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## Cutting-edge technology rocks into mining industry

Leading telecom, AI, automation help improve efficiency, safety, overall security

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On the golden coastline of eastern China's Shandong province lies the country's "Golden City" — Laizhou. Boasting rich gold reserves, the city's economy is underpinned by the gold mining industry, but like many other mines worldwide, it used to be plagued by workplace safety risks.

Now, thanks to advanced telecommunications and artificial intelligence technologies, local mines are undergoing a digital and smart makeover by embracing cutting-edge automation and unmanned solutions, which could offer lessons for mines around the world.

In the Jiaojia Gold Mine, a forklift is busy transporting gold, as a driver on the surface, about 77 meters above the vehicle, remotely controls the forklift from an office.

Meanwhile, in the nearby Sanshandao Gold Mine, many young miners are remotely crushing ore. They only need to operate buttons and handles to remotely command the mechanical arms hundreds of meters underground to perform the tasks.

Such operations free workers from dangerous environments and offer a glimpse into the evolution of China's sprawling mining sector. For companies such as Shandong Gold Group Co Ltd, which owns the two mines, embracing digital intelligence not only fulfills its own needs, but is also representing the general trend in industry development. At the same time, a series of policies on mine safety and the digital economy have greatly promoted the transformation process of the mining industry.

Huawei has offered cutting-edge technologies such as a WiFi-6 network to enable remote controls in the abovementioned two gold mines in Laizhou. WiFi-6 can support a range of innovative solutions, such as automated guided vehicles, industrial robots and many other compelling use cases.

Chen Wenfeng, vice-president of sales and marketing in the Huawei Mining Business Unit — a dedicated team that the company established to offer smart solutions to mines — said, "At present, most mines at home and abroad are between the stages of mechanization and automation, with great potential for intelligence."

"In the next three to five years, digital technologies will see wider use in the mining industrial links such as transportation and mineral processing," Chen said.

The moves are part of Huawei's broader push to build world-class smart mining solutions that integrate new-generation information technologies, such as 5G, WiFi-6, industrial internet and artificial intelligence, to boost mine safety and green efficiency.



**Above:** Employees monitor mining processes at the control center of Sanshandao Gold Mine in Laizhou, Shandong province, in February.



**Left:** An autonomous loader is remotely controlled by operators at the Jiaojia Gold Mine in Laizhou in February.

PHOTOS BY ZHANG WEI / CHINA DAILY

On the bank of Laizhou Bay, the auxiliary shaft of Sanshandao Gold Mine is being excavated toward a target depth of 1,915 meters. Once the excavation is done, the auxiliary shaft will become the deepest shaft project in China and even Asia.

With the gradual deepening of mining, environmental challenges, such as high temperatures, high humidity and low oxygen increasingly weigh on operational safety, with uncertainties such as rock bursts and water gushing also increasing. There is a pressing need to leverage digital technologies to boost security and safety.

Amid such context, Shandong Gold Group has established a three-dimensional visualized comprehensive management and control platform, which has realized the application of visualized intelligent management and control of ore flow in the whole process, unmanned driving of electric locomotives and the remote-controlling of rock drilling jumbos.

As a result, the production efficiency of Sanshandao Gold Mine has increased by more than 20 percent year-on-year and the annual direct economic benefits have reached more than 80 million yuan (\$11.6 million), the mine said.

Specifically, the remote-control-

“We hope that mines will become unmanned in the future ... If unmanned mining is possible, these resources will be better tapped, which will contribute significantly to human society.”

Ren Zhengfei,  
founder of Huawei

ling of rock drilling jumbos helps reduce the number of on-site operators by 80 percent, guarantees the safety of miners, saves shift time and boosts efficiency greatly. Meanwhile, in the subsequent transportation section, the unmanned electric locomotive system has realized remote loading, unmanned driving and automatic unloading, improving efficiency by 25 percent.

Meanwhile, the deep shaft of the Jiaojia Gold Mine has realized unmanned operation of forklifts. In September 2022, Shandong Gold Group and Huawei built the first WiFi-6 Mesh-supported network for the mine. A superior network connection is still one of the core requirements of gold mines because networking is the foundation for digitalization and intelligence.

Intelligent technology has helped Shandong Gold Group reduce the number of underground operators by more than 3,046, saving 460 million yuan in total labor costs.

But challenges still exist. Wang Chengxiang, head of the Jiaojia Gold Mine, said one of the challenges is how to quickly transmit information in a limited space. The special geographical environment of high temperatures and humidity also requires targeted solutions. At the same time, the industry is in great need of interdisciplinary talents.

Moreover, smart mines include not only unmanned operations, but information infrastructure construction, geological security systems, tunneling systems, intermediate mining systems, transportation systems, sorting systems and security systems.

Now, the top three research fields of smart mines in China are green management, accounting for 6.11 percent of all research; driverless technologies, accounting for 6.09 percent; and information and communication, accounting for 6.02 percent, data from market research company ITime showed.

