

# Control system upgrade to tension levelling line contributes to China Steel's US\$1M increase in profit

Since the China Steel Corporation implemented an integrated single Rockwell Automation control system to its tension-levelling line—maintenance has been reduced by 50%, and annual production has increased by 8.4%.

## Background

Located amid sugar cane fields in Kaohsiung, on Taiwan's south-western coast, the US\$3 billion China Steel Corporation (CSC) is the only integrated steel producer in Taiwan. Its production output is more than ten million tons of crude steel annually, approximately 71% of which is consumed domestically, with the remainder exported. The company has also earned high government recognition—from the Republic of China's Executive Yuan (cabinet)—winning the National Quality Award.

Prior to revamping in 1992, tension levelling line number 115 performed the operation of recoiling only. It included General Electric (GE) analogue drives controlled by a legacy GE programmable logic controller (PLC). When CSC added a new tension leveller section to the line, it chose Mitsubishi Heavy Industries (MHI) as the mechanical OEM and Rockwell Automation as the supplier for the electrical systems.

## Challenge

CSC steel mill was first commissioned in 1976 and, despite its relatively young age, the company has embarked on a program of upgrading all equipment older than 15 years. In the late 1990s, the



ageing equipment in line number 115 presented an opportunity to upgrade the drives and control system and, in the process, rectify any problems.

There were two main deficiencies with the tension levelling line. The first was that the recoiling section had insufficient line speed and tension due to meet the current production demand. This limited the gauge of strip that could be produced as well as the amount of steel that the line could process in a given time.

The second was the problem arising from operating a line with a hybrid control system from two vendors and two platforms—essentially, the connection was not seamless. Not only was there downtime of the line from interfacing and

interlocks issues between the two different systems, there was also much time wasted in fault-finding.

The challenge for CSC was to implement a solution that would address the shortfalls of the line while causing minimal disruption to steel operations. The technology would have to be reliable, easily maintained and well supported. In addition, it was important that the human-machine interface (HMI) was user-friendly and sufficient to meet the needs of operators.

## Solution

In 1997, CSC decided to replace the recoiling section and integrate a single control system over the whole tension

levelling line, with an improved HMI. At the same time, the issues of line speed and tension would be addressed by upgrading the payoff reel and tension reel motors, along with the GE drives. CSC commissioned Rockwell Automation to provide a solution, consisting of design, supply of hardware and software, engineering, PLC coding, and start-up services.

The key electrical items fitted were Rockwell Automation DC digital drives and a Distributed Control System (DCS). Complete control over the whole tension levelling line was achieved by directly interfacing the DCS for the tension leveller section with the GE PLC used for the recoiling section.

For the drive machinery, CSC decided on Rockwell Automation's 500 hp distributed power system (DPS) dc drives and motors for the payoff and tension reel, plus one 20 hp and two 7.5 hp FlexPak 3000 dc drives to replace the GE drives for the flattener and pinch rolls on the recoiling section.

The essence of the control upgrade was to replace the hybrid system—to promote the existing Rockwell Automation DCS to 'Line Master Controller' with I/O system to control the whole line. Now installed, the master controller has taken charge of the motor control center, motor starters and solenoid valves and provides PLC control of the line sequencing automation functions. It also acts as

line coordinator and master drive controller for three FlexPak 3000 dc drives, as well as the tension levelling section 'main' and 'stretch' drives and four dc servo drives for intermesh rolls positioning.

To improve the operator interface, the existing CRT monitor and operator desks at entry, main and exit were replaced. The new set-up consists of a PanelView 900 color graphic terminal located at the main operator desk, and SIGMA HMI stations located in both operator and control rooms. Line speed, tension, and all line run parameters can be configured on the HMI, which also provides line status, operation interlock status and alarm faults. Finally, it enables the trending of critical operating data for troubleshooting and diagnostics.

Due to long lead time associated with shipment and installation of the new 500hp drives and motors, the upgrade was conducted in two phases. The first took place in January 1998 and involved upgrading the Rockwell Automation DCS to Line Master Controller. The GE PLC was kept as an interface to the GE drives but the GE I/O and line control functions were removed. The shutdown took just ten days for Master PLC and line sequencing revamping. The second phase occurred in July 1998, and consisted of replacing the GE PLC and drives, payoff and tension reel motors. Revamping the dc drives and motors took 14 days.

