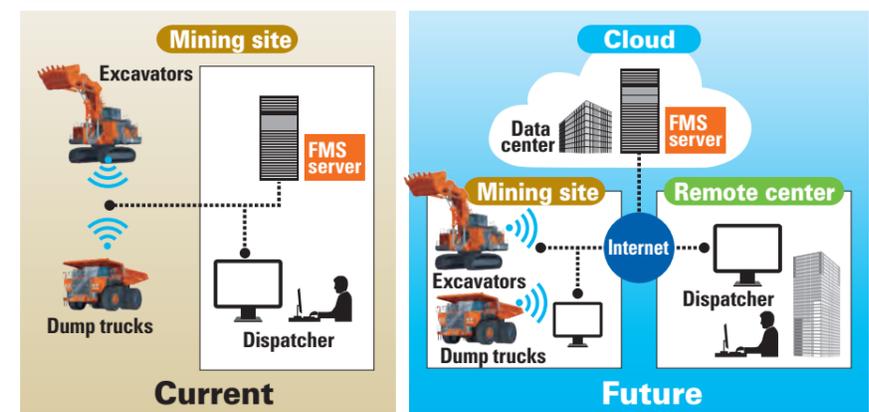
A sole implementation of technologies to a single dump truck will only enable one truck to be operated autonomously. But that's far from sufficient for operation in an actual mine site. A challenge for the AHS is how to operate multiple dump trucks in the same area. When several dump trucks come to an intersection at the same time, for instance, which one should stop and which one should go first? Mine sites have other types of equipment as well. How can you operate them all without affecting the productivity of AHS trucks? Answers to these questions will owe a lot to Wenco, who has been customizing and operating FMS at mine sites in many parts of the world.

Migration of FMS to cloud computing will drastically change the way mines are operated

The MICT that HCM envisions naturally has new ideas and features beyond Wenco's specialties. A typical example is cloud computing for FMS. In collaboration with the Hitachi Group, HCM and Wenco are working with Teck

Resources Ltd. on a proof of concept (PoC) project of a cloud-based FMS service. The project connects FMS to an external cloud server via the Internet so that data are collected and analyzed off-site to improve the mine's operation

Outline of current FMS and future FMS (Cloud-based FMS)



When a remote dispatching system becomes a reality, it will be possible to manage and provide instructions to fleets in a remote mine from a control center set up in a city.



Craig Utian
Client Services

Wenco is also proud of its high level of client satisfaction, a strength which it prizes. This is achieved by its intensive customer support program. Craig Utian looks after the whole process of customer support from the moment a contract is closed to inspection of hardware and software, shipment, installation, and post-delivery training. There is a great deal of expectation placed on the on-line training program for dispatchers, the development of which Utian has been leading. "Wenco Learning, the Wenco e-learning portal, is going to provide many benefits to our customers including fast and efficient access of our training programs, allowing trainees to learn at their own pace and providing a gradual learning experience as users become more proficient with our software applications."



Ron Davidson
System Support Engineer

Ron Davidson provides workshops and training to customers at mine sites around the world, helping them make the best use of Wenco products. One of his important tasks is to learn the challenges customers face at work.

"We provide training customized for each site within a limited amount of time. It's important to teach how to improve the efficiency of dispatching, but at the same time I focus on building confidence among dispatchers."



Team AHS
Martin Politick
 (center)
Katsuaki Tanaka
 (second from right)

The development of AHS is currently underway at three sites, located in Japan, Canada, and Australia. Wenco is in charge of building a distributed application between the office side, including the dispatch room, and the on-site equipment. The work has reached the second phase of development, where a pilot operation of multiple dump trucks is running at a site. Although development is concurrent in the three places in different time zones, "The development team members from the three countries had marathon discussions, living together for one month in Australia," says Martin Politick of the AHS team. "We are united in the approach. The real work in technology and engineering has just started; it is very challenging and exciting. Katsuaki emphasizes the same point: "Now comes the difficult part. How can we ensure safety in a mine site where there are neither the traffic lanes nor the stop lines that exist on public roads? The Hitachi Group now has a chance to show its true might."

and management. A mining company would therefore no longer need to install a server at each mine, reducing up-front costs and optimizing IT management costs.

