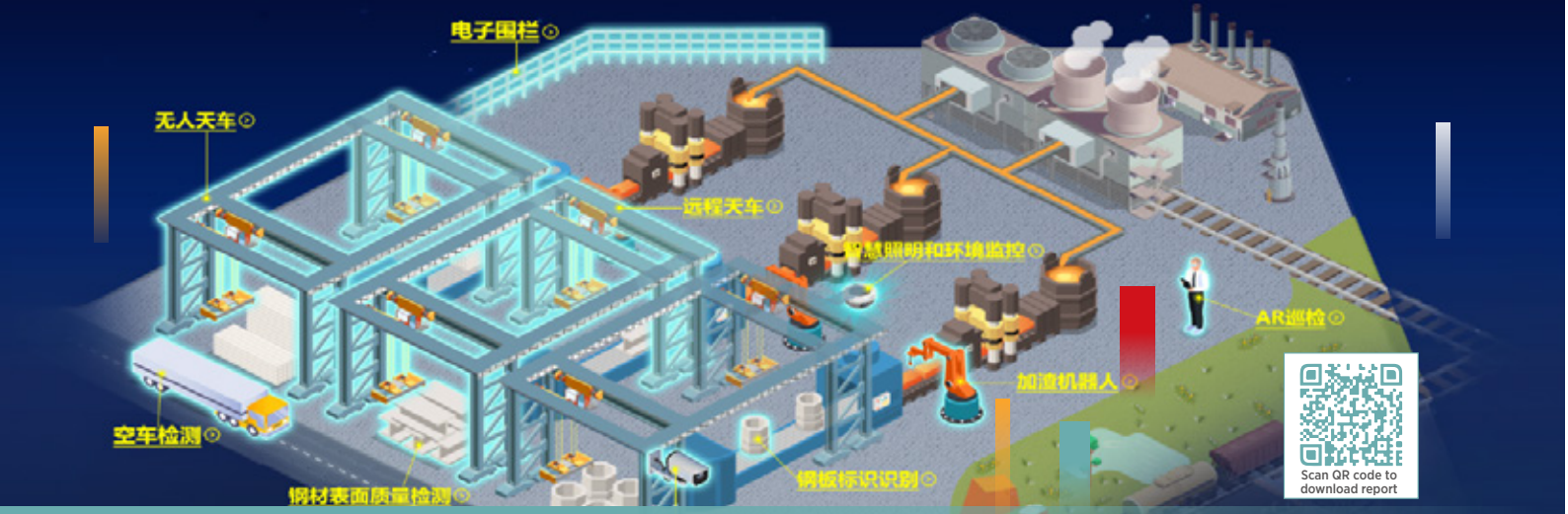


5G-based Smart Iron & Steel Project of Liuzhou Steel Group

"Spirit Like Steel, Ambition Like Sea. From a new starting point and in a new age of preferential policies, Liuzhou Steel Group will adhere to the spirit of the 19th National Congress of the Communist Party of China and Xi Jinping's Thought on Socialism with Chinese Characteristics for a New Era to uphold core philosophies of "inclusive, innovative, transcendent, and sharing" and seize the opportunity as the state is implementing the "Belt and Road Initiative". Boosted by the development of the Beibu Gulf, the Group will focus on the four strategic transformation goals, namely headquarters transformation and upgrading, orderly development of coastal areas, diversified and focused clusters, and strategic management and control by the Group, and fully deepen the supply-side reform to vigorously implement the coastal strategies, speed up the development of an international economy, and head for the goal of making into the world's top 500, as part of its effort to write a glorious chapter in the steel production history in Guangxi and even the whole country.

