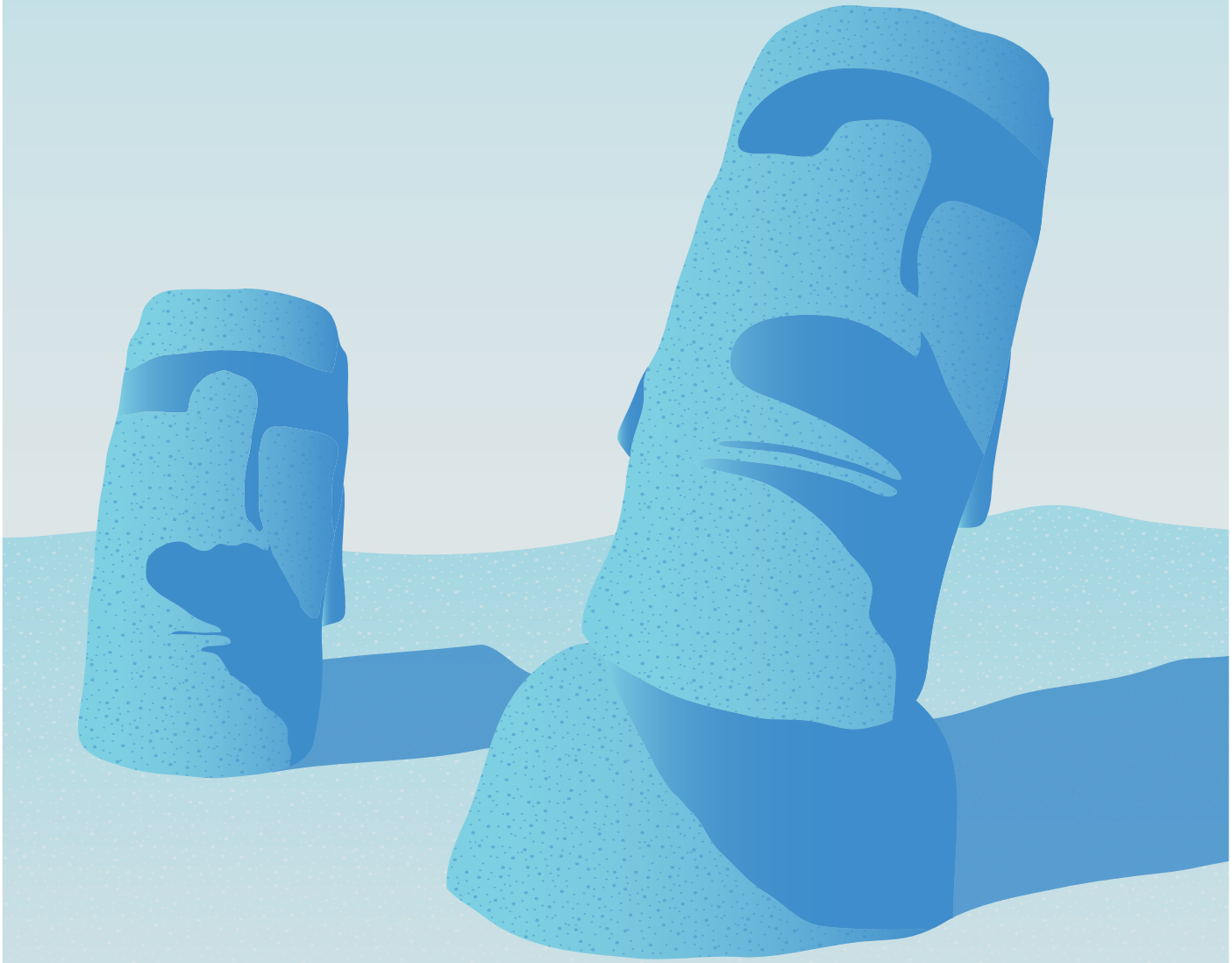
GLOBAL BUSINESS REPORTS

INDUSTRY EXPLORATIONS



CHILE MINING

2014

Economy | Mining Code | Exploration | Copper | Electricity | Water | Technology | Equipment

Dear Readers,

There can be very few countries in the world that enjoy such a close relationship with their natural resources, as Chile does with its copper minerals. The casual visitor will be immediately struck by the sheer variety of trinkets fashioned from the red metal and peddled at any and all touristic destinations. Those who stay a little longer will quickly realize, however, that this relationship goes much deeper. In most countries, commodities prices are an arcane set of figures relegated to the back of the financial pages. Not so in Chile, where any local taxi driver will be able to give you a good idea of what copper is trading at and how the forecasts look for the coming year. The supposed causes behind such fluctuations frequently become the subject of heated debate in the bars and cafes of the country's capital city, Santiago.

Chile is one of the most developed economies in the Americas, and it is unfair to write the country off as a mere copper mine; there are many more strings to the proverbial Chilean bow. Nevertheless, with the world's largest endowment of copper it seems fair to label the Andean nation a true mining country.

As such, the Chileans have perhaps suffered more than most from the downturn that has affected the world's mining industries over the last two years. Compounding the relative lack of interest from investors, which is an international trend, Chile's miners have had to deal with a slew of setbacks particular to the country itself. Traditional complaints of high labor costs, even higher energy rates, and a lack of fresh water have been joined by a new environmental tribunal system, which has given greater power to regional courts to halt resource projects.

The combination of these factors led to the suspension of a range of high-profile investments into the industry. Notable among these are Goldcorp's El Morro and Barrick Gold's beleaguered Pascua-Lama project. In total, 40% of the predicted $113 billion investment into Chilean mining has been struck off the official portfolio.

