

## An automation overhaul at China's Da Liu Ta coal mine realizes a 22% mine productivity improvement<sup>†</sup>

At one of China's largest coal mining operations, Rockwell Automation technology forms the heart of an automation overhaul that underpins its bold move into the e-mining age. The upgrade has produced a 260% increase in annual coal output, and enabled the company's Beijing-based executives to monitor mine operations remotely in real-time.

### Background

Da Liu Ta and its nearby sister mine Huo Ji Tu are located in China's largest coal reserve, the Shenfu-Dongsheng coalfield. The coalfield is some 1000 kilometers from Beijing, in the remote desert region straddling the borders of China's Shaanxi and Inner Mongolia provinces. Shenhua Group Corporation — a state-owned entity (SOE) created to develop the coal reserve — owns and operates these and other mines in the area.

The SOE is also chartered to build and operate coal loading, transport and electricity generation facilities — in effect, a total coal commercialization and export enterprise. This includes the construction and operation of a mine-to-coast rail link of almost 500 kilometers, a 50-million ton per year deep-water port at Huanghua and a special shipping fleet.

Development of Da Liu Ta — the first and largest of Shenhua's coalmines in the Shenfu-Dongsheng coalfield —



started in 1987, with first production in 1996, Da Liu Ta and Huo Ji Tu mines have independent underground and surface facilities, but share common coal washery, coal storage and train loading facilities.

Both mines use the 'longwall' continuous mining process, where a massive automated cutting head — the longwall mining machine — cuts back and forth across the face of large blocks (or 'panels') of coal many hundreds of meters in length. As the panel is cut, the longwall machine retreats behind hydraulic roof supports

and the mined-out area collapses in a controlled manner behind the longwall.

### Challenge

Both Da Liu Ta and Huo Ji Tu were designed around the traditional labor-intensive mining processes used throughout China's coal industry. Control and monitoring systems on both mine sites were generally disparate and not fully integrated. As a result, Da Liu Ta and Huo Ji Tu comprised a myriad of manual operations — such as the synchronization of multi-stage conveyors via telephone-linked manual operator stations dotted along the length of conveyors.

<sup>†</sup> Based on a measurement of "tons per man-hour"

"It was clear from what we saw [at Mingo Logan Coal] that the availability of 'instant information' — roof pressure, outbye throughput, surface storage capacity and so on — across the facility, was the key," says Lie Wei, president of Hua Guang Technology. "To realistically achieve this, we needed total integration of all the existing mine control automation systems, many using vastly different communication protocols."

Integrating control and automation systems would prove particularly challenging, as the mine used many major pieces of production equipment using a variety of third-party communication protocols.

Total control and monitoring system integration, plus an enterprise-wide information network was the prime objective—and Rockwell Automation China and Xi'an Hua Guang Technology Company Limited were selected by Shenhua as key partners.

## Solution

In early 2000, the Rockwell Automation China/Hua Guang Technology team embarked on a total automation system upgrade, aiming to achieve complete integration of all automation and control systems across both sites. The changeovers were made progressively during routine maintenance times and scheduled shutdowns to minimize interruptions.

Using this approach, the Da Liu Ta upgrade was completed over ten months in 2000, followed by a similar five-month upgrade in 2001 at Huo Ji Tu.

In all, the final installation comprises many thousands of digital and analogue input/outputs (I/O) and device-level fieldbus DeviceNet nodes, Rockwell Automation's Allen-Bradley brand powerful ControlLogix, SLC and PLC-5 controllers, all integrated over a network.

Rockwell Software PC-based operator interface software was deployed to provide the controller interface, along with Allen-Bradley PanelView human machine interface (HMI) technology throughout the installation for maintenance and diagnostic access.

Rockwell Automation's ControlLogix control platform provides the 'gateway' link to the range of legacy system protocols and systems used across the two mine sites. Very sophisticated, yet easy-to-use Rockwell Software NetLinx networking tools allowed the seamless integration of systems into the mine's new three-tiered data communications network:

- **Ethernet** at an operator interface/ supervisory level
- **ControlNet** network at a controller level, and...
- **DeviceNet** fieldbus network at the device level

This mine-wide data connectivity was also extended to those major production equipment items compatible only with legacy protocols,



including its JOY miner, gas monitoring system and two belt protection systems.

## Results

The results of the automation retrofit have been spectacular — Da Liu Ta alone has experienced a 22% improvement in productivity on a tons per man-hour basis, and a drop in staffing levels from 365 to 300.

Annual tons per year output at Da Liu Ta has climbed from the 1999 average of 5.6 million tons per year to 9.2 million tons in the calendar year 2000. This is almost a 65% improvement, and a massive 260% improvement on the mine's pre-1999 design throughput of 3.5 million tons per year.

"The success of the Da Liu Ta automation upgrade is a breakthrough in China's traditional coal manufacturing and coal management," reflected Yang Jingcai, Chairman of Shenhua Group's Shendong Coal Ltd. "Integration of industrialization with information technology can make China's coal mines more efficient and more competitive. Da Liu Ta has reaffirmed our commitment to use advanced information technology to upgrade traditional industries."