Pan Shiqing
Chairman of Liuzhou Steel Group

Partners 柳钢集团 LIUZHOU STEEL GROUP · 中国移动 China Mobile · HUAWEI

Case Overview

Liuzhou Steel Group is the largest iron and steel conglomerate in South China, Southwest China, and even the Pan Beibu Gulf economic zone. It is among the top 50 global steel enterprises and the top 500 Chinese enterprises, with more than CNY 100 billion of annual operating revenue and an annual comprehensive steel production capacity of 23 million tons. Liuzhou Steel Group cooperated with China Mobile Group Guangxi Branch and Huawei on a 5G smart steel project. By integrating 5G, cloud, and AI technologies into the production process, the project aims to build a digital Liuzhou Steel Group. The three parties jointly cooperated with the project team to innovatively launch eleven 5G + Industrial Internet application scenarios in the iron and steel industry, including the 5G Welder Cloud Eye quality inspection, cloud identification of solid waste, cloud identification of steel coil IDs, 5G-based smart cranes, 5G-based remote control of assembly machines, 5G-based remote control of stackers and reclaimers, 5G-based labelling machines, 5G-based predictive maintenance, 5G-based AR remote collaboration, 5G-based manufacturing centres, and security drills of 5G-based cloud networks. Currently, the project is the 5G industrial project with the most scenarios in China.

A series of 5G-based smart steel transformation has increased the benefits and cut the costs of Liuzhou Steel Group by more than 1 hundred million CNY. For example, the remotely controlled loader project has enabled on-site HD video backhaul and remote precise control of loaders, so that operators in the central control room of the Liuzhou Steel Group headquarters can operate the loaders in the Fangchenggang cold-rolled product workshop in real time and from multiple perspectives. This solution not only reduces the human resources required for one lifting operation by 60%, increases the efficiency by 400%, but also greatly improves the operating environment, operation safety, and workers' satisfaction about their jobs, which were known for their harsh conditions.

Relying on the low-latency data transmission of 5G networks and the real-time big data analysis of the industrial brain, Liuzhou Steel Group has employed the machine vision server and AI server in the cloud backend to replace the manual roller transfer. The solution is gradually promoted to other production lines to achieve the aim of a transparent factory of "Technology + Good appearance + Smart".

In the application of 5G-based remote control of cold-rolled cranes, cranes are remotely controlled based on the 5G multi-view capabilities. In the past, three people were required for the lifting task, but now only one person is enough to complete a single listing operation, with the human resources cut by 60%, and the lifting interval also decreases from 20 minutes in the past to the current five minutes, with the loading and unloading efficiency enhanced by 400%. Moreover, the control system uses a gamepad (the first application in the world) as the controller, which significantly improves the operating environment and addresses the recruitment challenge.

Industry Challenges

The entire production processes of the iron and steel industry are like a "black box" that cannot be seen, touched, or measured, as they feature the coexistence of multiple sites, phases, and variables, strong coupling, significant lagging, and nonlinear characteristics. This gives rise to the big uncertainty in iron and steel production processes and the product quality. Therefore, the steel industry is also the industry with the most urgent demand for intelligent mode. After China clarified the scope of new infrastructure, how to transform traditional manufacturing industry through new technologies including 5G has become the focus of many steel companies.

As an important steel company, Liuzhou Steel Group also faces many pain points that had been nagging the traditional manufacturing industry.

Harsh operating environment

The high-temperature, dusty, and noisy operating environment damages employees' health, which goes against companies' values.

Potential safety hazards

Some special positions have a tough environment and require continuous operation, which may easily cause human operation errors and result in safety and production accidents.

Low operating efficiency

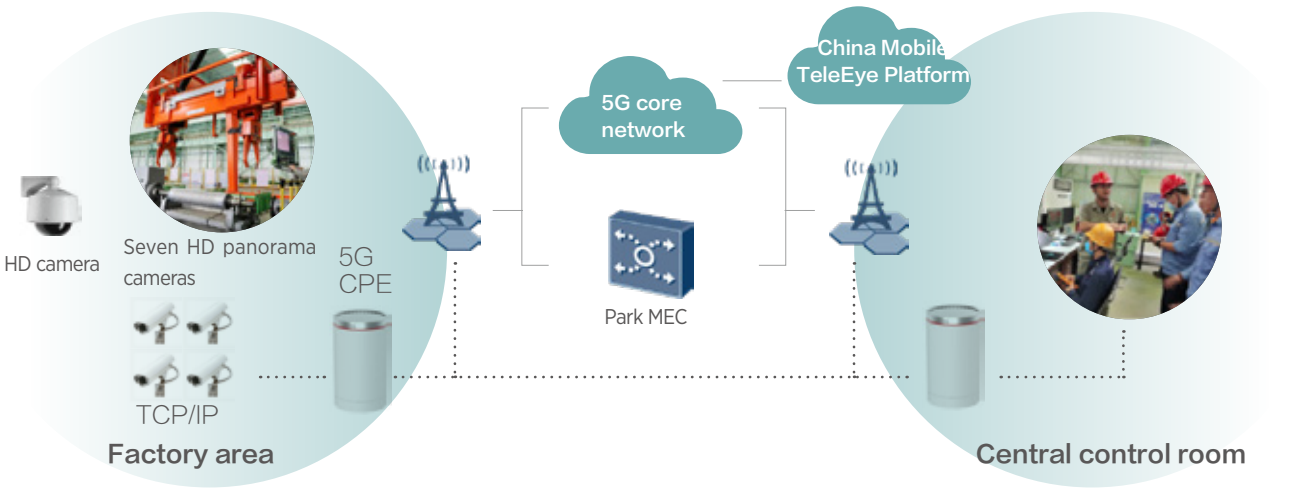
The on-site high-altitude boarding space is narrow and it takes long to get off, which undermines the working efficiency. Moreover, the positions of crane operation workers are scattered, lowering down the organisational and management efficiency. One crane requires multiple dedicated persons, which causes high waste of human resources.

