A Tour of Codelco's Santiago Operations Center
INTRODUCTION

Copper supplier to the world

Codelco – or the Corporación Nacional del Cobre de Chile – is the world’s largest copper producer, manufacturing 1.8 million tons of fine copper per year, representing 15 percent of global production.

The state-owned company controls the world’s largest known copper reserves, deep within the Andes Mountains of Chile. The 118 million tons of copper residing within Codelco mines is sufficient for more than 70 years of production at current production rates.

Organizationally, Codelco is split into four areas: research, exploration, acquisition and development. Each of these units support the company’s principal production sites, which are structured into the following Divisions: Andina, Chuquicamata, El Teniente, Gabriela Mistral, Ministro Hales, Radomiro Tomic, Salvador and Ventanas; plus, the El Abra mine, in which Codelco holds a 49% interest.
Joint venture with Honeywell Drives Process Stability and Business Performance

In 2007, Codelco formed a joint venture with Honeywell, through which Honeywell supplies Codelco with process automation technology and services to improve the performance of the company’s plants. The joint venture, called Kairos Mining, was designed to improve process stability and business performance at the sites.

“Kairos Mining is a long-term alliance that is helping Codelco achieve greater process efficiency through higher automation standards,” explains Claudio Zamora, President and CEO of Kairos Mining. “Honeywell Connected Plant technologies are enabling Codelco to optimize assets, improve operation continuity, and standardize automation processes and technologies.”

Innovating through Connected Operations

Today, Codelco is the midst of an ambitious, forward-thinking project to transfer operational control of its Andes-based mines and production facilities to the cosmopolitan streets of Santiago, the Chilean capital. Together with Honeywell, it has built a state-of-the-art, remote 24x7 Operations Center in the heart of the city, combining mining operations along with concentrator plant, roaster and maintenance functions for the Ministro Hales Division.

Zamora explains the rationale: “Based on Codelco drivers, we wanted to minimize safety risks to workers and improve their quality of life while increasing productivity. The fact is, people don’t want to work long-term in the mountains anymore, and technical talent is difficult to retain. So, Codelco decided to migrate plant functions hundreds of kilometers away, to the city center.”

The Santiago Operations Center uses the latest technologies to foster communication and interaction. It incorporates remote operation and remote monitoring centers equipped with video transmission equipment, video IP phones and a large-scale display wall; testing, development and training laboratories; and meeting, training and video conferencing facilities.
Improving Production Efficiencies at Key Sites

Today, the Operations Center is using data analytics, predictive maintenance and Honeywell Connected Plant expertise to deliver radically improved production, productivity and increased revenues at Codelco’s plants.

Operators can see production environments clearly through cameras and high-resolution screens, and are better coordinated since they can work together in the same room.

Codelco is also able to achieve the full automation of its Advanced Process Control (APC) systems, and to manage and exploit large volumes of data to improve production performance. Meanwhile, operations staff are alerted in real time to potential problems, and can modify processes to prevent the loss of continuity.

The Operations Center has helped Codelco fine-tune production, improve the use and availability of equipment and systems, reduce costs and increase the productivity of its teams.

Zamora says: “Honeywell has helped Codelco integrate processes, information and decision making – creating a connected production environment that’s delivering $45 million in incremental revenue annually through improved production quality and productivity for the Ministro Hales Division. The connected operating model was a brave business decision – and one that’s paying off.”

Visiting the Operations Center

Approved visitors can tour the Santiago Operations Center to better understand how Codelco is solving production and business challenges through connected technologies, and to see Honeywell advanced solutions at work.

There are eight major Operations Center functions that visitors can experience: Remote Support; Ministro Hales Remote Operations; Competency Management; Connected Assets; Application Development; Lifecycle Support; Advanced Process Control Support; and Process Support.

Over the following pages, we’ll take you on a tour of each of these areas, allowing you to better understand which functions are most relevant to your business.
REMOTE SUPPORT CENTER

There are three business drivers for Codelco’s Remote Support Center function in Santiago, through which cross-functional specialists support processes, advanced control applications, DCS and communications at Codelco plants:

• Sustain automation benefits over time
• Overcome the lack of on-site specialists
• Reduce downtime and improve operational continuity

Connected to the plants through a secure private network, the Remote Support Center provides centralized access to multi-plant process information and automation resources, plus services to follow-up processes, support plant operators, identify improvement opportunities and facilitate changes in operational practices to sustain automation benefits.

For years, Codelco’s far-flung sites were constrained by the availability and cost of qualified specialists. The Remote Support Center addresses this challenge by providing senior-level support across each plant.

The Remote Support Center also provides real-time monitoring of open-platform process automation systems, and online access to process data and control application information for different sites. This allows Codelco’s process specialists to study the impact that one process stage has on the next; the relationship between process variables; the identification of factors that might inhibit process performance; and the evaluation of best practices that can be replicated at other sites.

KEY OUTCOMES

| Increased production yield |
| Reduced operating costs |
| Improved risk and safety profile |

MINISTRO HALES REMOTE OPERATIONS CENTER

Codelco’s Ministro Hales plant, located in Chile’s northern Antofagasta region, is run from a dedicated Remote Operation Center in Santiago managed by Kairos Mining. The remote operating model is having a beneficial impact on process continuity and efficiency at the site.

The Kairos Mining team is enabling process continuity by improving safety; minimizing disruptions to plant access; and using condition monitoring to check the health of the plant’s process equipment.