The total overhaul of the control and information systems at the two mines has resulted in a wealth of real-time

operational information that is accessible from operator interfaces across the mine and beyond — a stark contrast to the 'islands of information' found at pre-2000 Da Liu Ta. Seamless connectivity between mine sub-systems now permits their efficient co-ordination, without human intervention or interruption.

The real-time operational information reaches far beyond the Da Liu Ta site, linking into Shenhua's Beijing corporate headquarters. This enables executives in Shenhua Group's modern Beijing offices to be 'virtual miners' — to monitor from their desktops vital production data drawn from the continuous mining process, and from the surface-based coal washery, stockpile and train loading system.

The link enables Shenhua's storage, rail, shipping and power station operations to be coordinated with

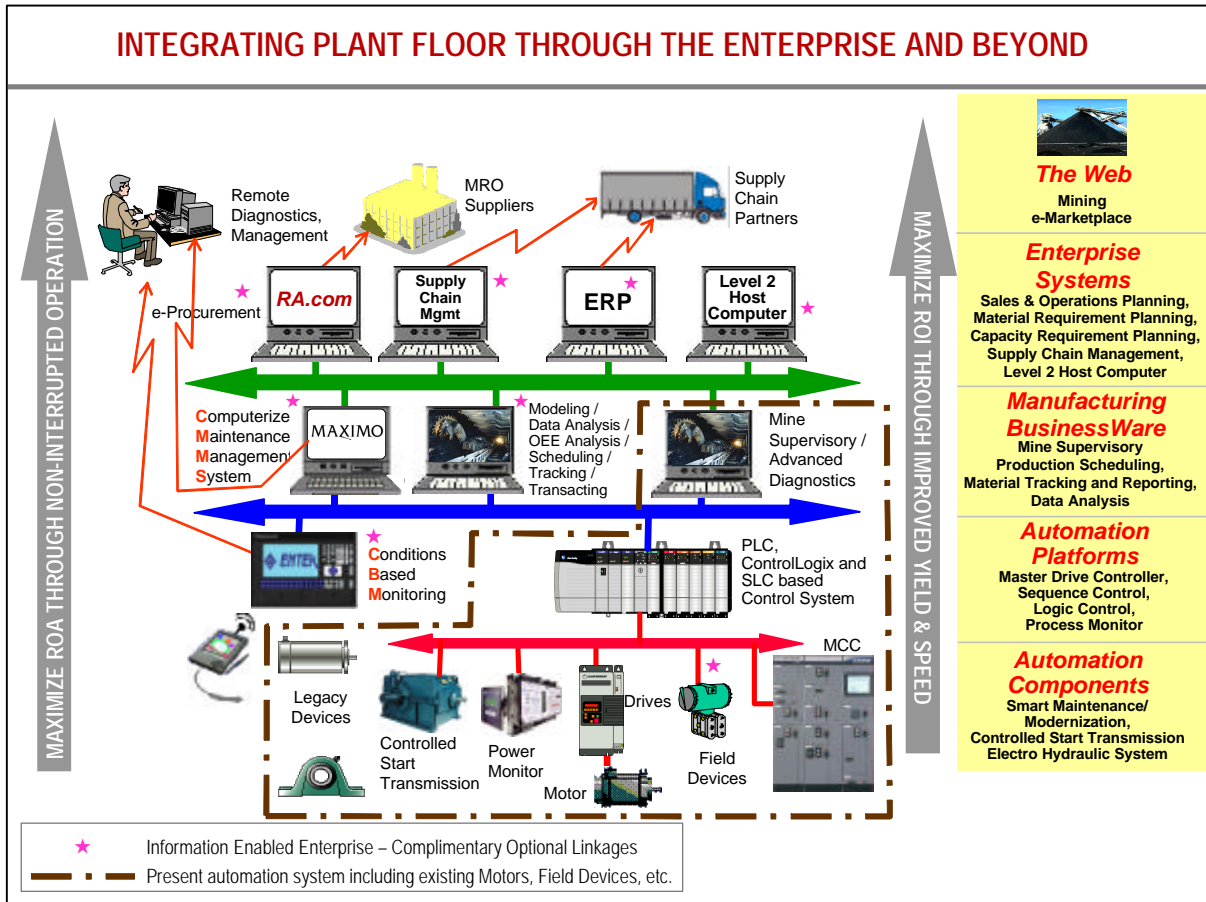
mining conditions occurring right at the Da Liu Ta and Hua Ji Tu coalfaces. The outcome is an unrivalled level of enterprise-wide co-ordination and efficiency.

The Da Liu Ta/Huo Ji Tu success has inspired Shenhua management to move into automation retrofits at its other coalmines, with the nearby Bu Lian Ta site scheduled for retrofit in 2002.

The architecture on the following page depicts Rockwell Automation's concept of an Information Enabled Enterprise. The area outlined with a brown dash line represents the present automation level under discussion in this document. The remaining portion illustrates a host of solutions that Rockwell Automation can provide today to integrate the plant floor to the enterprise and beyond.



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