The high-speed, enhanced-mobile broadband, low-latency, and high-reliability characteristics of 5G networks are perfect to meet the needs of Industrial Internet connections, which require diversity, performance differentiation, and communication diversification. It can keep network latency within milliseconds, which supports precise control and improves the production safety in the industrial manufacturing sector.

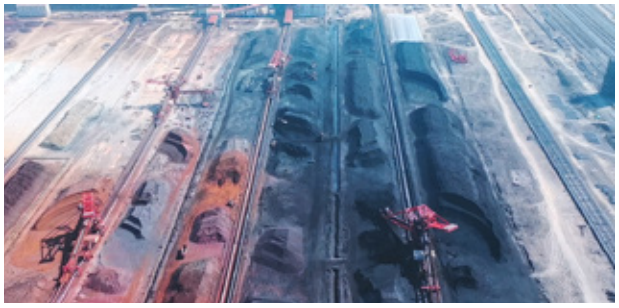
Solutions and Benefits

01 Smart remote-control scenarios: 5G + AI intelligent roller loaders

Cold rolled product is one of the main products of Liuzhou Steel Group. The grinding roller shift is responsible for providing rollers for various production lines. The grinding roller assembly workshop has very high temperature, and three people are required for each roller lifting operation. Two people stay on the ground to tighten the hoisting ropes, highlighting a low working efficiency and exposure to accidents. What benefits will be created by "transplanting" the gamepad to the factory machinery? The operator is controlling the 5G-based intelligent loader to lift the rollers with a gamepad. The devices that seem so unrelated are now perfectly integrated. Picking up the gamepad, the operator will become a game master to manipulate the loader. These futuristic technologies enable technicians of Liuzhou Steel Group to automate loader operations as if they are playing a large-scale 3D game. In view of 5G networks' technical characteristics including "enhanced mobile broadband" and "low latency", the project has customised a "control terminal + China Mobile 5G network + loader" solution to perfectly support HD video transmission and remote control with high precision. Thanks to this 5G + application, the cold-rolled steel plant has solved the pain points and difficulties that have plagued the company for years. As a result, workers' satisfaction of the positions known for harsh conditions has been greatly increased, the incidence of work-related safety production accidents has been reduced, and the labour productivity has seen a drastic increase. A single lifting operation that used to require three people can now be easily completed by only one person via a computer, the working efficiency being doubled.

