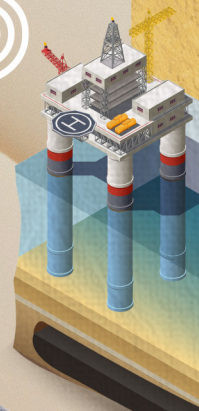
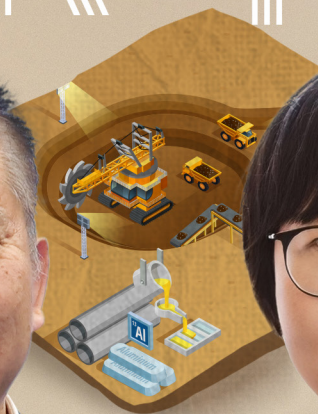
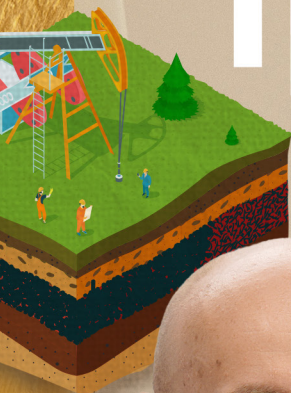


TRANSFORM



MICHAEL TOST

Professor for Sustainable
Mining Technology,
Montanuniversität Leoben, Austria



LIU ZHONGMIN

Academician of the Chinese Academy
of Engineering, Director of Dalian
Institute of Chemical Physics,
Chinese Academy of Sciences



LINDA HAN

Huawei's Corporate Vice
President and CEO of Oil,
Gas & Mining BU

AMPLIFY INTELLIGENCE FOR ENERGY AND RESOURCES INDUSTRIES

AUGUST
SPECIAL
EDITION
2024

#IntelligentEnergy&Resources
Mining | Smelting | Oil & Gas | Chemical Industry





IN THIS ISSUE, WE LOOK AT INTELLIGENT ENERGY & RESOURCES

MINING | SMELTING | OIL & GAS | CHEMICAL INDUSTRY

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Huawei's Corporate Vice President,
CEO of Oil, Gas & Mining BU

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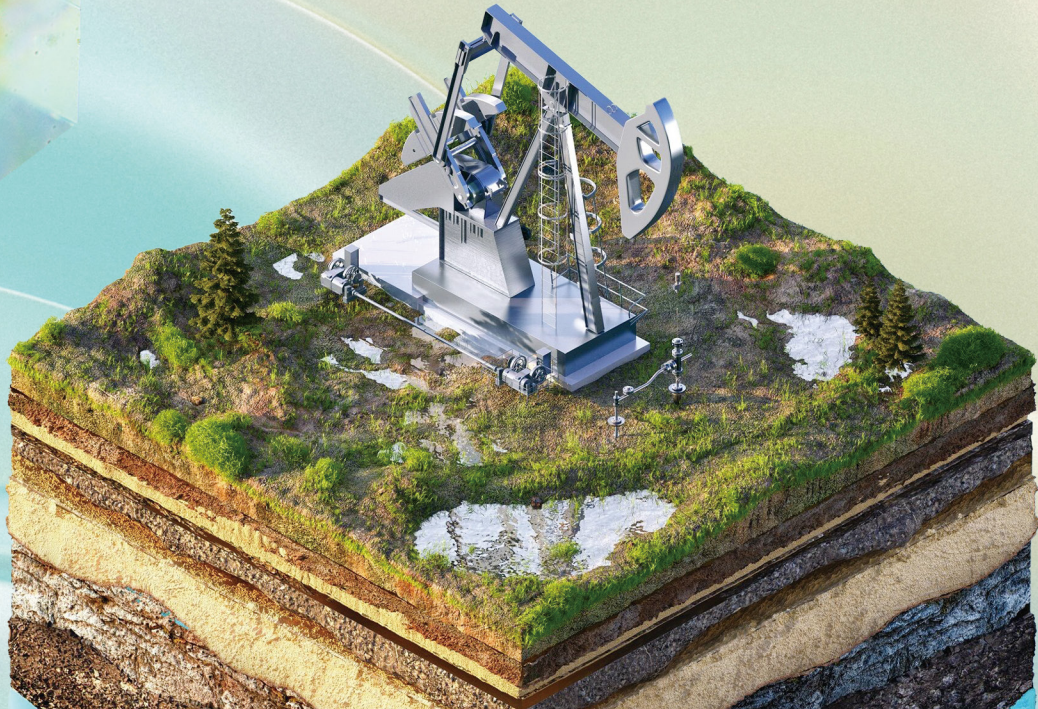
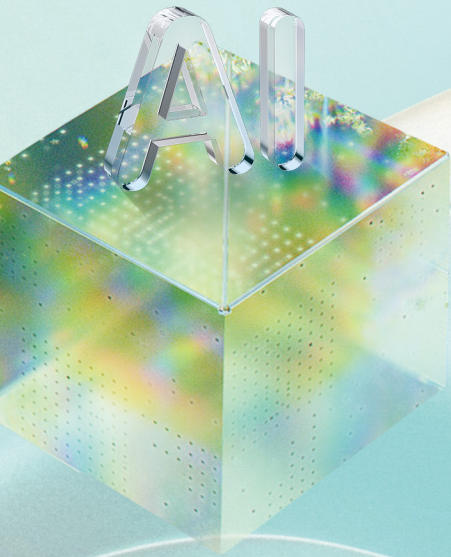
INTELLIGENT OIL, GAS AND MINING IN CHINA

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UNLEASHING NEW PRODUCTIVE FORCES THROUGH INNOVATION, COOPERATION, AND DEVELOPMENT

Linda Han

Huawei's Corporate Vice President,
CEO of Oil, Gas & Mining BU



Today, top customers in resource-based industries agree that intelligence, low-carbon, and alternative options for critical infrastructure are vital for maintaining business continuity.

Governments worldwide consider AI a critical national capability, with 50% of countries having already released AI strategies. China's 2024 Report on the Work of the Government has emphasized the country's priority to modernize its industrial system and develop new productive forces at a faster pace. The government aims to spur industrial innovation by making advances in science and technology. It looks to establish a strong foundation for the real economy, strengthen advanced manufacturing, press ahead with new industrialization, and transform traditional industries on top of fostering emerging industries. The government will work to strengthen the position of enterprises as the main innovators. It has plans to build innovation consortium with close cooperation between upstream and downstream players, as well as promote integration and innovation across the industry, academia, and research institutions. Ultimately, the goal is to accelerate the transformation of scientific and technological achievements into real productivity. These efforts will inject new vitality into traditional industries, making them higher-end, smarter, and more eco-friendly.

Forty-four countries worldwide have committed to achieving carbon neutrality and are promoting policies and legislation to reach this goal. At the UN Climate Change Conference held on November 30, 2023, 130 nations jointly signed a significant pledge to triple the world's renewable energy generation capacity by 2030. China has also pledged to reach peak carbon emissions before 2030 and achieve carbon neutrality by 2060. Green development is key, and new productive forces should be inherently eco-friendly. However, China's energy consumption per unit of GDP is 1.4 times the world average and 2.1 times that of developed countries. The six traditional energy-intensive industries (thermal power, steel, non-metallic ore products, oil refining and coking, chemicals, and non-ferrous metals) consume over 50% of China's total energy, with CO₂ emissions making up nearly 80%. In 2023, fossil energy consumption accounted for more than 82.5% of the total consumption in China, with coal consumption making up 55.3%. In addition, China depends on foreign supplies for 70% of its oil resources and 40% of its gas.

Due to the shifting global political and economic climate, a great number of countries are placing greater emphasis on infrastructure



security. As a result, many customers are seeking alternative options for building critical infrastructure to maintain business continuity.

Intelligence, low-carbon, and business continuity objectives and results should greatly enhance the total factor productivity. As far as the digitalization of resource-based industries is concerned, developing new productive forces involves "Three Leaps":

- Advancing means of labor (tools, infrastructure, and energy facilities) from mechanical and automated to intelligent by optimizing resource allocation and improving production tool technology.
- Advancing subjects of labor from raw materials to total factors of production that are represented by data assets.
- Advancing the labor force from technical workers to cross-disciplinary digital talent.

1. Advancing means of labor from mechanical and automated to intelligent and low-carbon, with “Industry + AI” as typical new productive forces

The means of labor encompasses production tools, infrastructure, and energy facilities. The shift towards intelligent means of labor is the most important manifestation of new productive forces. In the past, although tools were mechanized and automated, human expertise played a significant role in production. Today, AI is being integrated into various industries, including mining, oil and gas, metallurgy, and chemicals, to achieve intelligent linkage and autonomous decision-making. This integration will lead to continuous improvements in production safety and efficiency, along with further benefits.

In the **underground mining scenario**, Shandong Energy Group utilizes the Pangu mine model to verify the pressure relief borehole system’s construction quality. This reduces the manual review workload by over 80% and shortens the review from 3 days to just 10 minutes. The Group also employs the large model for intelligent medium density control in heavy-medium coal separation, increasing the yield of refined coal by more than 0.2%. In the open pit mining scenario, a great number of Chinese mining enterprises have implemented unattended methanol-powered mining trucks and pure electric mining trucks, leveraging cutting-edge technologies like fast charging and microgrid systems to reduce carbon emissions.

Hunan Iron & Steel Group, a major player in the **steel industry**, has adopted the Pangu steel large model to improve the accuracy of scrap steel grading to over 90%. Its subsidiary, Xiangtan Iron & Steel Group (Xiangtan Steel), also uses the model to analyze the compatibility and feature correlation between different raw coals, which reduces the coke cost by 5~20 CNY per ton. At Xiangtan Steel, the intelligent crane scheduling system, deployed by the large model team, can use algorithms to generate intelligent crane scheduling plans. It only needs one minute to “think” and issue a new scheduling plan that covers the next 30 minutes.

In the **oil and gas industry**, China National Petroleum Corporation (CNPC) used 7000 square kilometers of seismic data to train a large model, building a seismic interpretation model that boasts 1.5 billion parameters. The model significantly improves the accuracy of identifying major strike-slip faults and outperforms traditional methods in identifying weaker strike-slip faults with an efficiency increase of over 90%.

In the **chemical industry**, Huawei collaborates with top chemical companies to utilize AI in the real-time monitoring and analysis of sensor data. This approach increases fault prediction accuracy to over 95% and improves O&M efficiency by 20%.

2. Advancing subjects of labor to total factors of production that are represented by data highlights the importance of data as the foundation for intelligence. Information infrastructure can be built more efficiently when using “unified standards, architecture, and data specifications”.

Subjects of labor are fundamental to production, much like how land was crucial for the agricultural revolution and resources like coal, iron, and cotton were during the Industrial Revolution. Nowadays, data has become the fifth production factor and

a crucial asset for businesses. As data is the foundation of intelligence, the key to developing intelligence lies in the ability to efficiently and rapidly collect, transmit, store, and maximize the value of data.

However, there are bottlenecks at every link, from data collection, transmission, storage, to application. With data as a new subject of labor, production tools focused on intelligent equipment and AI must be developed, and new information infrastructure that facilitates data collection, transmission, storage, and application must be established so as to build new productive forces in resource-based industries.

To address issues such as diverse device types, inconsistent standards, and challenges to interconnectivity, Huawei Oil, Gas & Mining Business Unit worked with CHN Energy to roll out the MineHarmony operating system. This system offers a common language for devices to communicate and collaborate seamlessly. At present, the State Key Laboratory of MineHarmony has certified 300+ types of devices.

To tackle the challenge of managing multiple networks, Huawei has developed an integrated bearer network solution known as

“one network for all”. This solution uses a single-slice network to support various types of services. It has been successfully tested for commercial use and implemented at over 400 coal mines, serving major customers including Shandong Energy Group, Jin-neng Holding Group, Lu’an Chemical Group, and Shanxi Coking Coal Group.

To address issues such as siloed construction and low data quality, Huawei has built a cloud-based digital foundation that provides a secure, flexible, and efficient platform for data and capability sharing. This open, unified enterprise digital platform provides capabilities as services, with securely stored data that flows as needed.

To unlock the full value of data, enterprises can choose from different construction modes based on their business scale and digital capabilities during digital and intelligent transformation.