"Initially I didn't really expect much from the cloud-based FMS," says Peter Cunningham of Teck Resources Ltd. "But I see now that we can update software much more quickly. It used to take us 10 weeks to do this in all our mines, which are scattered over 10 locations around the globe. But now it only takes a few days. What a difference!"

The fact that mine sites will be remotely managed under a cloud-based FMS means that there are a fresh set of technical challenges, such as reliability and the needs for high speed and stability in the network. That is where the Hitachi Group comes in. As a provider of highly reliable ICT infrastructure, Hitachi's expertise has been capitalized for such requirements as robust information security for Internet connection and reduced response time to compensate for communication delays due to physical distance.

In the future, mines that are isolated with limited access will have their fleets managed and operated remotely from a control center in the city.

In addition, MICT shows a way to resolve the lack of information, which has been an issue in the mining industry for years. Dave Hewlett, who became Wenco's CIO last year, notes, "Thanks to the wider deployment of FMS, efficiency is improving in production. But the real problem is that management simply doesn't know what is actually happening at mine sites day to day." Hewlett is currently building an



Demonstration test for AHS dump trucks at Meandu Mine, Australia

information system that provides the information needed for decision-making in different formats. The system will cater to the different levels of responsibility within the client organization, from top management to the front-line.

"This system is not limited to the customer of HCM and Wenco," Hewlett adds. "Because it is applicable to any manufacturer's equipment or systems, we can now offer a truly consolidated view of mine operations while expanding our customer base."

David Noble, who is in charge of FMS development at Wenco, says, "The alliance with HCM opened up a new field, which we couldn't have done by ourselves. We are excited because working with not only HCM but also other Hitachi Group companies, including Hitachi Ltd., offers us great possibilities."

sorts of operational data from equipment working at mining sites through FMS. But in the last two years in particular those involved in mining have increasingly been hoping for "Pit to Port," which is the concept of optimizing the entire process chain of mining from extraction to processing, shipping, transportation, and loading at a port."

"Pit to Port has been a dream in the mining industry for years," says Phil Walshe, President & CEO of Wenco. "But nobody thought it'd be possible. Now that we have teamed up with not only HCM but also other Hitachi Group companies, we are ready to make the dream come true."

Furuno agrees, saying, "I feel it is only our Hitachi Group that can do it."

"MICT could lead to a completely new approach to mining management. Of course there are many more technologies and systems that are required to make Pit to Port come true," says Furuno. "AHS and cloud computing are just some of them. Having said that, I think Hitachi has almost all the seed technologies within its group. If not, we'll simply create them."

With strides of innovations in MICT, over the next several years the mining business is expected to go through dynamic changes beyond our imagination.

"Pit to Port," the mining industry's ultimate dream, will come true with Hitachi Group



Yoshinori Furuno, Vice President of Wenco, has been involved with Wenco since it became an HCM subsidiary in 2009. He recalls that he recognized "the extent of potentials the mining business has" after taking over the office. "What we were planning to do at that time was to provide feedback to our development people by collecting all



Phil Walshe
 President and CEO, Wenco

Yoshinori Furuno
 Vice President and COO

What is the KPIs-based management that is said to be the key to the future of the mining business?

Phil Walshe, a founder of Wenco, was formerly an FMS developer for a mining company. The business didn't do well and eventually folded. Walshe and his partners subsequently set up Wenco and released their own FMS in 1989. Since then he has been pursuing FMS that is user-friendly.

On the other hand, Yoshinori Furuno, Vice President, is an engineer who used to work as a system designer for mining dump trucks and excavators in HCM. He is very familiar with the networks and functionalities that are required to build an AHS. There is no doubt that both men are key persons to open up the future of ICT in the mining market, and they agree that the Key Performance Indicator (KPIs) is the critical part of MICT.