## Results

The end result is that the recoiling section tension has increased from

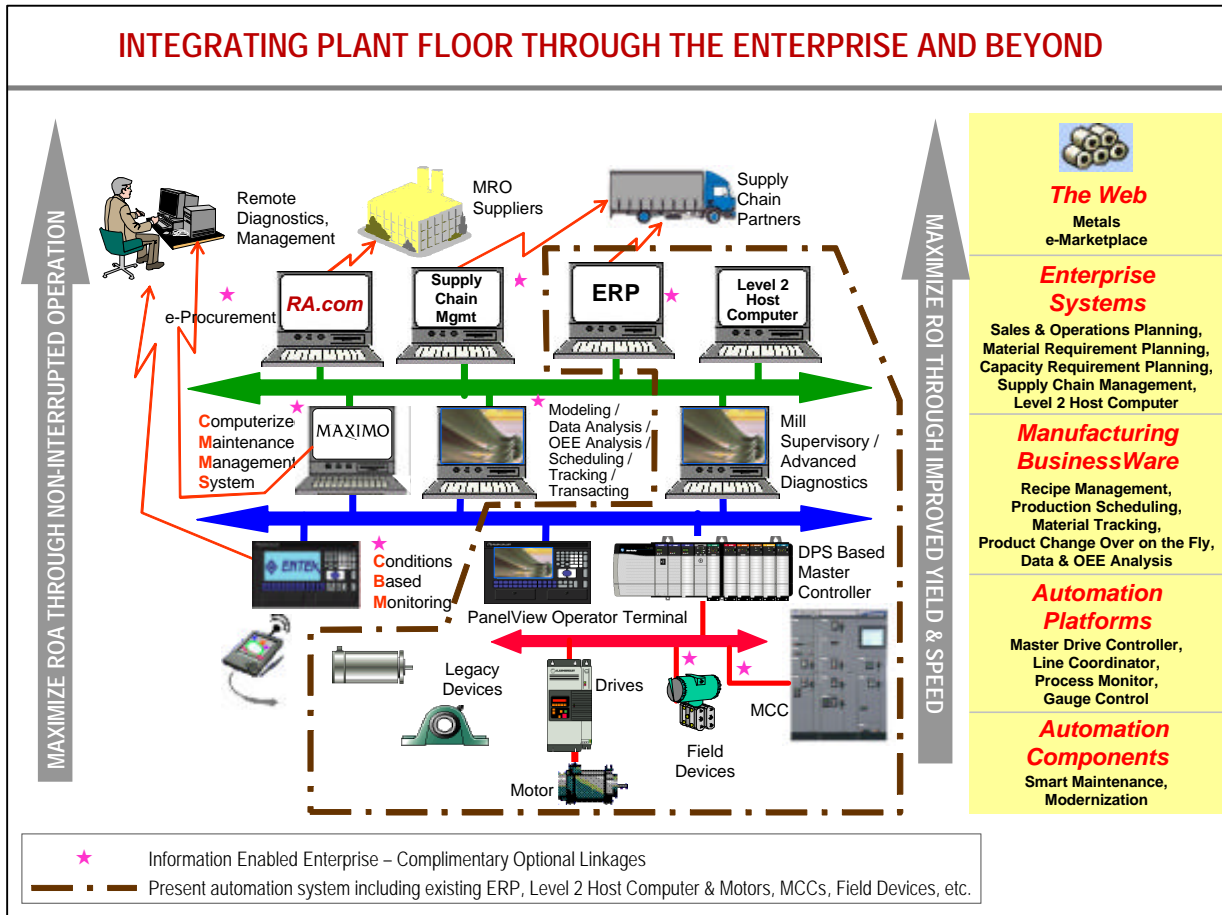
3,000 to 4,500 kg, and the line speed from 300 to 450 meters per minute. The immediate effect of the upgrade has been reduced machine downtime due to superior performance of the line. The maintenance has been effectively reduced by 50%, due to the lower incidence of equipment shutdowns and better fault-diagnosis available, and has produced savings of 1.5 hours per month of downtime on the line.

In addition, the improved line speed has led to recoiling production increases. The higher line tension of the recoiling operation has meant that strip steel with gauge 3.0 mm or greater can be produced using this line.

The upgrade of the tension levelling line control system combined with the improvement in line speed has helped boost the annual production by 8.4%. The net result has been the generation of an extra US\$11.7M in revenue, which, after taking into account all Production costs, amounts to an increase of US\$1.05M in annual profits. Return on investment was achieved in one year.

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.

## INTEGRATING PLANT FLOOR THROUGH THE ENTERPRISE AND BEYOND



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