- Leading enterprises can choose to build their own AI models and computing platforms, continuously iterating to develop their own characteristics. Examples include Shandong Energy Group’s Pangu mine model and Hunan Iron & Steel Group’s Pangu steel model.



- Enterprises with regional advantages and a desire for collaborative development can adopt the intensive management mode to build an ecosystem. Industrial Internet platforms in places like Shanxi and Ordos dig deep into massive data to provide resources such as computing power, data, and large models. They also bring together software and hardware companies, research institutes, and other units for joint innovation.
- Small and medium-sized enterprises can leverage third-party platforms to enjoy an inclusive construction model. This kind of model requires less investment and yields quick results. By simply investing in the Enterprise Intelligent Cube (EIC) and the digital twin enabling platform MetaWorks, enterprises can develop AI applications across scenarios. For example, relying on the platform of Yunding Technology, coal mining enterprises including Wugou Coal Mine of Wanbei Coal-Electricity can launch applications easily by fine-tuning the large model.

3. Advancing the labor force from technical workers to cross-disciplinary digital talent makes cross-industry understanding and integrated operations decisive forces.

We all know that having highly skilled workers is the most crucial factor in gaining the first-mover advantage and seizing strategic

initiative. Talent can lead the world in technological advancement and create innovative production tools. They can truly comprehend industrial bottlenecks and pain points, and only they can develop problem-solving applications by combining their industry expertise with digitalization.

In terms of talent selection and development, our team has made some mistakes in the past. We aimed to cultivate the perfect “cross-disciplinary talent” who understands both AI and the industry, as well as equipment. However, perfection does not exist, and the most scientific approach is to abstract simplicity from complexity. Since the most stable geometric structure in the world is a triangle — stable, firm, and pressure-resistant — companies should create a similarly resilient structure in business. Resource-based enterprises, equipment providers, and service providers like Huawei, which provides information infrastructure and AI tools, should work closely together for joint innovation. By combining our strengths to form a steadfast triangle, we can achieve mutual development and create an intelligent industrial ecosystem.

With new fields emerging for innovation, we need strategic talent who can lead in technological advancements and produce innovative production tools, as well as application-oriented talent who can sort out and master new means of production. The aim of gaining cross-industry knowledge is to enhance our understand-

ing and ability to develop effective strategies. We can establish platforms, teams, and mutually beneficial mechanisms to create value through integrated operations. This will help us grow together, achieve digital and intelligent transformation, and ultimately improve the total factor productivity.

In recent years, Huawei’s industry-specific teams and R&D experts have immersed themselves in various scenarios within resource-based industries to understand their pain points. They have also collaborated closely with equipment vendors and design institutes, improving their professional skills and tools while integrating Huawei’s digital, intelligent software and hardware into industry scenarios and equipment. Huawei has established close cooperation with leading enterprises like Shandong Energy, Shanxi Coke Coal, Huaneng Group, China Coal Energy, Shaanxi Coal and Chemical Industry Group, Shendong Coal Mine, Ningxia Coal Mine, China National Building Material Group, Conch Cement, CNPC, and Sinopec. Huawei’s training programs for digital transformation have attracted over 15,000 from these leading enterprises, including their managers, business personnel, and technical personnel. These programs promote deep understanding and practical thinking through cross-disciplinary and cultural exchanges. As a result, digital, intelligent and low-carbon transformation has become a tool for achieving business strategies, improving efficiency and safety, reducing costs, and enhancing competitiveness.

Conclusion: Unleash new productive forces through innovation, cooperation, and development

The intelligent and low-carbon future is a shared future for all humanity. Countries and companies have the right and the need to participate in intelligent and low-carbon development. By jointly promoting the innovation and application of digital and intelligent technology, they can become the best version of themselves.

Huawei aims to create a digital-real ecosystem and a new information infrastructure centered on AI, supporting the Three Leaps in productivity. This can be achieved through continuous joint innovation with industry customers and partners. By utilizing the afore-said Three Construction (advancement) methods, we can tailor AI to the specific needs of industries like mining, oil and gas, smelting, chemicals, and building materials, creating significant customer benefits. Although the potential for productivity improvement is inherently there, it can only be fully realized through innovation, cooperation, and development, which can then stimulate enterprise potential and unlock new productive forces.

As the saying goes, “A rising tide lifts all boats.” We believe that by combining our wisdom and resources across industries, we can overcome the challenges of developing new productive forces, drive the economy towards high-quality, high-level development, and ultimately benefit mankind.

LARGE MODELS EMPOWER THE CHEMICAL INDUSTRY WITH A NEW DEVELOPMENT PARADIGM



Liu Zhongmin

Academician of the Chinese Academy of Engineering (CAE), Director of Dalian Institute of Chemical Physics, Chinese Academy of Sciences

Ye Mao

Researcher of the Dalian Institute of Chemical Physics, Chinese Academy of Sciences, and Deputy Director of Low Carbon Catalytic and Engineering Research

In the chemical industry, the development of new technologies is hindered by prolonged cycles and high risks. It is remarkable that an R&D engineer can make a technical achievement and witness its practical application within their lifetime. To leverage AI in accelerating technological R&D and driving it to mass production is a topic well worth exploring.

The chemical industry, a key player of process manufacturing, has consistently grappled with the challenge of protracted technological development and application. Typically, an initial small-scale experiment must be conducted, followed by a medium-scale experiment. Eventually, the scale can be gradually expanded to mass production and application.

The chemical industry adopts a phased technological development and application strategy due to the inherent complexity of chemical reaction processes. Even an angstrom-level (\AA , unit of length, equal to 0.1 nanometer) change in chemical bonds can result in significant 10-meter-level changes in the reactor. The entire chemical plant occupies a vast area of several square kilometers, making it theo-

retically challenging to accurately describe such a complex system.

Therefore, the chemical industry is restricted by physical constraints, limited time, huge costs, and extremely high risks of failure. These things have become a bottleneck to the development of new chemical technologies. For example, it took 30 years for methanol-to-olefin technology to go from the lab to industrial application, undergoing three phases of technological development and experiment.

Even if the development of a new technology is complete, it may become obsolete during final implementation due to how long it took to make and changes to market demand and technical environments. Many technologies die in the medium-scale experiment phase, either in the lab or in industrial applications. Therefore, we need to change our mindset and explore new approaches to R&D.

The chemical industry has been focusing on the development of intelligent technologies in scientific research for many years. Now, we should focus on deploying intelligent technologies in industrial applications to solve the problems of slow technological development and difficult implementation, shifting from "AI for science" to "AI for engineering."

Today, AI technologies represented by large models are growing rapidly, changing the traditional R&D mode of the chemical industry and providing a new data-driven development pattern for complex chemical systems. We can use AI and digital twin technologies to simulate the amplification process from labs to factories, and learn and improve the models in virtual plants to accelerate R&D. At the same time, we need to partner with technology companies like Huawei to develop innovative large models. We can contribute our chemical industry expertise and experience and cooperate with partners to develop professional vertical application models with moderate numbers of parameters. In this way, we can reduce the cost and threshold of large model applications, benefiting the entire chemical industry.

By further evolving professional large models into intelligent twins, we can build a vir-



tual plant that connects to and interacts with the physical plant. The models can be applied in physical plants to verify assumptions and accumulate experience. Physical plants provide a large amount of data for model training and improvement so that the virtual plant can simulate the physical plant in all aspects. Eventually, the results of small-scale tests are verified directly in the virtual plant, greatly shortening the development cycle that used to take more than a decade to complete.

If all chemical plants can connect such a system, specific processes can be optimized and controlled, and chemical industry planning will become more efficient and agile. As a result, it no longer takes three years to plan for the next five years. Such a transformation will undoubtedly boost the competitiveness and growth of the chemical industry in China.

The Dalian Institute of Chemical Physics of the Chinese Academy of Sciences and Huawei have jointly developed a large model for the chemical industry. The model includes basic modules such as data processing and professional knowledge graphs, as well as key modules like automatic generation of reaction dynamics and automatic generation of process flow diagrams. For example, with the automatic reaction kinetics generation module, the large model can extract reaction mechanism knowledge from massive literature, generate a possible reaction network by converting the mechanism into a reaction rule, and automatically recommend an experimental solution. Finally, a robot performs a high-throughput experiment to construct reaction kinetics for industrial process development. This chemical large model is now being iterated from version 1.0 to version 2.0.

We are currently developing a comprehensive model application ecosystem for the chemical industry, aimed at propelling the intelligent and low-carbon transformation of the sector and securing a dominant position in the industry's transformation process. The objectives are outlined below:

- **Eliminating the bottleneck of cascaded amplification:** The large model is used to simulate and predict the behavior of chemical reactions in reactors of different scales, thereby reducing the number of medium-scale experiment processes and accelerating the R&D of new technologies.
- **Shortening the R&D period:** The large model is used to process and analyze massive amounts of data and quickly identify the optimal path, significantly shortening the R&D cycle of new technologies.
- **Reducing R&D investment:** The large model is used to reduce the number of experiments, improve R&D efficiency, and reduce new technology R&D costs.
- **Enabling industry users:** Intelligent tools are provided for industry users to optimize the production process and improve efficiency as well as product quality.
- **Supporting intelligent decision-making and planning:** The large model provides accurate data analysis and prediction, which helps management departments make more intelligent and effective decisions and plans.

The integration of AI in the chemical industry has already demonstrated promising outcomes, while also presenting a plethora of challenges, particularly in the realms of engineering and process development. Chemical processes are characterized by a complex, multi-scale system, wherein the development is driven by both empirical data and theoretical frameworks. Moreover, the continuous and dynamic nature of chemical processes renders it more challenging to establish a digital twin, as compared to discrete systems.

To develop chemical large models and intelligent twins, it is essential to cultivate a comprehensive understanding of cross-disciplinary knowledge, technologies, and expertise, foster cross-disciplinary collaboration, and develop AI talent with expertise in the chemical industry. Furthermore, it is also vital to strengthen the synergy and cooperation between industry, academia, and research institutions.



RIVETING PERFORMANCE

By adding digital technology to a simple steel bar, these researchers are trying to make underground mining safer and sustainable



Michael Tost

Professor for Sustainable Mining Technology
Montanuniversität Leoben, Austria



Philipp Hartlieb

Senior Scientist and Mining Engineer
Montanuniversität Leoben, Austria

What aspects of sustainable mining are you focused on at the moment?

Michael: Our focus is on underground mining in Europe, where there is fierce competition for land that might be used for purposes other than mining – agriculture, for example, or tourism. We’ve already seen instances where existing open-pit mines were not allowed to expand, so we’re looking at how they might continue to operate as underground mines.

From an environmental standpoint, open-pit mines are generally considered less desirable than those underground. They use more land and have a bigger impact on it. In underground mines, by contrast, some waste material can be kept underground and used for backfilling – refilling an excavated hole – so you also need less land for waste disposal structures. From a safety point of view, however, underground mining could be seen as more risky.

In Europe, competition for land is pushing the industry in the direction of underground mining. At Montanuniversität Leoben, we are working on new underground mining methods that are more economic than current ones, and are focusing on particular aspects of digitalization.

What are some of the key technologies being developed?

Philipp: One technology we’ve been working on is a digital rock bolt.

When you mine underground, you need artificial support for the rock mass to stabilize it for a specified period of time. That can be two weeks or 200 years. You can simulate the load-bearing capacity of your support measures; and you can simulate the behavior of the rock mass to see whether it’s going to break, or collapse. After that, you can generically install support measures. But you still don’t have information about how the support measures really perform.

A rock bolt is a steel bar that is inserted and then tightened or glued into the rock mass. Rock bolts can be up to three meters long. Other support measures include wire mesh, which helps prevent rocks from falling, and shotcrete, which is concrete you spray on the rock wall to stabilize it.

Before you go into the mine, engineers will have checked for areas where you might expect to find instabilities. Among other things, they use something called measuring bolts. These bolts

have no supporting capacity; they are just installed for measuring the behavior of the rock mass. The thing is, they're pretty expensive: roughly 2,000 euros, or dollars, apiece. Because it comes at such a high cost, you tend to think very carefully before buying and installing something like that, and you only install them at very specific spots that you've identified beforehand.