Efficiency is a difficult thing to define for mining companies because mines differ in size, topography, ore type, and the extent of processing. In addition, mines continue to operate for decades and their conditions change over their lifespan. A mine has a wide range of variables such as equipment, site access, attention to the surrounding environment, maintenance costs, and market conditions.

These all influence the mine's performance, and their respective weights on the final result change over time. Among these factors, KPIs are the one area to be relied on the most.

At a copper mine in Bulgaria where Wenco's FMS was installed, costs increased 1% due to the installation, but productivity rose as much as 16%. It is a good example that cost reduction is not necessarily a good indicator of efficiency improvements.

"It's very easy to process and present data to customers to their liking, but it's important for us to provide the most appropriate KPIs as the information," says Walshe.

"If the top management shifts its approach to a KPIs-centered management policy, the mining industry will drastically change," Furuno concurs.

"When ICT is fully advanced, you will be able to oversee many different mines at the same time. When it comes, which variables should be used for KPIs? Technologies such as visualization and AHS tend to be the hot topics, but we need to remember that they are just some of the tools used to increase profits. It's an important job for us to clearly communicate the significance of KPIs to our customers."

THE FUTURE IS CERTAIN: MICT to be CORE TOOL in the mining business

Construction Machinery Makers and Electronics Giants will Unite to Compete for Market Share

New values to come from "One Hitachi," the source of technologies and human resources

Today the mining industry is undergoing a difficult time. It is clear that mining companies want us not only to provide highly energy-efficient, robust machinery but also to help reduce overall mining costs and thereby contribute to profits. Meeting such demands will require a wide range of technologies in the areas of

equipment, materials, and power trains, to name a few. It is certain that these will be integrated together with mining's ICT= MICT as the core technology. MICT is essential in the development of AHS, the goal of which is to reduce operating costs and improve safety, and in the development of FMS, which aims to increase efficiency and facilitate optimization at mining sites where various types of machinery are operating. That being said, ICT for the mining business cannot be achieved by HCM alone.

That is where Wenco comes in. Wenco has been working in the mining sector for more than 25 years, providing FMS for better efficiency. With the availability of Wenco's technologies and expertise, HCM three years ago created a special team that is dedicated to the development of MICT, and we have been working to expand it since then.

The AHS currently under development at HCM offers the advantage that it can be retrofitted to existing equipment thanks to the fact that its architecture is a combination of independent technologies such as Vehicle Traction and Stability Control, Operating Assistance and Fleet Management. Without Wenco's technologies and expertise, we would not be so far ahead.

In addition, we have a full spectrum of businesses in the Hitachi Group, commencing with Hitachi Ltd., to support us in various ways and that includes access to their ICTs. If HCM and Wenco need a certain cutting edge of technology we have yet to develop, the collective strength of the Hitachi Group stands ready to offer it. We call it "One Hitachi."



Makoto Yamazawa *Deputy General Manager*
HCM's Global Mining Division

For example, the demonstration project for AHS that is currently underway in Australia gathers experimental data from six dump trucks, three real and three virtual. This is because mine sites typically allocate six dump trucks to each excavator, but using six pieces of physical machinery for validation takes cost and time. As well, actual machines are subject to failure. That is where the ICT of the Hitachi Group makes a difference: it enables the team to utilize simulation technology to incorporate virtual dump trucks, thereby increasing productivity and efficiency in the development work.

In fact, HCM is a latecomer in the development of AHS, but I believe we have caught up with our competitors by leveraging Hitachi's comprehensive technology resources.

Migration of mining information to cloud computing is another advantage that the Hitachi Group has brought to HCM. In the current system the exchange of information occurs only within a single mine site. Once information is shared in the cloud, it is possible to analyze big data coming from multiple mines,

which enables us to provide solutions that were previously impossible to devise based solely on information from a single mine.

Combining state-of-the-art technologies to realize Pit to Port

The ultimate goal of the solutions coming out of MICT is the optimization of "Pit to Port," which mining companies for years had thought of as unattainable. The goal is to improve total supply chain efficiency from test drilling, excavation, extraction, processing, and delivery as well as the efficiency of data analysis for decision-making and communication for all levels from top management to the frontline. We believe that we are in the closest position to realizing that dream. The Hitachi Group companies can provide not only ICT but also whole needed functions in a mine site and its surroundings from plants for production, processing, and shipping to technologies and systems to treat water and generate electricity and furthermore, railway traffic management system and port facilities for shipping. We even have

a consulting unit. We can package these services and offer them to our customers.