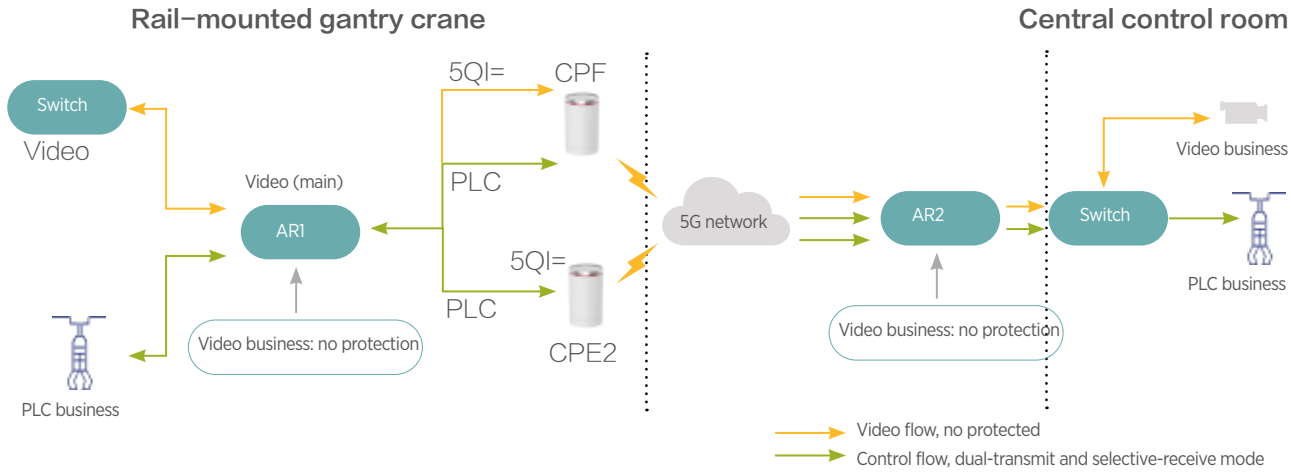


02 Smart remote-control scenario: 5G-based self-stabilizing remotely controlled reclaimers



Stackers-reclaimers are used to transfer coal ore and iron ore in the stockyard and workers usually operate them outdoors in the open, are exposed to strong sunlight, coal powder, and ore dust. The stockyard environment is harsh, and operators need to climb to the cab on top of the vehicle to control the crane. This operating mode features a low operating efficiency and a harsh, dangerous environment. Remote control has become an irresistible trend to improve operating efficiency and eliminate work risks.

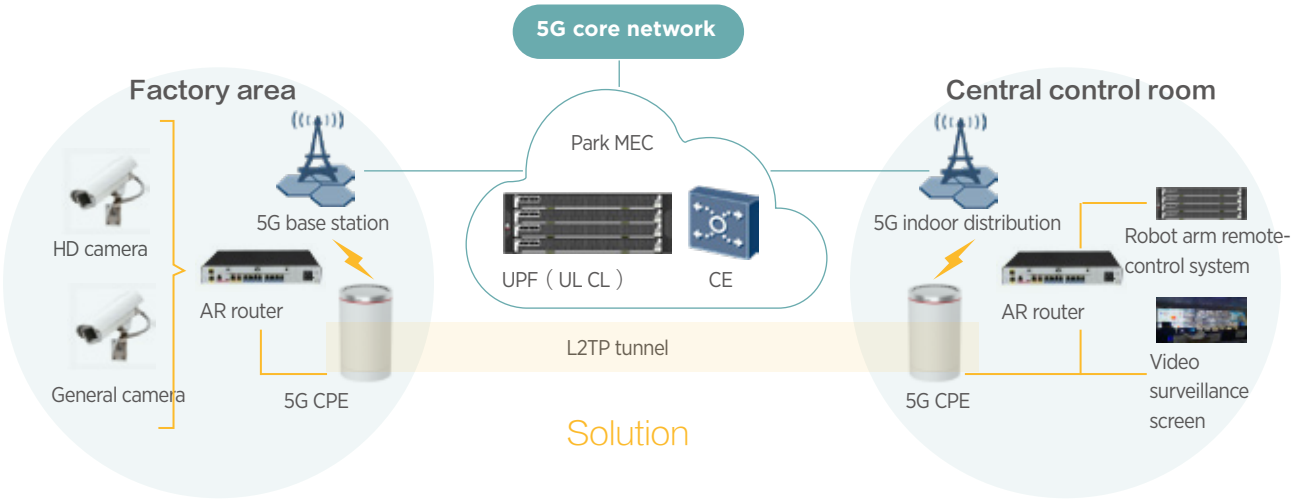
Taking advantages of the 5G base stations which have a high power and an optimal coverage distance of within 500 m as recommended, 5G networks featuring high uplink bandwidth, a stable uplink bandwidth of more than 200 Mbps per cell, and the industry's leading dual-transmit and selective-receive technology can ensure stable PLC control latency of below 100 ms and other technical advantages. As a result, network coverage and transmission delay in the outdoor environment can be well addressed to improve the operating environment and efficiency via remote control of stackers.