We're looking at ways to digitalize the standard rock support bolts by installing a cheap sensor on every bolt that would be installed anyway. This will allow us to analyze the behavior of each bolt. Mining engineers will then know how they are stressed, or how they are elongated if the rock mass is moving. You will know if one of them fails, so you can replace it. You'll know whether to increase or reduce the number of bolts you install. You'll know if you need to change the entire mining layout because the stress distribution of the underground structures is going in an unexpected direction. You have much more knowledge about the rock mass and the behavior of the underground structure.

To do all of that, you not only need the sensors, you would also have to set up a small communication network inside the mine, and appropriate capacities for the Industrial Internet of Things.

So are the digital rock bolts mainly for safety, or do they also help with sustainability and environmental protection?

Philipp: Both. Local failures identified by those rock bolts are more safety-related, and by local, I mean anything that takes place in a very confined area. But anything we observe as a global trend in the mining operation is more related to sustainability. That's because we'll be able to optimize the mining layout and the mining sequence in a way that allows us to get a greater quantity of valuable materials out of the mine, more efficiently and without compromising safety.

Michael: So, for example, you cannot extract 100% from a deposit with traditional mining methods. A good illustration is the mining method called "room and pillar," where "rooms" of ore are excavated and "pillars" of unused ore are left in place to support the roof. Using that method, you might have to leave in place pillars that make up half of your deposit. But if you have better information about that mine, you can potentially reduce the size or number of your pillars. That means that, for any deposit of a given size, you might be able to extract significantly more ore. More efficient extraction helps sustainability.

Do these digital rock bolts exist now, or are they still being developed?

Philipp: They're being developed. We have prototypes installed in some European mining operations, but we're still working to produce an industrial-grade sensor-and-bolt combination.

Sounds like something every mine would want to have. Once you perfect the technology, do you expect it to become universal in the mining industry, or are there hurdles to broad adoption?

Philipp: Different mines have different scales. There are small quarry operations producing 500,000 tons a year, with two dump trucks and three or four excavators operated by about 10 people; then there are huge mines producing hundreds of millions of tons, with 20 of the largest trucks you can imagine, and associated auxiliary equipment. The approach of those two different types of mines will be completely different.

When you talk to a small-scale operation and say to them, "Let's digitalize your processes, then you'll perform better," they're going to say, "I can't optimize two dump trucks down to 1.8 trucks." When you talk to a very large company, it's different.

The second aspect is network connectivity. The mining environment is constantly changing over time, which makes it complicated to maintain the network. You need to maintain your power supply, and your supply of fresh air and water. You also need a 5G, Wi-Fi, or LoRa network. And with every piece or layer you add, you're expending effort.

So, depending on the mining system you're using, you will need to consider whether it's worth the effort to install the digital rock bolts. That's one of the major hurdles to adoption.

Is this something that's more likely to be adopted by larger mining companies, rather than smaller ones?

Philipp: Potentially, yes. But what we've also observed is that, if there is an interested engineer in a small operation, they tend to be extremely flexible. As a researcher, you can just go to them and say, "Hey, let us test something," and they say, "Okay, let's do it." In a big operation, by contrast, you need to go all the way up through

management. But on balance, it's probably more likely that a larger operation would adopt the digital rock bolts.

Were the digital rock bolts invented or developed by your university? Or are they being worked on by different researchers in different parts of the world?

Michael: There are different initiatives with different technologies. Eventually, we'll see which one is most successful. The one I have in my hands here [holds up a steel bar] is something our university is developing together with a rock bolt manufacturer. The sensors were developed here at our university.

“
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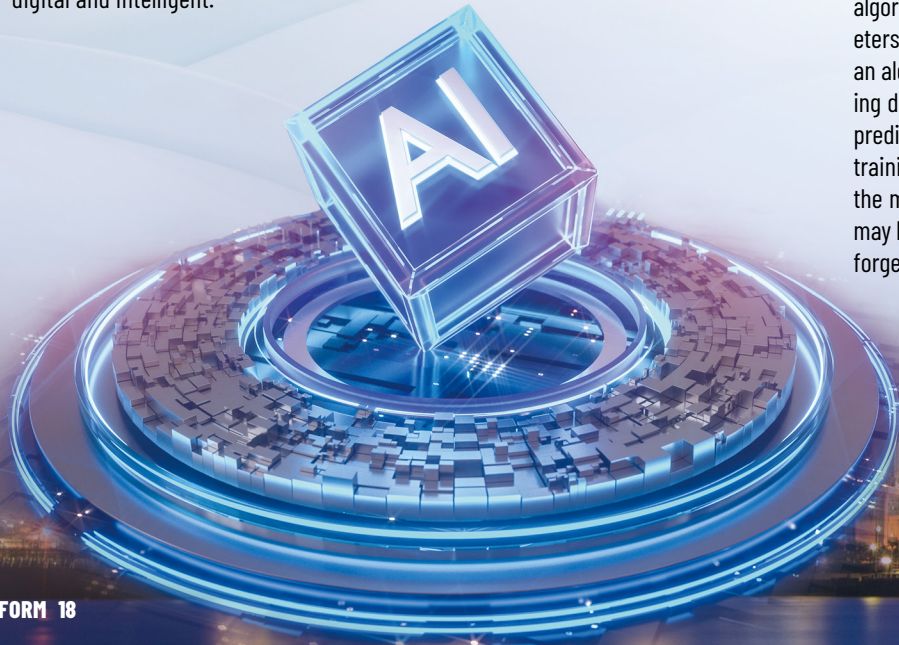
BUILDING LARGE AI MODELS BEST SUITED TO INDUSTRY NEEDS



Jiang Wangcheng

President of Solutions, Huawei Oil,
Gas & Mining BU

In 2024, the Chinese government proposed the AI+ action plan in its work report, regarding AI as an engine for developing of new productive forces. Over the past two years, the field of AI has seen a sudden rush of wind in its sails. The emergence of ChatGPT was like a tsunami that made large AI models a buzzword in the tech industry. After ChatGPT, many other large models sprang up worldwide. Many large model companies are targeting traditional industries and exploring ways to leverage large model technologies to help industries go digital and intelligent.



Challenges to the deployment of large models in traditional industries

In 2021, Huawei established an Oil, Gas & Mining Business Unit, with the aim of using AI to enable manufacturing industries. Today, AI is widely applied in coal mining, smelting, oil and gas, and the chemical industry. However, there are five key challenges that hinder the smooth application of AI in the industrial sector.

First, the accuracy of small models and expert models (also known as traditional models) is low. In model training and inference phases, the accuracy of many small models is relatively low, since past computing power could not meet their requirements. In addition, the knowledge storage and learning structure on which algorithms depend is simple, and the number of parameters is small. As a result, overfitting may occur when an algorithm fits too closely or even exactly to its training data, resulting in a model that can't make accurate predictions or conclusions from any data other than the training data. For example, when learning a new skill, the model forgets the old skill it has already learned. It may have learned the skill of subtraction, but then it will forget the skill of addition.

Second, traditional large models are highly customized, difficult to generalize. If a model is developed and trained for a specific scenario and then applied to other similar ones, the model needs to be re-developed or optimized. It is no small feat to smoothly migrate and replicate the model cross scenarios. This high level of customization leads to poor generalization and high costs. In one example, a building material company invested heavily to build a smart factory model. However, due to poor generalization, the model's success could not be replicated across the other 140 factories. In another example, a large smart coal mine model was verified in more than 40 scenarios, but it remained in the demonstration phase due to poor generalization. It was nearly impossible to integrate the model with real production services.

Third, negative samples (abnormal cases) cannot cover all scenarios or cases. Although the basic logic of AI is to solve a large number of problems in the production process, comprehensive negative samples are often difficult to obtain because new, unknown problems will keep emerging. It is not enough to rely merely on historical problem samples for learning and prediction.

Fourth, data security concerns abound. Data security concerns arise from concerns over the public cloud environment, especially in fields involving sensitive service data and core technologies. When production data is trained outside a company, data security issues may arise. Large enterprises attach great importance to data security. They tend to deploy AI training centers on the private cloud rather than public cloud.

Fifth, there is a lack of talent reserves. AI development has a high threshold on personnel skills. Enterprises focus on production and often lack sufficient IT talent to support AI deployment and application.

Unlike in the Internet field, the integration of large models in industrial fields is relatively slow. Large models have great potential

to optimize production processes, improve product quality, and reduce operation costs, but the effect of their application in industrial fields is not ideal owing to complex environments, diverse types of data, and a high technical threshold.

Help traditional energy industry to tackle these challenges

Huawei is committed to developing innovative technologies and products to help customers tackle these challenges. To overcome the issues surrounding AI implementation in the industrial field, Huawei has launched **a new, two-tier architecture of cloud-edge synergy for central training and edge inference.**

The gist of this architecture is that the training center deployed on the group side and the inference mechanism on the edge side can work collaboratively. On the group side, normal data and known negative samples are used for training and development, and the trained model is pushed to the edge side for inference. During the process of inference, the system accurately judges known negative samples and also identifies and captures abnormal, unknown data. Abnormal data will then be marked and sent back to the group side periodically or quantitatively for further learning and analysis.

Through the **"learning through using" cycle** featuring abnormal data capture at the edge, learning and optimization at the group, and application at the edge, the model can continuously adapt to new production environments and exceptions. This effectively solves otherwise hidden issues that cannot be addressed in traditional architecture. This also **improves its generalization as well**



In all these cases, AI has demonstrated a great potential and value in solving industrial problems. Industrial problems are often complex and difficult to solve. Huawei has ventured down the most difficult but also the most valuable path. With AI, Huawei is gradually surmounting these challenges and driving industry development with new productive forces.



as its capability to cope with new problems, negating the need for customization. The success rate of direct deployment in new scenarios exceeds 20%.

Many large models have emerged in China. However, few vendors can deploy AI training centers on private clouds, because this requires both good private cloud products and good AI training platform products. Huawei is one of the few vendors that can provide different solutions for different customers with different requirements.

It is worth mentioning that Huawei has worked to lower the skill threshold of AI development through large model workflows and deployment architecture optimization. This facilitates the quick implementation of AI in enterprises.

Pangu Model 5.0 — the model of choice for traditional industries

On June 21, 2024, Huawei officially released Pangu Model 5.0 at the Huawei Developer Conference. The model contains different parameters and a diverse range of functions, including the visual model, prediction model, Pangu natural language model, multi-style model, and scientific computing model. Huawei Pangu Model 5.0 has three prime features. It fits a diverse range of business environments, is a multi-style model, and is capable of powerful thinking. Rich innovative applications and implementation practices are designed to continuously solve industry challenges. Therefore, different models are optimized for specific application scenarios and requirements.

In terms of the large vision model, we designed a foundation model with 1 billion parameters and pre-trained the model on a dataset consisting of more than 100 million unlabeled images, achieving high classification precision on ImageNet benchmark. Take the mining industry as an example, through AI-based video analysis, exceptions can be accurately detected in real time, improving security and efficiency. By continuously improving the performance of the large vision model, we can deploy it in more application scenarios and create new opportunities for computer vision applications.

The predictive model is oriented to structured data. It provides accurate prediction capabilities through model recommendation and

convergence technologies. It can be widely used in areas like meteorological prediction, pharmaceuticals, new materials, coal blending/washing, and gasification furnaces. The prediction large model may further establish an association model between data and production results by learning and analyzing historical data, so that it can predict results corresponding to new production data. This capability helps enterprises detect potential problems in advance, optimize production processes, and improve production efficiency and device reliability. In the coal mine field, we expanded the CV large model and prediction large model according to customer requirements, achieving many desired outcomes.

In addition, through model generalization, the Pangu Model 5.0 solves the problem of large-scale industrial application that is typical of the traditional AI workshop development mode. It supports multiple natural language processing tasks, including text generation, text classification, and Q&A system.