Our competitors, too, will come up with different strategies and tactics. The keen competition may not be confined to construction machinery manufacturers; it may be competed between alliances of manufacturers and world-class electronics/electric machinery manufacturers. It is said that a major Internet company with no prior connection to the mining industry is exploring a possible venture in this field.

Accelerating the expansion of MICT Technology development unique to the Hitachi Group

I believe we need to acquire more IT companies to compete with them. Wenco's takeover of Automated Positioning Systems (APS) last year was an effort. APS has a high-precision drilling system that provides real-time navigated information for boring and blasting veins during operation. With this technology on hand, we can expand our coverage of the market. We will be able to provide



solutions to small-to-medium-sized mines and underground mines, which we have not covered thus far.

We also need to advance the development of technologies by capitalizing on our strengths. One example is Asset Health Management (AHM), which is a system that predicts breakdowns by collecting and analyzing data on the health condition of each piece of equipment to reduce downtime, minimize requirements for spare parts inventories at mining sites, and reduce the size of the maintenance workforce.

We also want to promote trolley dump trucks. This is a difficult area for our competitors to venture into because electricity transmission poles must be installed and cables must be run, all of which would require significant investments of time and effort. In the well sites for shale gas, a demand to LNG (liquefied natural gas) to power equipment is appearing.

Our business model will be chang-

ing as well. The current model is to sell and maintain equipment, but this will shift to a management-based model emphasizing maintenance such as Predictive Maintenance and parts provisioning. That will require MICT specialists, and we need to develop the talent. Fortunately, we have ICT experts within the Hitachi Group; their allocation among the group companies will be the key.

As the solutions and systems we offer become more and more diverse, we will need people to support them as well as people to provide training in different software products.

Providing Hitachi Group solutions for all stages of Pit to Port

Taking into consideration all these things, I still think we have an advantage. This is because it takes both time and effort to realize the benefits of MICT.

Each mine is different in terms of type of ore in the ground, location,

size, and management policy. A program that is working very well at a copper mine is not necessarily going to produce the same results with coal. It is a field where attention to detail is required. Not only relying completely on the MICT and the machinery work but also closely monitoring the sites and looking after customers. Within Hitachi group, it is easy for us to share technologies and expertise for integration and detail engineering, and we are proud of our past successes with such collaboration.

We persevered in our efforts to ensure our customers receive individual attention, never gave up on R&D, and tirelessly worked on our products; and our tenacity is finally starting to bear fruit. With MICT at the core of the business, HCM will remain committed to technology and personnel development and continue to provide the best solutions to any area or any stage in the mining business.

Capitalizing on a broad range of Japanese technologies for increased efficiency and optimization in the mining industry, the Hitachi Group has great potential.

With the market in stagnation, operating mines are required to cut costs that remain high. It is also getting tough to secure profitability due to, among other things, increased initial investment to extract deeper mineral deposits. Additionally, resources nationalism demands having minerals benefited within the country of origin in order to foster downstream industries.

Mining companies are countering by consolidating the market through M&A, business diversification, concentration of primary assets by selling off non-core assets, and cost reduction by improving efficiency and optimizing operations. Against this background, the productive utilization of heavy machinery with ICT is in demand.

However, mining companies are conservative and show a tendency to adopt proven technologies rather than new ones. Small-to-medium-sized companies that do not possess a strong business network are disadvantaged because they are unable to respond to the requirements of mining companies in a rapid manner. I have higher expectations that a major company like the Hitachi Group that operates worldwide in many different fields will play the center role in providing packaged

services to the mining industry, using a wide range of Japanese technologies.



Norihiro Yamaji
Deputy General Manager
**Japan Oil, Gas and Metals
National Corporation
Vancouver Office**