03 Smart remote-control scenario: 5G-based self-stabilizing remotely controlled cranes

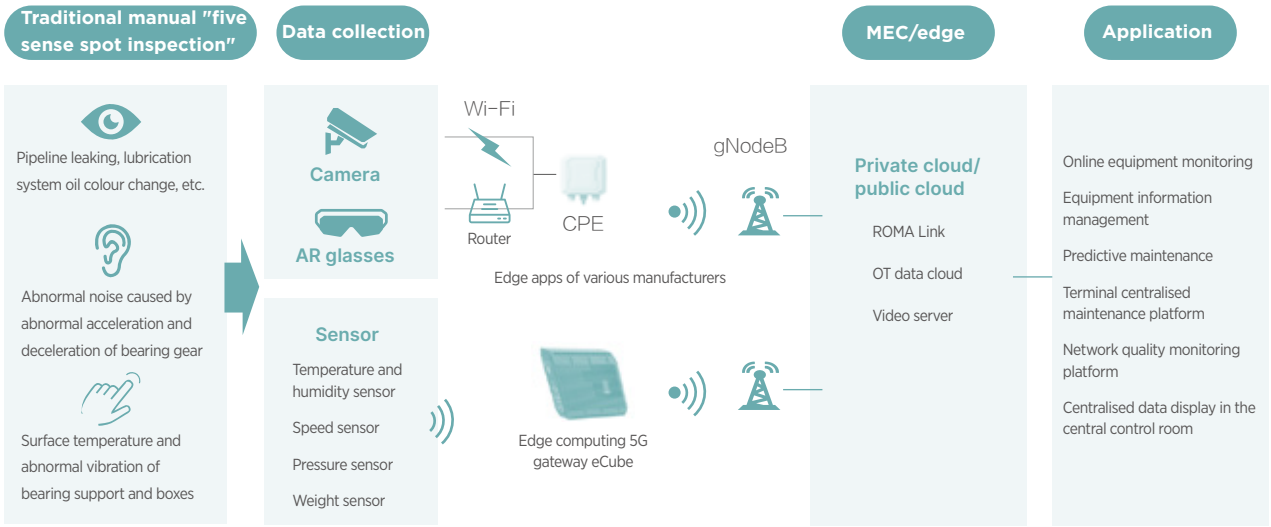
Cranes are used for loading, unloading, handling, and transportation. They are one of the most important pieces of steel production equipment and a key factor for the operational efficiency of steel plants. Cranes often operate high above the factory floor. In the past, manual operation was required from the crane operating room. This mode was inefficient and exposed employees to high temperature, noise, dust and corrosion, and electromagnetic interference. To increase efficiency and eliminate operational risks, it is necessary to develop a remotely controlled crane system.

Targeting the existing problems and the wireless environment, in addition to the site situation (such as obstructions and metal structure shielding), wireless network signal coverage requirements, access concurrency and speed, data security, future scale-up, construction costs, and other factors, the project relies on 5G networks' enhanced mobile broadband, low latency, and high reliability to enable HD video remote monitoring and 5G-based remotely controlled cranes from multiple perspectives. A single lifting operation which used to require three people now only requires one, cutting the manpower by 60%, improving the working environment and recruitment efficiency, shortening the lifting interval from 20 minutes to five minutes, and increasing the handling efficiency by 400%.



04 Intelligent operation and maintenance scenario: 5G data acquisition and predictive maintenance

The operation and maintenance of traditional equipment require three shifts a day to perform spot inspections, with workers manually recording operating states of thousands of equipment. This mode relies heavily on the sense of responsibility and experience of point inspectors. If 5G networks are used, data can be collected within a single day by using equipment sensors to complete data deployment and release. Thanks to this solution, important devices such as rolling mills, fans, and winding engines can be monitored online 24 hours a day, increasing the overall operation and maintenance efficiency by 30%, and the AI diagnosis accuracy has exceeded 85%. With the production continuity ensured, unexpected shutdown caused by equipment failures can be avoided to the maximum extent.