Long-Time Coexistence of Large and Small Models

The prevalence of large models doesn't mean we should abandon small and mechanism models altogether. It's like having a car and a bike at the same time. Small and mechanism models will always have a role to play. In industrial scenarios where the system runs properly with stable working conditions, small models should continue to be used. Large models are essentially different from small models. A large model requires a large number of samples and high-quality data input. Without sample and data input, the efficacy of large models will be compromised. During scientific research or the development of new equipment and processes, there may be no available data support. In this case, mechanism, physical, and chemical knowledge must be used to describe the model, which means mechanism models are indispensable. Large models cannot completely replace small models. They will co-exist in the long run to jointly drive the development of traditional industries.

Especially in the coal mining industry, Huawei provides a relatively universal IT and CT platform. Coal mining customers can innovate and develop applications on their own on Huawei's plat-

form. The intelligent transformation of the coal mining industry is a multi-modal process that requires participation from the entire industry chain. Huawei's role is to build and provide the platform, rather than directly participating in the specific operations of coal mines.

Huawei is deepening the application of AI in the industrial field. In the steel industry, Huawei's AI applications are enabling the prediction and optimization of blast furnaces and continuous casters. In the coal industry, they have been deployed in key links such as coal washing. In all these cases, AI has demonstrated great potential and value in solving industrial problems. Industrial problems are often complex and difficult to solve. Huawei has ventured down the most difficult but also the most valuable path. With AI, Huawei is gradually surmounting these challenges and driving industry development with new productive forces.



BUILDING “INTELLIGENT BRAINS + INTELLIGENT FACTORIES” FOR MINES

THE PANGU MINE MODEL SIMPLIFIES AI DEVELOPMENT AND FACILITATES LARGE-SCALE COMMERCIAL USE



Liu Bo

General Manager of Yunding Technology



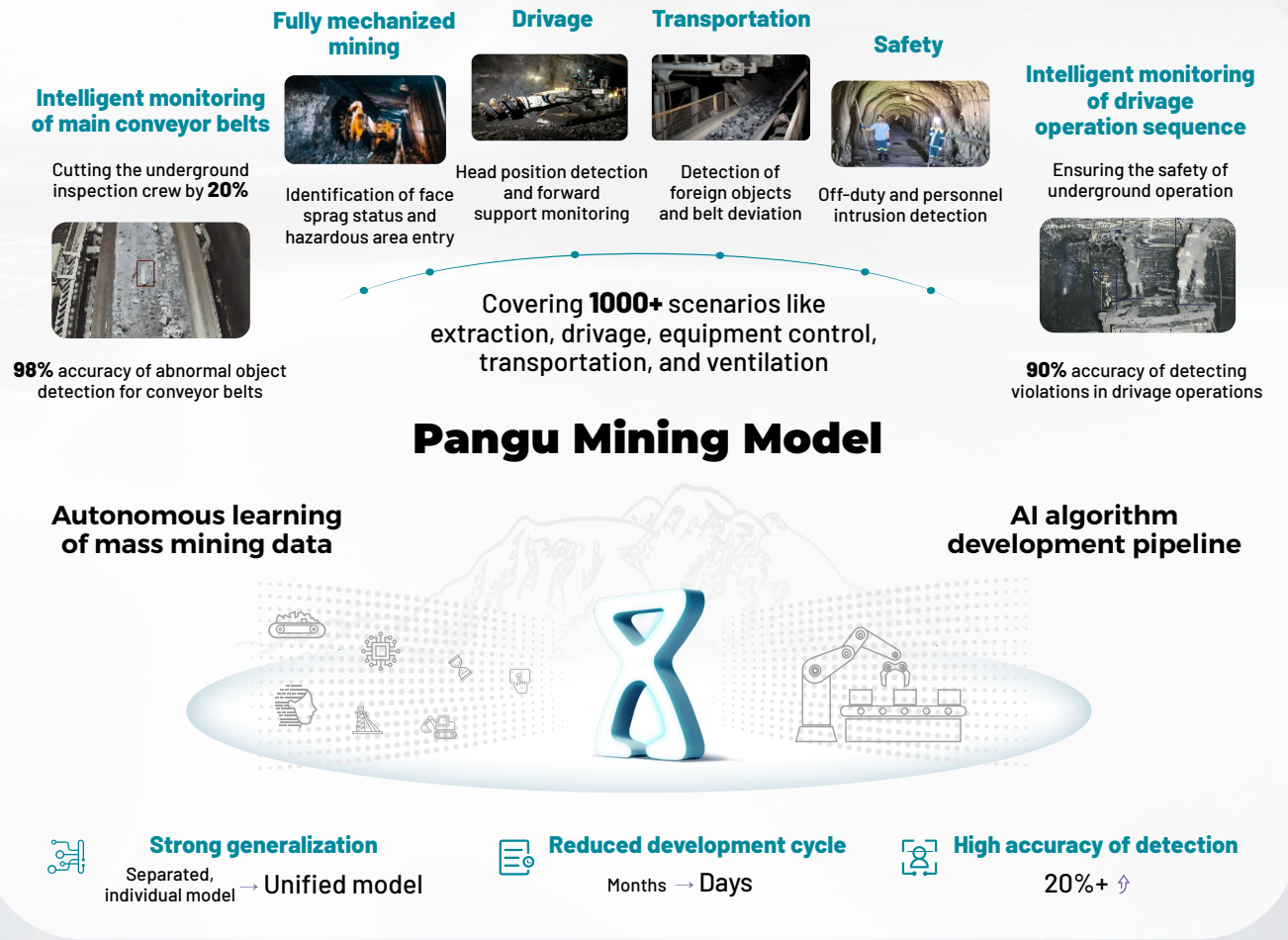
Technological innovation is leading the intelligent transformation of the coal industry. The integration of new information technologies with coal resource development and utilization has accelerated, resulting in the creation of a set of methodologies and solutions that can be easily replicated.

By the end of 2023, the number of intelligent mining faces had increased from more than 400 to almost 1,600. AI and other advanced technologies have led to the development of construction methods that can be used in different coal seam conditions. This has helped us make working conditions safer and boost efficiency.

On July 18, 2023, Shandong Energy Group, Yunding Technology, and Huawei jointly launched the Pangu mine model, the world's first commercial AI model for the energy industry. They had developed an architecture with cloud-edge synergy and thus introduced the “intelligent brain + intelligent factory” mode for the mining industry.

By utilizing algorithm training and closed-loop service management approach, the Pangu model offers comprehensive services for the creation and execution of intelligent scenarios in the energy sector.

In early 2023, Yunding Technology and Huawei agreed to coordinate further R&D into the utilization of the Pangu mine model with the aim of lowering some of the barriers to AI development, enhancing model identification accuracy and generalization, and providing intelligent enablement for safe mine



production. That is, the Pangu mine model is able to require only small amounts of data from mine wells for autonomous learning. This can improve safe production across various stages of mining, including digging, drivage, equipment control, transportation, and ventilation.

Safety during production has always been a major point of concern in the coal industry. Drivage (constructing a horizontal or inclined heading or roadway) is a key process. However, traditional operations often take place in confined spaces and involve numerous procedures, making it difficult to ensure both safety and engineering quality.

Yunding Technology achieved a significant breakthrough in intelligent supervision for the drivage process. It figured out how to integrate AI with the drivage processes, technologies, and equipment. Yunding Technology orchestrated on-site construction procedures and developed a complete set of AI scenario applications based on the Pangu mine model. The technology ensures personnel safety, standardizes operation behavior, and guarantees support quality. The Pangu mine model improves the safety and efficiency of coal production, while also making the development of innovative applications more inclusive to the whole industry.

Efficient decision-making is critical in the intelligent transformation of the coal industry. Yunding Technology has developed a refined management solution for coal preparation plants by utilizing the Pangu mine model, and technologies such as IoT, data analysis, and cloud computing. All of these build upon traditional industrial automation. The solution is

based on coal preparation plants' automation systems and integrates intelligent operations systems.

For example, in a conventional coking process, the varying compositions of raw coal result in different levels of sulfur and ash. Coal blending is then typically performed manually. This process is heavily dependent on operators' experience, making it difficult to achieve an optimal ratio of sulfur content, ash content, and other characteristics of raw coal. As a result, the quality of coke produced during each coking process can vary.

Yunding Technology tackled this issue by using a prediction model to organize and extract the expertise of its experienced operators and experts. This knowledge was then transformed into a quantifiable and actionable model. By implementing the coking coal blending model, it becomes possible to predict the quality of the resulting coke. Quality prediction, which previously took two



to three days, can now be completed in just one minute thanks to the AI.

Pangu models help accumulate knowledge and lower the threshold for AI development. The Pangu mine model combines the experience of experts in both the AI and mining fields. Now, it only takes one or two individuals to develop a single mining application scenario. This scenario can be executed in just two weeks and has been shown to enhance identification accuracy by 20% in real-world testing scenarios. In addition, the workloads required to label data samples can be reduced by more than 80%, freeing up many human resources and allowing for a greater emphasis on developing and operating AI applications.

By 2024 Q1, Yunding Technology had created 67 AI application scenarios across nine key fields, including coal mining, drivage,

and transportation, utilizing the visual and predictive capabilities of the Pangu mine model. Now, rapid and extensive replication is taking place. Shandong Energy Group, for example, has implemented 682 scenarios across 32 mining units. Yunding Technology has also kicked off AI project construction for eight coal mining enterprises, including the Wugou Coal Mine of Wanbei Coal-Electricity, and one chemical enterprise.

Pangu models will continue to be used in the mining industry as we explore AI applications in mines to enhance production intelligence. Moreover, Pangu models will extend their influence to other industries including the chemical, logistics, electric power, and new energy industries. This will further promote the extensive application of AI along the entire energy industry and create beneficial outcomes for both upstream and downstream counterparts.

HUNAN IRON & STEEL GROUP MAKES THE STEELMAKING PROCESS SMARTER AND MORE EFFICIENT WITH THE FIRST STEEL INDUSTRY MODEL APPLIED

On April 28 at the 2024 Hunan Advanced Manufacturing Application Scenario Conference in Changsha, Xiangtan Iron & Steel Group (Xiangtan Steel), a subsidiary of Hunan Iron & Steel Group Co.,Ltd., stood alongside China Mobile Hunan and Huawei as they launched a Pangu Large Model application for the steel industry. Their collective goal with this launch was to promote the integration of traditional industries and AI, and to set a new standard for the digital transformation of the global steel industry.

Two days later, on May 30, Xiangtan Steel was awarded for their application of AI model in the steel industry at the AI for Good Summit in Switzerland. The application was named by the International Telecommunication Union (ITU) as one of the Innovate for Impact Use Cases of the year, standing out among over 219 submissions by companies from 38 countries.



From manual calculation to model computing

Xiangtan Steel’s main factory stands about 30 meters high and houses several large pieces of metallurgical equipment, including three converters, three refining stations, five ladle furnaces, and five continuous casters. The air surrounding the equipment ripples from the heat rolling off them. Five cranes slowly transport 150-ton steel ladles that hold molten metal clocking in at 1000 °C, spanning a distance of 500 meters.

Coordinating the cranes is a major challenge for the steel mill. According to Wei Shuilian, an information engineer at Xiangtan Steel, it’s like completing a series of high-risk math tests, in a boiling hot classroom. Traditionally, cranes are manually controlled, and only experienced workers can operate the cranes. However, due to the complexity of the steelmaking process, relying solely on the experience of the crane operators can lead to process issues unsmooth, unaligned practices.

At Xiangtan Steel, the transition from manual crane operations to using large models for coordination has solved many of these issues. Their new intelligent crane scheduling system, equipped with steel models, integrates a vast amount of data, including steel production plans, crane maintenance information, the real-time location of the steel ladles, and various business rules.



This system uses algorithms to generate intelligent crane scheduling plans. What’s even smarter is that if there are any sudden changes to the production plan, the system only needs a minute to “think” and issue a new scheduling plan covering the next 30 minutes. Now, thanks to AI, even novice crane operators can become “experienced operators.” The status and trajectory of each piece of equipment is displayed on the screen in front of the operator’s seat, making it easy for them to follow the prompts and complete the operation. With the support of the large model, the turnover rate of steel ladles has greatly improved, and the waiting times and energy consumption per batch have decreased, leading to a cost savings of 1.2 CNY per ton of steel.

Large model’s “eagle eyes” supervise the “last-mile” of steel production

Conveyors play a critical role in steel mills by transporting material in bulk. They typically operate for 24 hours a day at a speed of two meters per second, and their status directly affects the continuity of steel production.