Simultaneously, Kairos Mining specialists have boosted process efficiency by integrating the management of operations and maintenance; establishing better coordination between process operators; and ensuring consistency in operations criteria. Additionally, they are heightening operators’ situational awareness; improving the quality of decision making through the visualization of productive chain variables; boosting product quality through an advanced control app; and reducing water and energy consumption.

At the Ministro Hales Remote Operations Center, you can see various Honeywell solutions at work, including: the Experion® Process Knowledge System platform; sleek, intuitive Experion Orion consoles; an alarm management system; control operations for SAG, grinding, flotation and roasting processes; Digital Video Manager; and remote radio communications.

KEY OUTCOMES

| Delivering $45 million in incremental annual revenue |
| Faster, better access to expertise whenever it’s needed |
| Improvement in safety indicators due to less exposure to hazardous areas |
COMPETENCY MANAGEMENT

Through its Competency Management program, Codelco is improving the knowledge, aptitude and efficiency of its employees while adapting them to technological change.

Nearly 1,400 Codelco employees have completed competency management training to build their knowledge of control system technology, advanced control applications and process operations. Training sessions are conducted on-site, in the Kairos Mining Remote Operations Center and via the web. The result? Employees are getting more out of Codelco’s installed systems.

The training has also facilitated the adoption of new technologies and operational practices, and helped to standardize the learning of mining process behaviors and operational criteria, creating a strong foundation for operational efficiency and commercial success.

KEY OUTCOMES
- Delivering $45 million in incremental annual revenue
- Faster, better access to expertise whenever it’s needed
- Improvement in safety indicators due to less exposure to hazardous areas

CONNECTED ASSETS

Connected Assets allow operators to boost operational efficiency, make more timely decisions, reduce downtime and improve information transparency.

Using remote access and monitoring tools, operators can analyze data from different plant sources, including field instruments, processes, DCS, control applications and network devices. Analytics allow the operators to identify abnormal conditions and predict potential failures. They can also access plant systems and applications safely; and create key indicator dashboards to assist the operations team.

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KEY OUTCOMES
- Timelier, more informed operational decisions based on data
- Problems anticipated before they occur
- Improved operational visibility and transparency

APPLICATION DEVELOPMENT

Codelco is using Application Development to improve the efficiency of crushing, SAG, milling, flotation and thickener applications at the Ministro Hales site. Collectively, the improvements are helping to reduce the variability of process output, increasing the tonnage of copper recovered for processing.

Advanced process control is achieved through Honeywell Profit® Suite applications. Profit Suite is based on Robust Multivariable Process Control Technology, which compares current and historical process and disturbance variables to execute feed forward and predictive control, improving control performance. The Profit Controller is based on mathematical models which use information from the process itself, unlike expert systems which are based on rules provided by experts and therefore subject to personal perceptions.

KEY OUTCOMES
- Higher recovery of copper
- Increased treatment of ore
- Reduced energy consumption
ADVANCED CONTROL APPLICATION (APC) SUPPORT

Changes in manufacturing process dynamics, technology obsolescence and operational practices can cause control strategies to lose their effectiveness over time unless their performance is periodically evaluated and re-tuned to process conditions. The APC Support function helps identify ongoing improvements to Codelco’s control strategy and operator performance.

Control applications must be set by operators according to process conditions. APC Support specialists help operators deal with abnormal situations and provide guidance to stabilize processes.

Honeywell solutions that comprise the APC Support offering include: remote access to APC applications, DCS and process historians; and APC monitoring tools.

KEY OUTCOMES
- Best practices standardized across the company
- Faster deployment times
- Improved sustainability

LIFECYCLE SUPPORT

Lifecycle Support services are administered to Codelco plants to ensure operational continuity; analyze process output and operational practices; and achieve long-term automation benefits.

Specialists manage functions such as basic control, advance control applications, information applications, communications, systems, mechanics and metallurgical processes. They also perform real-time monitoring of open platform process automation systems; manage online access to the DCS; and control applications across company sites.

Additionally, the specialists monitor server and application availability and system parameter values that exceed thresholds, and analyze system events. When an abnormal condition is detected, the monitoring system sends an email or a mobile phone notification to support staff for further diagnosis and corrective action.

Key components of the Lifecycle Services offering include: real-time process video; remote access to site control applications (DCS, APC) and the site process historian; data analytics to diagnose problems and identify trends; automated distribution of antivirus and Windows updates; centralized backup; system monitoring and alarm notifications; and knowledge database management.

KEY OUTCOMES
- Continual refinement of operational practices
- Process issues resolved faster
- Improved operational continuity
PROCESS SUPPORT

Process Support specialists in Santiago deliver real-time monitoring of process automation systems and provide access to process data and control applications at multiple sites.

The support team continually analyzes process variations, allowing the control strategy to be fine-tuned. Modifications might involve control model tweaking, or the addition of new process variables, instrumentation or tools. Proposed changes are highlighted in process reports and discussed in meetings with stakeholders.

Honeywell’s Process Support offering for Codelco includes: remote access to local process historians, DCS and APC, as well as data analytics tools for cross-process overviews, statistics, trends and correlations analysis.

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<th>KEY OUTCOMES</th>
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<td>Increased process stability and performance</td>
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<td>Control strategy can be fine-tuned according to process conditions</td>
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<td>Continually evolving and improving operational practices</td>
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Want to Learn More?

If you’re interested in learning more about the Codelco Santiago Operations Center or the Honeywell solutions deployed there, or in visiting the site, please contact your Honeywell Account Manager to discuss the options available to you.

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