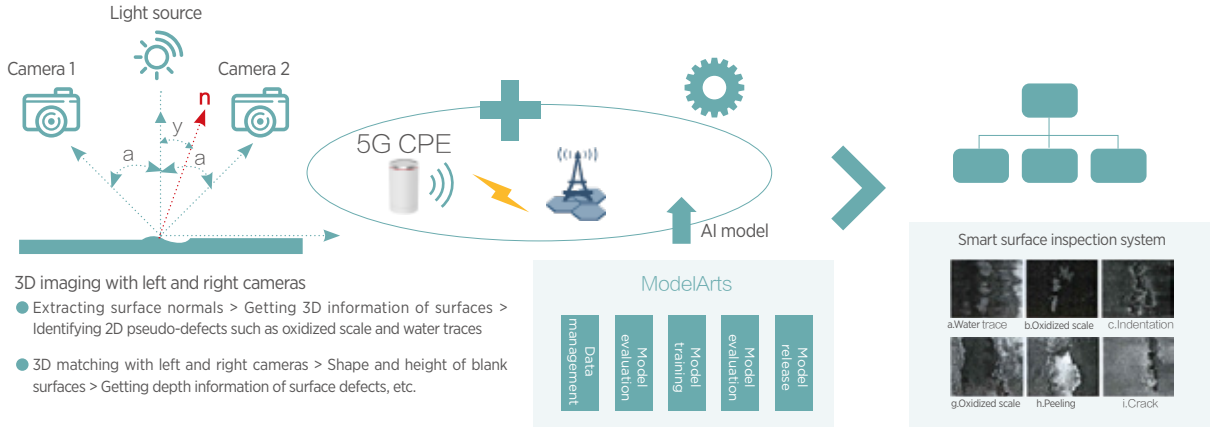


05 Intelligent operation and maintenance scenario: AR remotely assisted assembly

5G + AR cross-border remote collaboration sees its first application in Liuzhou Steel Group. In the past practices of important equipment debugging and repair, the external engineers had to travel to the scene, which was time-consuming and costly, and reduced production efficiency. With the 5G + AR solution, these engineers can add real-time annotations and make audio/video interactions and exchanges from the first-person perspective, with the front and rear teams connected seamlessly. The application of 5G + AR solution also boasts positive reference significance for promoting the efficient multi-base coordination and strengthening the sharing of advantageous resources of Liuzhou Steel Group.

06 Intelligent vision scenario: 5G + AI Welder Cloud Eye quality inspection

The cold-rolled steel plant has three welding lines, with welding operation once every three to five minutes. Previously, appearance defects of weld joints were observed visually. However, this approach was prone to large deviation, high work intensity, and high labour costs, and it was impossible to record and trace the welding quality with images. The Welder Cloud Eye quality inspection adopts 5G-based videos to collect images in real time and perform automatic detection online 24 hours a day via AI. This not only reduces the manpower cost by 55%, but also increases the recognition accuracy by 40%, with the welding quality recordable and traceable as well.



07 Intelligent vision scenario: automatic identification of steel coil IDs

Steel coil ID is an important identifier of the coil in the production process and is used for quality tracking. In the traditional mode, workers manually recorded the IDs, being low in efficiency and making it hard to trace coils throughout the process. Moreover, it was not easy to lay wiring in the production line. With 5G solution, services can be quickly released online. The 4K AI cameras deployed on the production line can read coil IDs in real time and then send back the data via the 5G network to the production system, delivering a higher operating efficiency at a lower deployment cost.

Summary and Next-steps

5G connectivity is the foundation and cloud is the key carrier for the steel and iron industry to transform from "manufacturing" to "intelligent manufacturing". The 5G + Smart Factory benchmark application project of Liuzhou Steel Group which values several hundred million CNY leverages the new architecture of "5G + AI + application" to enable steel surface quality inspection, remote control of cranes, intelligent predictive maintenance, and AR remote collaboration among other new scenarios to help the Company address challenges in product quality, production efficiency, and recruitment difficulty among others, so as to ultimately build a 5G smart factory with leading technologies and flexible production capacity.

To gain more insights into the industry trends, be better poised for greater opportunities, tap to more values from transformation, and realise the transformation from "dividing the cake" to "baking a bigger cake", it is necessary to deeply understand the pain points of the industry, build consensus around the ecosystem, and gather diverse capabilities. We should start from the top-level design to pin down scenarios and analyse customers' business scenario demands based on their strategic businesses, that is, "discover values". The key of "innovation enablement" is to adhere to the "5G first" principle, empowers application innovation with network, and continuously optimises the suitable plan.