Conveyors usually require experienced workers to conduct regular inspections. They check for misalignments, bulging, foreign objects, tearing, and a host of other issues. If a belt breaks, the blast furnace is forced to shut down, which can result in a poten-

tial loss of one ton of molten iron for each minute that it's down. An alarm is triggered when the conveyor belt deviates by only five centimeters, and a severe alarm is triggered when it deviates by a decimeter. The belt is 1.6 meters wide, with a buffer of two decimeters on either side. The conveyor belt is made of a mixture of rubber and steel wire, and bulging can occur over time due to friction.

Experts from Huawei Oil, Gas & Mining Business Unit stationed at the mill conducted a detailed field survey of these issues and decided to employ an intelligent conveyor supervision solution using 5G and computer vision technology. Based on regular sampling, the system can intelligently supervise the conveyor belt's operations around the clock, predict trends that could result in bulging, and issue early warnings. The scenario design and alarm processing logic have since been continuously improved based on feedback from mill workers. After a month of large model training, the accuracy of the intelligent supervision has increased to 98%, effectively reducing the frequency and intensity of manual inspections.

Data-driven production transforms steel mills into a “central kitchen” for new applications

The potential of the Pangu Large Model is obvious to those pushing for intelligent transformation within the steel industry. The “0 to 1” breakthrough made by Xiangtan Steel with the large model was just the first step. They are now leveraging internal development to go from “1 to 10,” applying the model to diverse scenarios. In Xiangtan Steel's high-speed wire rod mill, production lines can each turn out a single coil of wire in just one minute. In the past, workers had to conduct rough sampling for inspections by flashlight. The high temperature of the product reduced inspection efficiency and made inspection a relatively unsafe job.

Now, eight industrial cameras are controlled by a cloud platform to perform real-time 180-degree quality inspections on every coil produced. Once the platform detects defects, workers can remotely review them on their computers. Xiangtan Iron & Steel's own software team developed the wire coil quality inspection system with the guidance of Huawei's technical team in just 10 days, marking a significant improvement in development efficiency compared with their previous development process, which could take more than a month.

“The Pangu Large Model is an important innovation our group is using to promote the in-depth integration of traditional industries and AI. Moving forward, we are committed to maintaining our strategic focus, enhancing our top-level design, gaining experience through ongoing practice, and collaborating with partners to drive innovation. Starting with Xiangtan Iron & Steel, we aim to enable and impact thousands of industries.”

Li Jianyu
Chairperson of Hunan Iron & Steel Group



In May 2024, Huawei and Xiangtan Steel were awarded by ITU as one of the Innovate for Impact Use Cases of the year for their Steel Pangu Foundation Model



“Pangu steel large models offer significant advantages thanks to their ability to generalize and lower the bar to pipeline development. This can help industrial enterprises improve their investment efficiency in technological innovation and establish a sustainable and healthy innovation ecosystem.”

You Peng
President of Huawei Cloud's Big Data and Artificial Intelligence



Thanks to low-code and no-code development tools, technicians can now efficiently convert business knowledge into technical language, turning their office into a “central kitchen” that creates new AI applications via modular development. Modular application development not only reduces development thresholds but also lowers the cost of development. In the past, a scenario transformation could cost millions of yuan, but now it only two to three hundred thousand.

Whilst 5G's high bandwidth and low latency make possible the efficient collection and transmission of data from a variety of different devices, AI steel models enable data to command production and to make effective decisions. For example, the AI prediction and optimization system can predict the temperature and composition of molten steel in real time and intelligently control the power supply and feeding, so that the whole steelmaking process can be completed within a specified time, while reducing the workload of workers. The intelligent coal blending system can better control the proportions of raw materials used, combining the state-of-art coal blending methodology to accurately predict the quality of incoming coke.

As of April 2024, Xiangtan Steel's deployment of the Pangu Large Model covered 23 intelligent application scenarios in nine specialties, including coking, sintering, ironmaking, steelmaking, rolling, and quality inspection, within two categories of visual and predictive applications. These applications are used for production optimization and quality control. The large model has also helped them reduce energy consumption by 10%.

In the future, the group plans to implement more than 60 innovative application scenarios to achieve further cost reductions, quality improvements, and efficiency enhancements. Xiangtan Iron & Steel is just one of many manufacturers in traditional industries that will be taking advantage of the productivity unlocked by this new phase of AI-powered development.

AUTONOMOUS DRIVING ENHANCES SAFETY AND EFFICIENCY IN OPEN-PIT MINES ON THE YUNNAN PLATEAU

Massive trucks carrying tons of freshly mined ore drive constantly up and down the roads surrounding one mine in Lanping County, Nujiang, located in Yunnan Province, China.

These heavy vehicles, each weighing hundreds of tons, can slow down when encountering uneven terrain and smoothly navigate steep slopes. The project site is provided by Yunnan Jinding Zinc Co., Ltd. The company's deputy mine director Jiang Xinyan said, "They are autonomous driving trucks. We already have a fleet of these trucks operating alongside remotely controlled excavators to extract minerals from the open-pit mine."

Jinding Zinc operates Asia's largest open-pit lead-zinc mine, located on the Yunnan Plateau. Whilst Technology Engineering Subsidiary of Yunnan Chihong Zn & Ge Co., Ltd. (Chihong T&E), the project operation company has teamed up with Huawei and China Mobile on the industry's first pilot of an autonomous driving solution in a plateau environment here. High-altitude, low-temperature deployments in regions with rugged terrain, such as Yunnan and Guizhou, have traditionally been extremely challenging. But many of China's metal mines are located in such areas, so the success of this project has significant implications for the entire industry.

The highest point of Lanping sits about 2,750 meters above sea level, which is not actually considered an extreme altitude on the Yunnan Plateau. But even this altitude presents a number of challenges for the engineers from Chihong T&E and Huawei.

Their project sits on a 3.2 km stretch of the mine's surface. Autonomous driving trucks weighing over 100 tons and almost 4 meters wide encounter difficulties on the rough terrain. They struggle with steep slopes, right-angle turns, scheduling for ultra-narrow two-way roads(6-meter-wide), and continuous unconnected slopes.

"The first time I drove an off-road vehicle here, I was so nervous. The road has a 9% incline, and it was so bumpy and muddy that I felt like I was going to be thrown out of the car," said Li Tianze, Huawei's resident project engineer. The cabs of mine trucks are elevated high above the ground, making sharp turns bracketed by cliffs particularly perilous.

Autonomous driving engines, the engineers insist, will be able to easily handle road sections that are challenging for human drivers. Autonomous driving trucks currently have tour trajectory planning modules that can adjust the vehicle speed based on the terrain. Engineers also have customized algorithms for specific driving scenarios like abrupt braking on uphill and downhill slopes, right-angle turns, and ultra-narrow roads. These specialized algorithms help the trucks easily handle the mine's complex environments.

Besides dealing with the difficult terrain, the engineers have decided to add a hybrid grouping capability that manages not only their autonomous driving vehicles, but also manned vehicles and remotely controlled excavators. This coordination capability should ensure stable operations across the entire road section the pilot sits on. The solution jointly proposed by Chihong T&E and Huawei uses a cloud platform to run a unified brain for the mining area that can plan paths for multiple vehicles to avoid conflicts. The planned paths include not only key coordinates but also driving speeds and expected arrival times at each key node, as well as the control modes required by different vehicles. This ensures that the vehicles are evenly distributed around the work area to avoid congestion.





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If our experiment succeeds, it will show that the autonomous driving technology can be widely used in similar mines on a larger scale. There are many non-ferrous metal mines in the remote parts of China with harsh environments, not just in high-altitude areas. Intelligent transformation is a long process, but we hope to promote the implementation of these safe and efficient production technologies to benefit the mining industry.

Zheng Yanchao
Project Leader of Chihong T&E

”

Li Chenxu, an on-site engineer from Chihong T&E, has been stationed at the mine since the pilot began. He explained, “In July and August, production in the mining area often stops due to heavy rain. It not only obstructs the driver’s vision but also makes the roads muddy, so we are constantly adjusting the routes we used. This made it hard to use the autonomous vehicles, since they could not adjust on their own as easily and steadily.”

To address this problem, Chihong T&E and Huawei tried various ways to further optimize their solutions. For example, for the autonomous driving vehicles, they now first analyze key indicators of roads and use a 3D road condition model to simulate what the truck will have to do during travel. They then use relevant algorithms to make the vehicle control more precise and efficient. In addition, they now use the big data infrastructure and large-scale production systems to more quickly adapt to the mine’s complex and ever-changing status, significantly improving the quality of their maps and making sure the maps are continuously updated.

Mining companies mainly face three big challenges in terms of safety, recruitment,

and efficiency during production and operations. The remote locations and harsh conditions in mines make it extremely difficult to recruit anyone, let alone young people, and the mining industry’s current workforce is aging rapidly. Mines are also struggling with low overall production volumes and inefficient transportation, while costs continue to rise. For instance, mining equipment is often not being fully utilized. Vehicle dispatch is inefficient and their fuel costs are extremely high. Truck and shovel operation is not coordinated, resulting in delayed production data updates and suboptimal mineral blending plans, ultimately leading to decreased product quality. From a business development perspective, unattended mining is a critical step forward as it addresses all three of these issues. But it is only possible through intelligent transformation.

Chihong T&E has teamed up with Huawei to tackle these challenges by utilizing Huawei’s 30+ years of ICT expertise, which specifically in intelligent mining construction, thanks to its recent partnerships with leading coal mining companies like CHN Energy, Shandong Energy Group, and Shaanxi Coal and Chemical Industry Group. Since June 2024,

engineers from Chihong T&E and Huawei have been testing autonomous driving applications in extreme weather conditions at Jinding Zinc’s mine. Pointing to a mining truck coming at him from another direction, Li Chenxu smiled and said, “Commissioning is currently challenging, and with the rainy season approaching, we need to accelerate our plans. In two to three years, you probably will not see many people here at the mine. The whole thing will be operated from an office at the base of the mountain.”

Zheng Yanchao, the project leader from Chihong T&E, sees the autonomous driving project at Jinding Zinc as just the beginning. “If our experiment succeeds, it will show that the autonomous driving technology can be widely used in similar mines on a larger scale,” he explained, “There are many non-ferrous metal mines in the remote parts of China with harsh environments, not just in high-altitude areas. Intelligent transformation is a long process, but we hope to promote the implementation of these safe and efficient production technologies to benefit the mining industry.” He added that planning for the next challenging high-altitude unattended mine is already underway.



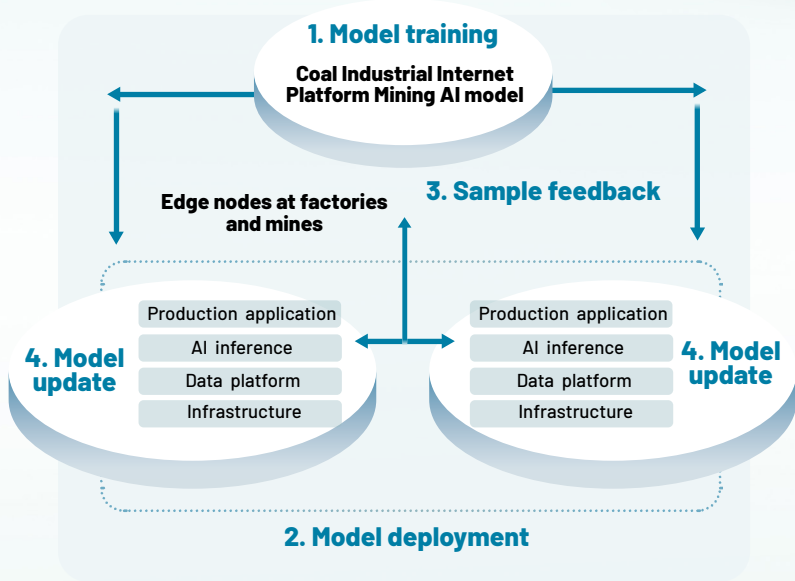
AN INDUSTRIAL INTERNET PLATFORM CREATES A NEW ERA FOR THE COAL INDUSTRY IN SHANXI PROVINCE

The Shanxi Coal Industrial Internet Platform was launched in Taiyuan on March 27, 2024. Developed by Shanxi Jinyun Interconnection Technology, the platform aims to support the upgrade and digital development of Shanxi's coal industry – an industry for which it is quickly becoming a model.