Chen from Huawei said there are more than 4,000 coal mines in China and more than 10,000 metal mines. All underground geological conditions are different and how to adapt solutions to each specific environment is a very big challenge.

"The journey of mining's intelligent technological transformation only has a starting point and no end point," Chen added.

By MA SI

Subterranean coal mines, which have traditionally struggled with internet connectivity issues, are becoming safer and more efficient as Chinese tech firms are exploring how to use 5G technologies to rejuvenate the sector.

Yao Wujiang, a technician at Yangquan Coal Industry (Group) Co in Shanxi province, said the company has deployed 5G networks inside a 534-meter-deep mine with technical help from companies such as China Mobile and Huawei Technologies Co.

The superfast wireless technology can help convey real-time data from inside the mine, including gas density, temperature and humidity. With the help of the 5G network, video calls between workers on the surface and underground also become easier.

"But the application of 5G in mines is still in a nascent stage," Yao said, adding that relevant government departments can offer technical and financial support to mines that have deployed 5G networks.

Yangquan Coal Industry is only one of the companies in the coal-rich province of Shanxi to embrace digital technologies to pursue high-quality

development. Over the past five years, Shanxi has deepened its energy revolution, accelerated the release of high-quality coal production capacity, promoted the construction of 5G smart mines and carried out pilot projects for green coal mining. The proportion of advanced coal production capacity has increased to 80 percent in the province.

In the next five years, Shanxi will speed up the construction of a green energy supply system and strive to achieve the ratio of advanced coal production capacity to about 95 percent and the installed capacity of new and clean energy to 54 percent, according to the province's government work report in 2023.

To help accelerate such a transition, Huawei has also adapted its self-developed operating system HarmonyOS to the needs of the mining sector. Customized as HarmonyOS for Mining, the operating system's variant brings the power of the IoT to mining and fills the connection gap between devices. It also provides services for the digital and intelligent transformation of the coal industry.

Huawei has partnered with China Energy Investment Corp to explore how to use the OS to boost efficiency

achieve this step, it will be of great significance to Canada and Russia's mining in the Arctic Ocean. The conditions are extremely harsh and not suitable for living, but such rich resources are located there. If unmanned mining is possible, these resources will be better tapped, which will contribute significantly to human society," Ren added.

Governments in China are also rolling out favorable policies to promote the use of digital technologies to ensure safety in mines. In October, the Ministry of Science and Technology, for instance, unveiled a

notice on advancing the industrial use of AI technologies with smart mining highlighted as a typical application scenario.

Last year, the National Development and Reform Commission, the nation's top economic regulator, and the National Energy Administration jointly released a 14th Five-Year Plan (2021-25) for the energy sector, which calls for the wider use of 5G, cloud computing, the internet of things and big data in areas such as coal mines.

Amid the policy call, progress is underway in mines across China.

## IoT, 5G dig underground sector amid pursuit of high-quality development



A worker operates an intelligent 5G mining system at an underground coal mine in Lyuliang, Shanxi province, in July 2021.

WEI LIANG / CHINA NEWS SERVICE

in coal mines and created a benchmark for the application of HarmonyOS in mining.

Experts said Huawei's efforts to apply a variant of HarmonyOS to the industrial internet showcase the company's ambition in the IoT era. The industrial internet refers to the convergence of industrial systems with the power of advanced computing, analytics, sensing and new levels of connectivity.

Wang Zhiqin, deputy head of the China Academy of Information and Communications Technology, a government think tank, said in an earlier interview that the industrial internet is a typical application of 5G and it will enable the superfast wireless technology to upgrade a wide range of traditional sectors.

Local Shanxi companies are also developing technologies to help boost safety in coal mines. Jingying Shuzhi, a Taiyuan-based software company, for instance, has developed a solution called Mine Brain in partnership with Huawei and the China Coal Research Institute.

Powered by big data and AI, Mine Brain can boost safety in coal mines by optimizing workplace and supervisory efficiency. It can replace humans in hazardous environments

and take on tedious and repetitive tasks, Jingying Shuzhi said.

For example, Mine Brain's computer vision capabilities can monitor scraper conveyors, reducing the number of people needed and increasing efficiency.

Meanwhile, computer vision can identify unsafe scenarios like people working in front of shearers or missing hydraulic support guard plates and issue warnings through the broadcast system. The system can then generate software records, making these types of incidents part of future safety assessments, Jingying Shuzhi added.

Jingying Shuzhi said its strength in algorithms delivers an AI model for Mine Brain that includes early warning algorithms and expert models.

Already installed in mines across the country, including in Shanxi and Anhui provinces, Mine Brain has been applied to tasks like water prospecting and gas extraction and has shifted acceptance testing methods from underground to above-ground. It also provides remote intelligent diagnosis and warning alarms for operations and construction compliance, building a solid safety foundation, the companies said.