Shanxi is the first province in China to roll out a provincial industrial internet platform for the coal industry. This platform draws

on the technical support of partners such as China Unicom and Huawei and provides advanced, cost-effective intelligent products and solutions with unified standards, data formats, and architectures (called the “Three Unifications” for short).

The platform has proven sufficient to meet the intelligent transformation requirements of the local coal industry, helping coal enterprises reduce costs while amplifying the positive effects



of digitalization. The Shanxi Coal Industrial Internet Platform is an integrated industrial internet platform with a large AI model at its core. It includes an app store, a mining AI model platform, an operation support platform, and a cloud computing center.

The app store is a transaction and service platform for intelligent mine products and solutions aimed at ecosystem enterprises, integrated delivery enterprises, and coal production enterprises. The store provides open and transparent prices, helping **coal production enterprises** select the products and services that best suit their needs while reducing the trial-and-error that often drives up decision-making costs.

For **ecosystem enterprises**, the store has an admission authentication system. Admitted enterprises can access the mining AI model platform, a large amount of scenario-specific data, and the cloud computing center's resources to develop and release premium, yet reasonably priced, intelligent products. This helps ensure that traded commodities meet the platform's “Three Unifications” requirements.

Finally, the standard products and services provided on the platform help **integrated delivery enterprises** quickly and affordably replicate intelligent coal mine solutions across the industry.

As previously mentioned, the Coal Industrial Internet Platform was developed by Shanxi Jinyun, a subsidiary of Shanxi Capital Investment and Operation. Jointly built by China Unicom and Shanxi Jinyun, the platform's cloud computing center is the largest fully national-developed intelligent computing center in Shanxi. Its first-phase supports 64 petaflops of computing, and will eventually be scaled out to over 200 petaflops to support AI applications across the province as well as training and inference for complex AI algorithms and machine learning models. This can

reduce the cost of application development by over 80%.

Additionally, the platform uses Huawei's Pangu model for the mining industry, which supports intelligent vision and prediction model training and application. Zhao Hongyan, Deputy Governor of Shanxi Province, said that Shanxi presents optimal conditions for AI training, thanks to its numerous coal mines and diverse application scenarios. Coal mining enterprises can integrate the mining AI model with other cutting-edge industrial technologies and learn from the experience of other ecosystem partners to quickly roll out industry applications and products that use AI to improve quality and efficiency. The Coal Industrial Internet Platform aggregates a number of industry ecosystem strengths to enable intelligent mining and accelerate the implementation of AI across the industry. The platform has created a special channel for industry data accumulation that can leverage Shanxi's diverse coal mining scenarios. This facilitates application development and data governance, informs production decision-making with data, and improves efficiency and safety within the coal industry. The platform is also helping the province find a suitable approach to convert Shanxi's resource endowment into economic productivity.

At present, the platform has served 260 ecosystem partners

and hosts over 380 intelligent products in the app store. These products are handily meeting the needs of intelligent coal mine construction. The platform utilizes a powerful AI model to establish a robust AI operating system that includes central training, edge inference, cloud-edge collaboration, learning while using, and continuous optimization. It provides a strong foundation for future growth and prioritizes cutting-edge technology development so that users can stay

260 ecosystem partners
+ 9 strategic partners



up-to-date with industry standards and ensure their intelligent products are secure, advanced, standardized, open, and highly functional. Wang Hongqiao, Vice President of the China National Coal Association, has praised the platform's develop-

ment and construction, emphasizing the importance of promoting Shanxi's experience nationwide and working together to achieve high-quality development.

AI applications for various service domains

Our goal is to create an intelligent system based on the industrial Internet that can comprehensively perceive, connect in real-time, analyze and make decisions, learn on its own, make dynamic predictions, coordinate control, and finally evolve toward **digitalization, network connectivity** and **intelligence**.



Mining
Intelligent excavation
Intelligent mining
.....



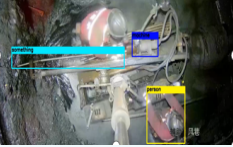
Comprehensive assurance
Device monitoring
Fault diagnosis
Early warning
.....



Main transport
Belt tear detection
Foreign object detection
Coal load calculation
.....



Subsidiary transport
Precise positioning
Intelligent scheduling
Vehicle monitoring
.....



Comprehensive management
Hazard monitoring
Geological assurance
Personnel positioning
.....

ORDOS LAUNCHES INDUSTRIAL INTERNET PLATFORM, EMPOWERING REGIONAL INTELLIGENT TRANSFORMATION

Ordos plays a significant role in China's energy sector. It is one of China's biggest coal and electricity bases and runs the country's largest new-energy power generation project. At present, Ordos has over 300 registered coal mines. In 2023, its coal production surpassed 800 million tons, making up almost 20% of China's total. Ordos is also home to many industrial parks and over 600

companies generating annual revenue of more than 20 million CNY (2.75 million USD). This diverse business landscape and modern industry system create fertile ground for industrial internet applications.

The Ordos Industrial Internet Platform was launched at the Ordos Industrial Internet Developers Conference on January 20, 2024. With a large AI model and

an industrial app store at its core, this platform is also Inner Mongolia's first industrial internet platform based on a large AI model.

Initiated by the Ordos municipal government, the Ordos Industrial Internet Platform was developed by Ordos City Digital Economy Development Investment Co., Ltd. It is centered on the MineHarmony operating system and AI, and aims to bring together AI computing power, industrial large models, AI algorithm models, application development platforms, and IoT technologies to create a comprehensive industry platform that covers production, training, research, and application.

The platform's main hub consists of an AI infrastructure, a data enablement platform, a large AI model for mines and chemical engineering, an application development platform, an app store, and an operation support platform. On the platform, users can train AI models, develop applications, manage model application delivery, and support edge deployment and services. Furthermore, partners can

launch, order, and trade products based on the platform portal. They can also showcase their products and solutions online through platform advertisements and digital exhibition halls.

The lightweight platform for enterprises is deployed at the edge. The central platform delivers and deploys AI services for model inference and running applications. During operation, any abnormal samples can be sent to the central platform. The model can then be optimized through iterative updates based on the learning-while-using mode, improving inference at the edge.

By utilizing unified underlying data standards and specifications, the system of central training, edge inference, and cloud-edge collaboration can effectively enable the industrial production of AI applications. This will ultimately lead to the creation of an intelligent decision-making support system driven by data and AI, accelerating the development of industrial intelligence.

The IoT operating system is crucial for building the industrial internet and serves as the foundation for making mine devices smart. The MineHarmony IoT operating system is the first to support a variety of coal mine devices, thanks to technologies like the unique soft bus and unified Mine Device Transfer Protocol (MDTP). By utilizing unified standards, architecture, and data specifications, the operating system effectively removes barriers between vendors and enables interconnection between devices. The goal is to assist coal enterprises in achieving intelligent sensing, intelligent decision-making, and automatic execution to gradually automate coal mining, transportation, and management, ultimately leading to unmanned production.

In April 2023, the Key Laboratory of MineHarmony Innovation was established in Ordos. In 2024, Ordos plans to establish a software and hardware industrial park to support the development of MineHarmony in terms of equipment, adaptation, application, and innovation. This will encourage the gathering of talent and ecosystem development in the technology sector of Ordos, leading to high-quality development within both digital and traditional industries.

Now, 18 AI partners, 16 MineHarmony partners, and 10 mining companies in China have signed agreements to join the platform. The platform's unique "factory-behind-the-store" model facilitates the integration of development and operations,

allowing for platform-based innovation, R&D achievement conversion, and business value realization. Essentially, industry applications developed in the back-end factory can be accessed through the front-end portal, benefiting all industry chain partners and effectively addressing the challenges of workshop-based AI development. This includes high barriers to entry and lengthy development periods, which hinder the widespread adoption of AI.

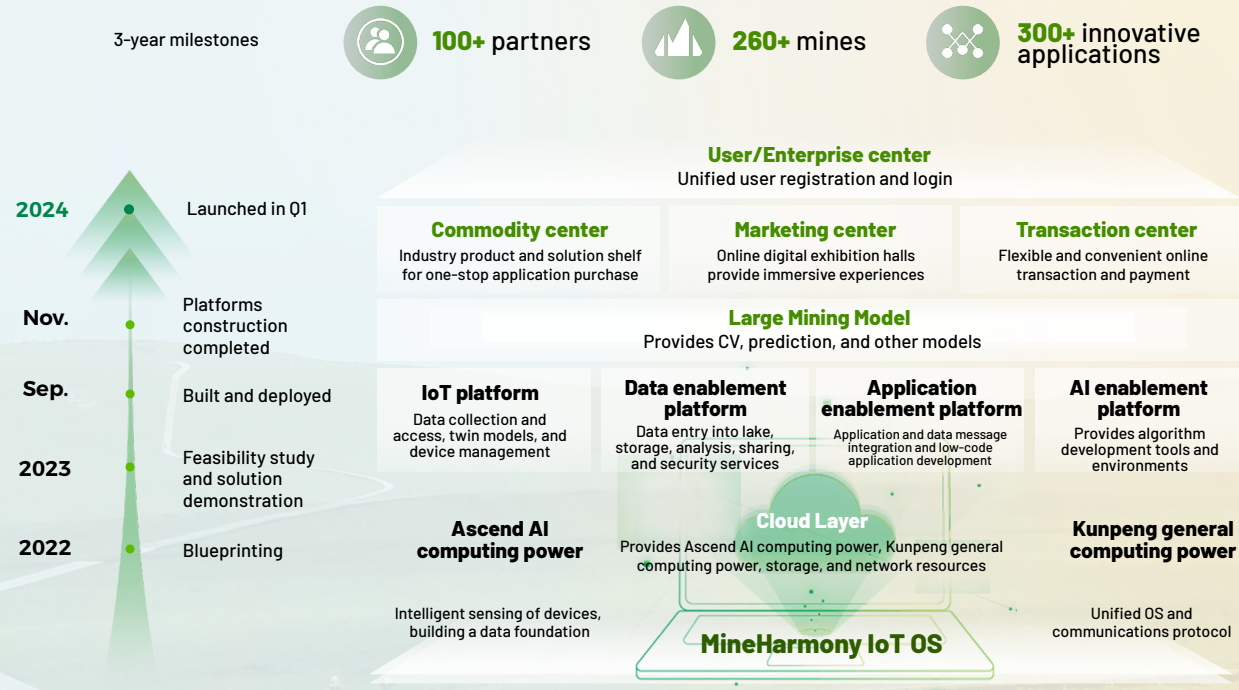
The use of digital technologies is set to revolutionize industries, and the Ordos Industrial Internet Platform is leading the

way. By the end of this year, the platform aims to connect 68 intelligent mines, with plans to expand to 160 by 2025. This will make it possible to implement intelligent coal production, while also creating a smart bridge that connects mine production with ecosystem partners. Furthermore, the Ordos Industrial Internet Platform will expand beyond the mining industry and into other sectors. It will be utilized to explore new avenues for industry development, such as chemical engineering, cashmere, and smart manufacturing of new energy. This will serve as a catalyst for regional industrial transformation and help Ordos develop its digital economy.



Ordos Industrial Internet Platform

Positioning: industry intelligence incubator



INTELLIGENT UNDERGROUND DEVICE SAFEGUARDS OCCUPATIONAL HEALTH AND MINE PRODUCTION



Being the world's largest coal producer and consumer, China puts significant emphasis on coal energy in its national resource development strategy. But the coal industry is facing great challenges, including complex geological conditions, harsh environments, and security risks

Improving mining and production safety has therefore become an urgent need and important development direction for smart mining construction.

Long labor-intensive work in underground environments leads to many health risks, including chronic and sudden-onset diseases. Traditional equipment for miners is often heavy and difficult to carry. With simple functions designed for limited scenarios, such devices are not built to dynamically monitor and manage the health and safety of coal mine workers. The occupational health management situation is dire.

To protect the health and safety of workers, Beidou Tiandi and Huawei jointly created an occupational health management solution designed to protect mine workers. Based on sensing, positioning, and next-generation communication technologies, the solution improves a coal mine's monitoring abilities, emergency handling management, and auxiliary command and dispatch for emergency rescue. The solution promotes the steady improvement of coal mine safety, quality, and efficiency.



The intelligent device solution is also equipped with a smart coal mine equipment platform, which enables smartphones to quickly connect to underground operation devices and implement efficient management. By adopting MineHarmony OneHop and near field communication (NFC), the solution helps workers read onsite operation device parameters, maintain and upgrade devices, and improve work efficiency. Wearable watches customized for mining can monitor the heart rate, blood oxygen, blood pressure, body temperature, and other physical data of underground workers in real time, and upload it to a health management platform through Bluetooth or Wi-Fi.

Intrinsically safe wearable watches are explosion-proof watches that limit the electric sparks or energy of the thermal effect generated inside electrical devices and by connected conducting wires, preventing the watches from igniting. If an emergency occurs, workers can use the watches to send SOS alarms to the platform. At the same time, the ground display system displays an alarm window, and ground personnel can quickly respond to the alarms based on the location provided by the precise positioning module of the mine lamp.



Currently, the worker health management platform and intelligent devices have been successfully launched in multiple coal mines and energy companies. Take the Zhuanlongwan Coal Mine of Shandong Energy Group as an example, the worker health management platform was deployed and launched in March 2022. The entire platform system is designed based on environmental safety and worker health. It adopted technologies such as big data collection on smart terminals, comprehensive multi-dimensional data analysis, and smart health detection to provide full-lifecycle health services for workers. Currently, the Zhuanlongwan Coal Mine is equipped with over 1,000 intrinsically safe watches, which have been updated to version 2.0.




On the worker health management platform of the Jinjitan Coal Mine, more than 300 intrinsically safe watches and MineHarmony-based mine lamps have been put into operation. The Beidou Health AI mirrors were put into use on June 15, 2022. With these tools, vital signs such as heart rate, blood oxygen, step count, and body temperature of all mine workers during their operations are evaluated and clearly displayed since the facial dynamic blood data were captured by the mirror camera.

In September 2023, the worker health management platform of Dongtan Coal Mine officially went live, establishing electronic worker health records for more than 2,500 workers in 25 underground positions and key ground positions of the mine. The Dongtan Coal Mine installed more than 2,600 smart watches and 30 multi-parameter portable instruments, as well as worker health appliances in wellhead healthcare stations. So far, the platform has collected more than 14,850,000 data records. By analyzing the collected data, the platform has established a risk assessment model and filtered out eight workers who required special attention. The system effectively ensures normal mine production operations.

On October 25, 2023, the mobile phone reconstructed based on Huawei Mate 60 series for the mining business went live. The mobile phone supports two-way satellite communication, NearLink technology, and multi-device collaboration. At the same time, the industry's first mine bone-conduction headset and MineHarmony multi-parameter detection alarm instruments were released. The bone-conduction headset adopts Huawei's industrial noise reduction algorithm and bidirectional bone-conduction technology, which can meet the requirements of clear communications in strong noise environments such as mining, washing, and transportation without blocking workers' ears.

With the digital and intelligent development of occupational health, the safety evaluation and warning of the coal mine operation environment are interconnected with intelligent individual equipment in real time, effectively protecting the health and safety of workers and greatly improving the operational efficiency of enterprises.





QINHUANGDAO 32-6 OILFIELD — EXPLORING THE JOURNEY OF AN INTELLIGENT OFFSHORE OILFIELD IN THE DEEP SEA

The oil and gas industry is urgently in need of digital transformation thanks to the looming global energy transition. It needs digital solutions to reconstruct its business and management models in a way that ensures its future competitiveness.

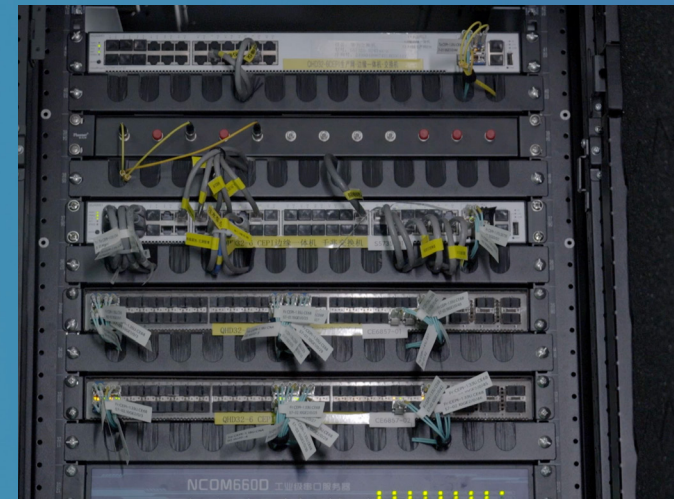
The China National Offshore Oil Corporation (CNOOC) is the largest offshore oil and gas producer in China. It started digital oilfield construction in 2008 and released its *Outline of Smart Oilfield Top-Level Design* in 2020. Since then, the CNOOC has partnered with Huawei to deploy digital solutions in its core oil and gas exploration and production (E&P) services, starting the offshore smart oilfield construction. Their Qinhuangdao 32-6 Oilfield pilot project has just been completed.

Huawei Cloud: a solid foundation for offshore oilfields that improved production efficiency by 30%

CNOOC decided to use the Huawei Cloud Stack (HCS) to build a central control system that could connect different systems via a unified platform that enabled delivery of visualized and intelligent IT resources and support digital offshore oilfield construction. The system uses tens of thousands of smart sensors to continuously collect parameter data from different systems, devices, and environments, then feed it to a central hub to be analyzed and processed.

At the same time, the parameter data is transmitted to the land control center of the Tianjin-Qinhuangdao 32-6 Oilfield 200 kilometers away. The central control system's analysis is then used to guide production decision-making. The central control system is the 'brain' and interacts with the 'hub' of the land control center, upgrading the whole intelligent oilfield.

Today, oilfield workers spend most of their time using the intelligent oilfield management system to monitor and plan production in real time. Ren Hongwei, an infrastructure engineer from CNOOC's Tianjin Branch who worked on the intelligent oilfield construction project, said: "We have deployed more than 40 intelligent algorithms for reservoir research and fault analysis models for oil wells on the cloud platform. These algorithms and models can prevent a variety of problems and minimize production losses. Our production efficiency improved 30% during the solution's trial run."





HCS CodeArts: enabling smart applications that cut R&D time by 30%

HCS can be used to build a cloud platform that provides “fertile soil” for smart applications to grow. The platform provides infrastructure enablement, but it’s the applications themselves that are the key to intelligence.

In the past, developers lacked unified management tools, code specifications, and standards. CNOOC had more than 3,000 software developers who complained about the previous R&D process, which had made product iteration inefficient and negatively impacted product functions.

In response, CNOOC set up a special research project that eventually adopted CodeArts, a software development pipeline from HCS. The CNOOC has since used CodeArts to develop an intelligent procurement system for procurement execution and warehousing and logistics management, an intelligent oilfield solution for cross-work notification, regional risk notification, real-time operation monitoring, and AI-enabled violation identification, and an application development cloud platform. These systems have helped them build an integrated digital platform for CNOOC’s supply chain.

8 core technologies of CodeArts

- CodeArts
Reg
- CodeArts
Wiki
- CodeArts
Repo
- CodeArts
Check
- CodeArts
Build
- CodeArts
Artifact
- CodeArts
Pipeline
- CodeArts
TestPlan

In addition, they have also adopted CodeArts Snap, a smart development assistant for the Pangu R&D model, to unlock smart code generation, smart Q&A, and smart collaboration. These new capabilities helped developers boost development efficiency. For example, they’ve developed an intelligent, secure, and efficient offshore oil and gas mining and operation model for the Qinhuangdao 32-6 Oilfield. CodeArts Snap helped 500 of the CNOOC’s developers compile more than 1.3 million lines of code, and launch more than 100 digital algorithm models under eight core technologies. Their R&D time was reduced by 30%, and the commissioning and deployment time of the intelligent oilfield management system was shortened from one week to one day.

From the intelligent oilfield development system to the intelligent R&D of the management system, cloud computing and artificial intelligence have revolutionized CNOOC’s production methods. “Digital and intelligent transformation changed our

technical models and our traditional operation and management methods. It also changed our mindset,” said Lin Yang, general manager of the intelligent oilfield construction project team from CNOOC Tianjin.

In the future, CNOOC plans to deepen its cooperation with Huawei Cloud to transform oil drilling and production platforms into “smart islands.” It will also continuously optimize its production models and management processes, and build intelligent oil and gas fields featuring unmanned operation sites, visualized reservoir research, collaborative production and operations, and scientific strategic decision-making. Huawei is committed to enabling intelligent and efficient offshore oil and gas exploration and production, and contributing to global energy security and economic development. We will develop more scenario-specific solutions to help oil and gas companies ‘dive into’ deep seas across the globe.

REFINED PRECISE EXPLORATION HELPS REJUVENATE DAQING OILFIELD

The discovery of Daqing Oilfield in 1959 coincided with the 10th anniversary of the founding of the People's Republic of China, and marked a significant milestone for the country's development. It helped China shed its reputation as an "oil-poor" nation, and the oilfield was subsequently named Daqing, which means "Great Celebration."

The oilfield's development was difficult, as China's petroleum industry had to be built from the ground up, but it is also a tale of daring innovation. Over the last 65 years, Daqing Oilfield has taken a unique approach to technological innovation: "Applying one generation of technology, while researching the next, and reserving the last." By simultaneously focusing on three generations of oil extraction technology, they have produced more than 10 million tons of oil over the last 21 years, making it one of the highest-producing single refineries in the world. Today, Daqing Oilfield focuses on what it calls "post-reservoir and unconventional oil" resources, which present a number of technological challenges.

After much research, Daqing Oilfield has determined that **precise and refined exploration will be the answer to increasing reserve**. It also decided to **dig deeper into already developed oilfields to maximize output**.

Oil and gas exploration can be compared to a CT scan of the ground. The more precise data is collected and processed, the more accurate an understanding operators get of the ground's geological structure. This increases the possibility of finding oil.

Oil and gas exploration involve a large amount of data and a long processing chain. Over time, however, the oil reservoir exploration system

of Daqing Oilfield has become outdated, with computing tasks often taking several days. Moreover, new data center construction is traditionally quite costly, requiring high initial investment into resources that will be underutilized and consume vast amounts of energy. In fact, the electricity costs alone for running the center for four years can equal to the cost of the IT equipment. The company need-

ed new storage and computing resources if it hoped to achieve more precise exploration.

Daqing Oilfield chose to lease high-performance computing resources from Huawei Cloud to meet these demands instead of building its own data center. Under this model, Daqing Oilfield established a high-speed cloud data center core network with 400G bandwidth by deploying almost 700 advanced servers, storage systems, and network devices. This has given them access to **833% more overall computing power**, which can allow them to complete from 120 trillion floating calculations per second to **1000 trillion floating calculations per second (equals to 1PFLOPS)**. Huawei Cloud's high-performance computing cluster can efficiently run international mainstream seismic processing software, which has reduced Daqing's business launch time from 30 months to 5. Daqing Oilfield's operation and maintenance workload have also been reduced, thanks to the unified operation and maintenance and synchronous upgrade capabilities that come with Huawei Cloud.

One Daqing Oilfield manager explained that their previous computing cluster only had the computing and storage capabilities needed to

complete small-scale pre-stack time migration processing. In complex faulted oil and gas target areas, the cluster simply could not support more advanced algorithmic processing methods. The new high-performance computing cluster and massive storage system provided by Huawei Cloud allows for pre-stack depth migration processing of layers up to eight kilometers deep. The processing area for pre-stack seismic data can also be expanded to 2000 square kilometers, thanks to the 500% increase in capability.

This new deep exploration is helping Daqing Oilfield revitalize old oilfields to increase and stabilize production. Production at many of their oldest wells had started to slow after 50 years of exploration. However, reduced production does not necessarily mean that there are no oil reserves left. By leveraging Huawei Cloud and AI technology, Daqing Oilfield has quickly built a cognitive computing platform to extract more value from massive amounts of "silent" and "useless" data. This allows them to take a more scientific approach to developing adjustment plans and implementing measures to explore the potential of old wells.

Daqing Oilfield now uses a cognitive computing platform to predict the output and water content indicators of three typical blocks. They have also established an indicator prediction model for medium- and high-permeability rare oil sandstone reservoirs. The prediction reaches over 90% precision, which is about 10% higher than standard prediction methods, making the management of oil well production more dynamic and single well measure decision-making more efficient. Together, these solutions help oilfields increase storage and production, reduce costs, and improve efficiency.

The oil industry is currently undergoing a major transformation thanks to digitization. Oil and gas exploration just happens to be the industry's testing ground for many of these emerging technologies. The application of intelligent technologies such as cloud computing, big data, and AI to oil and gas exploration will undoubtedly help bring us one step closer to a new era for this traditional industry.

DELIVERING INTELLIGENT, ALL-WEATHER INSPECTION FOR OIL AND GAS PIPELINES

Oil and gas continue to be an indispensable part of the global energy system, but challenges persist in the transport of these vital resources.

In China, oil and gas are mainly produced in the northeast, northwest, and southwest regions, while consumers are largely concentrated in the southeast coastal and south-central regions. The distances between these regions are massive. For long-distance overland transport of oil and gas, transmission pipelines remain the most cost-effective option.

Underground pipelines are commonly used in China, but are harder to inspect than above-ground pipelines. Traditional manual inspections are inadequate for risk prediction and emergency response. Incidents such as construction accidents, tampering, and natural disasters can cause supply interruptions, oil spills, fires, and explosions. This can result in serious environmental damage, economic losses, injury, and death.

So can we create an intelligent 24/7 pipeline inspector to supervise and detect pipeline risks in real time? The latest practice delivered by Huawei and PipeChina Shandong Branch has done exactly that.

Safeguarding pipeline and energy reserves

With one-tenth of China's pipelines, Shandong Province is a nexus of oil and gas transportation. The pipelines managed by PipeChina Shandong Branch run through complex natural environments such as farmland, wetlands, and bodies of water.

The company has partnered with Huawei to create an optical fiber warning system for oil and gas pipelines. The system enhances pipeline security through accurate identification and prevention of incidents such as oil theft and construction accidents, thereby protecting farmland and water resources from potentially disastrous oil spills and gas leaks. Huawei's distributed optical fiber sensing technology is used to intelligently supervise the linearly distributed pipeline areas.

Distributed optical fiber sensing technology functions similarly to the sensory nerves in the human body. When an intrusion occurs in a pipeline, the accompanying optical fiber cables deployed along the pipeline can sense vibrations. Different vibration patterns are quickly analyzed by the optical fiber sensing equipment to identify the event type and promptly issue an alarm, achieving intelligent pipeline supervision and early warning.

The optical fiber warning system has a three-layer end-edge-cloud architecture. The first layer is deployed at pipeline stations and valve rooms to collect raw vibration data from the optical fiber sensors. The second layer is deployed at PipeChina Shandong Branch and uses core algorithms such as wa-

terfall charts and alarm compression models to aggregate and process alarm data. The third layer is deployed at the PipeChina and uses the IMS system to achieve closed-loop alarm management. It also links with video security and drones to form a robust risk prevention system through the coordinated efforts of the three-layer architecture.

The system's algorithm models are optimized to prevent false alarms caused by passing vehicles. At night, the sensitivity of vibration alarms is increased to detect third-party drilling and tampering. False alarms are suppressed to enhance warning accuracy and reduce unnecessary on-site inspections. This significantly improves the pipeline in both efficiency and security.

Launched in December 2023, the optical fiber warning system spans 1,173 kilometers and has accurately identified and prevented more than 100 risks of third-party tampering.

As a major energy artery, oil and gas pipelines have a significant impact on global energy supply, so their security is of critical importance. Facing the major challenge of digitizing oil and gas pipelines, Huawei hopes to collaborate with oil and gas companies to develop more solutions to safeguard pipelines and ensure energy delivery by integrating new ICT such as optical sensing, AI, and big data. When it eventually takes shape, it will be an all-weather intelligent inspector for oil and gas pipelines.

SINOPEC TIANJIN PARTNERS WITH HUAWEI TO EXPLORE INTELLIGENT FACTORIES

The global energy landscape is currently undergoing seismic changes, and China's ongoing need for refined petroleum products is creating both challenges and opportunities for its energy industry. Major petroleum and petrochemical companies are seeking new development paths to improve efficiency, ensure security, and promote technological innovation. The refining industry in particular is embracing new ICT technologies in the hope of going digital and eventually realizing an intelligent transformation and upgrade.

Sinopec started building intelligent factories over a decade ago. It has gathered extensive practical experience in planning and scheduling collaboration, as well as in intelligent production, warehousing, and logistics. This has left it well-positioned to explore intelligent refinery systems.

Full 5G Connectivity Facilitates Intelligent Production of Oil Refineries.

5G is not a new concept in the oil and gas industry. As early as 2021, a collection of government agencies in China jointly released the *5G Application Implementation Plan in the Energy Field*, which emphasized the importance of 5G as a strategic resource that can be used to build new infrastructure for energy transformation.

Sinopec Tianjin's Nangang Ethylene Project is one of the key energy transformation projects listed in China's 14th Five-Year Plan. From the very beginning, Sinopec Tianjin decided to integrate intelligent scenarios and engineering projects into its Nangang campus through "synchronous design, construction, and use". This approach has enabled Sinopec Tianjin to create a digital twin that is an exact replica of the physical factory. The digital twin facilitates digital delivery/intake and engineering control in the construction phase and enables in-depth application of the campus platform in the operation phase. This has allowed them to integrate engineering construction and intelligent factory operations, enabling the digitalization of physical factories and visualized on-site management.

5G is an important part of Sinopec Tianjin's intelligent factory. According to Gao Wenqing, the company's chief informatization expert, the company's intelligent factory project relies on an ICT infrastructure made up of 5G networks, UPF, BeiDou satellite positioning, and NB-IoT. It also uses multiple supporting technologies such as BIM, VR, and GIS in its "5G + BeiDou" intelligent campus to synergize monitoring, management, display, and interaction functions. Integrating 5G technologies into petrochemical production and management scenarios unlocks new efficiencies by combining data and management flows. It

resolves various issues encountered during intelligent transformation and helps realize real-time transparent production and management.

Safety management is both the top priority and the first task of refinery development. Sinopec Tianjin has implemented an electronic work permit system to strengthen on-site safety management. Compared to traditional paper permits, this system uses 5G-powered and explosion-proof portable terminals to speed up operations. The high-precision combination of 5G and BeiDou satellite positioning also ensures workers can't clock in or out unless they are within one meter of their work area. This makes it much harder to forge or improperly issue safety inspection and permit records off-site.

Unfortunately, non-compliant operations are a common and easily overlooked aspect of safety management. With 5G, on-site operation videos can be transmitted directly to the cloud, where AI-powered recognition and big data analysis can be utilized to establish models for analyzing non-compliant operations, such as PPE violations, and non-compliance with standard operating procedures. The analysis of abnormal behaviors and scenes makes early warnings, real-time alarms, and post-incident tracing much easier. This automated on-site operation management is significantly more effective than manual operations.

For example, Sinopec Tianjin now uses a 5G-powered intelligent recognition system to detect fires in its installations. This system rapidly identifies, analyzes, and autonomously evaluates flame characteristics in videos collected by key devices installed in high-risk areas, such as those where temperatures regularly run above 220°C and where there is a high susceptibility to corrosion or chemical leaks, as well as around storage tanks, loading



and unloading platforms, hot oil pumps, and high-temperature pipelines. When a fire is detected, the system immediately sends out an alarm, reducing the need for manual inspections. This means that safety teams can take action before the fire gets out of control.

Sinopec Tianjin has also implemented a series of intelligent applications in its warehousing, safety management, environmental protection detection, intelligent process control (IPC), and remote employee training. The construction of intelligent factories can comprehensively improve operational decision-making efficiency, production efficiency, safety and environmental protection, collaborative development capabilities, and enterprise development capabilities.

Improving Intelligent Factory Construction

If we compare an intelligent factory to a highway, then 5G technologies are like the roadbed, ICT infrastructure is the road surface, and various business applications are the vehicles. A reliable and stable road is key to worry-free vehicle operations.

Digital platforms: Traditional application development models often result in fragmented management, data silos,

and scattered resources. By building a digital twin industrial Internet platform featuring cloud-edge-device collaboration, rapid application development, and highly reliable assurance are made available for all services. With this platform, cloud-native service applications can speed up service deployment by reducing service provisioning time from months to weeks.

Computing and storage resources: Intelligent algorithms and models improve the intelligent analysis and decision-making capabilities of refineries. A “partitioning + layering + plane division + security” design not only supports the migration of existing service systems such as production and sales collaboration to the cloud and the deployment of new services, but also reserves redundant resources to support future service evolution without needing new investment.

Networks: Wired and wireless integration simplifies network O&M. A single Space-Air-Ground Integrated Network (SAGIN) can support both office and production services, and allow for unified O&M. This better integrates OT and IT services and solves multiple issues such as inaccurate fault locating and the difficult O&M on traditional refining service networks.

Intelligent factories with digital twins combine engineering construction and factory operations. Building a data resource

“

The construction of intelligent factories can comprehensively improve operational decision-making efficiency, production efficiency, safety and environmental protection, collaborative development capabilities, and enterprise development capabilities.

Gao Wenqing

Sinopec Tianjin’s Chief Informatization Expert

”



Sinopec Tianjin’s Digital Platform Live Demo

center with digital twins can create a unified data foundation, whilst digital delivery can enable industrial Internet platforms that bring together the strengths of cloud, edge, and devices. Together, these components have been used to build the “super brain” behind Sinopec Tianjin’s intelligent factories, making Sinopec Tianjin a new model of intelligent development in the petrochemical industry.



INTELLIGENT OIL, GAS AND MINING IN CHINA

Ordos — the City of Coal and Technology

Ordos — China's largest coal mining city — leverages Huawei Cloud Stack to implement automated monitoring, warning and handling of coal mine production processes, boosting efficiency and security. A new Industrial Internet platform was also built to empower coal mine companies with large models.



Scan a QR code to watch the video!



Ansteel Mining Works with Huawei to Build a Digital Steel Foundation with High-Security Production Networks

To accelerate mine production with digitalization, Ansteel Mining has worked with Huawei to build a high-security production network that seamlessly integrates dual fed and selective receiving and Wi-Fi Mesh technologies. This has enabled intelligent production and spearheading the digital transformation of the mining industry.



Scan a QR code to watch the video!



Scan a QR code to watch the video!

No Man's Land: Autonomous Driving on Mines

Autonomous driving is transforming open-pit lead-zinc mines of the Yunnan Plateau. We climbed to 2,800 meters to witness the latest application of autonomous mine trucks jointly developed by Chihong T&E and Huawei in Yunnan's Nuijiang Lisu Autonomous Prefecture. Through our joint endeavors, we aim to build safer, greener and more efficient open-pit mines.



Digging 1000 Meters Underground: Miners Empowered by Cutting-Edge Technology

Coal is a crucial energy source driving China's industrialization and urbanization. Historically, coal miners work in an extremely hazardous environment. Today, with the advent of technology and artificial intelligence, what changes have been made to their working conditions at a depth of over 1,000 meters below the earth's surface?



Scan a QR code to watch the video!



Xinhua News Agency: Made in China | AI Makes the Impossible Possible

AI is revitalizing the coal mine industry. Watch the video: *Made in China | AI Makes the Impossible Possible* from Xinhua News Agency to see how AI algorithms revolutionized underground coal mining.



Scan a QR code to watch the video!

Qinhuangdao 32-6 Oilfield — An Intelligent Offshore Oilfield Jointly Created by CNOOC and Huawei

Offshore oilfields are constantly evolving. Watch the documentary *Footprints of Time* to see how CNOOC partnered with Huawei to build a digital and intelligent oilfield in the depths of the ocean.



Scan a QR code to watch the video!



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