However, this should not be seen as cause for pessimism. The phrase "mining is a cyclical industry" is a common refrain amongst our interviewees. Those with enough experience to have lived through previous cycles recognize that, to a certain extent, it is simply a case of holding on until market sentiment improves. In the meantime, costs have been reigned in, expansions have been curtailed and operations have been streamlined. When the cycle turns again, Chile's mines will be stronger than ever.

After all, while some may grumble that the country has become too expensive, or fret that new investors will favor alternative destinations for their exploration dollars, Chile is a solid and serious mining jurisdiction. The high concentration of expertise in all things copper, combined with unparalleled geology, will ensure that Chile retains its title as world copper capital for many years to come.

Our thanks go out to all the companies, associations and individuals who helped make our stay in Chile a truly unforgettable experience.

Ana-Maria Miclea & Nathan Allen,
Global Business Reports

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Building a Foundation for the Future:
An Introduction to Chile and its Mining Sector

"At the moment, Chilean miners are suffering from spiraling opex. The prolonged rise of commodity prices over the past years did not translate into higher profits for most mines because costs increased at an equal or greater rate. This situation has led to the cancellation of several proposed investment projects as they will not be able to operate profitably unless new power generation capacity comes online. Some producers are looking to develop their own power plants in an effort to control energy costs, but only the largest players – at the moment just BHP Billiton and Codelco – will be able to take such drastic steps."

- Ricardo Glade, General Manager, JRI

Image: Shutterstock

An Introduction to Chile

A brief overview of the country and economy

CHILE AT A GLANCE

Source: CIA World Factbook

Population: 17,363,894 (July 2014 est.)
Capital: Santiago
Chief of State: President Michelle Bachalet (since 11 March 2014)
GDP (official exchange rate): $335.4 billion (2013 est.)
Growth Rate: 4.4% (2013 est.)
GDP per Capita: $19,100 (2013 est.)
Economic Sector Breakdown: agriculture: 3.6%, industry: 35.4%, services: 61.0% (2013 est.)
Exports: $77.94 billion (2013 est.): copper, fruit, fish products, paper and pulp, chemicals, wine
Imports: $75.7 billion (2013 est.): petroleum and petroleum products, chemicals, electrical and telecommunications equipment, industrial machinery, vehicles, natural gas
Major Trade Partners: USA, China, Brazil, Argentina, Japan, South Korea

$335.4 billion

GDP
(current US dollars) 2013

Source: CIA World Factbook

4.4%

GDP GROWTH RATE
2013

Source: CIA World Factbook

Over the past four decades, Chile has been one of Latin America's most consistent economic performers. Chile's market-oriented economy derives strength from its high levels of foreign trade, sound financial institutions, and governmental policies, which have led the country to receive South America's highest sovereign bond rating. Chile weathered the global financial crisis largely on the strength of its copper exports, whose prices remained relatively stable compared to other commodities. Copper alone provides 19% of government revenue. With the exception of a slight contraction in 2009, Chile has averaged a real growth rate of almost 5% per year. Chile has 22 trade agreements with 60 countries, including the USA, China, the European Union, Mexico, and South Korea, while its copper earnings have allowed it to invest in sovereign wealth funds, which provide a buffer for the state's budget during market downturns. Chile was the first South American country to sign the OECD Convention, when it did so in May 2010. Chile appears poised to elevate its international profile further, as it assumed a nonpermanent seat on the UN Security Council from 2014 to 2015.

Politics undergirds economic performance, of course. The election of Michelle Bachelet from the Socialist Party in December 2013 opens a new chapter in Chile's history, but Bachelet is no stranger to Chile, having served as President from 2006 to 2010. From 2010 to 2013, she garnered international recognition as the head of the newly created United Nations Entity for Gender Equality and the Empowerment of Women from 2010 to 2013. Although Bachelet breezed through her reelection campaign, ruling with her center-left coalition will not be easy. Her administration got off to a rocky start, as four of her appointed undersecretaries were forced to resign for various reasons between her election in December 2013 and the time she took office in March 2014. Nonetheless, she is likely to brush aside these early political stumbles, as she enjoys clear majorities in parliament. Moreover, her administration has been active in its first 100 days in office, advancing proposals to address her campaign platform, most notably to reform education.

Chile faces the twin long-term challenges of demography and energy. Like many developed countries in Europe, Chile's society is aging, and has fertility below replacement level, low mortality rates, and high life expectancy. The country will have to keep its working-age population employed while as the same time find new labor to care for the elderly. Chile will have to attract and welcome more immigrants, and there are plenty of capable workers throughout South America that can assimilate to Chilean society and culture and speak the local language. Chile has reduced poverty over the past two decades, but income inequality persists and could complicate efforts to attract immigrants, who will be seen by Chileans as taking jobs.

In addition to labor, energy will be a major obstacle, as the country is dependent on foreign energy. In 2013, Chile imported 169,700 barrels per day of oil, a large figure for a population of its size. Chile's dependence on foreign energy is not only a problem for the mining sector and is certain to play a role in shaping the country's political future. Chile has relied on Argentinian natural gas, but when the Argentines faced gas shortages themselves in 2004, it stopped pipeline shipments to Chile. The mining industry does not have to pay taxes on any fuel that is used for operational purposes, and in this climate of rising oil prices and export-dependency, many in Chile resent this special treatment. In order to address the situation, Chile is growing its capacities to produce hydropower and geothermal energy and import liquefied natural gas (LNG). Bachelet has committed the government to building a new LNG terminal in the southern part of the country, which will complement its terminals in the central and northern parts of the country. This demonstrates that energy policy is not only designed to serve the concentration of mine sites in the Atacama Desert but to address the wider problem of energy in Chile.

Chile and much of Latin America has enjoyed a recent boom in commodities-driven growth, which prompted Chile committed to a slew of new mining investments in the future. Given the country's past performance of adding value to the mining sector, being a incubator of new technologies, and fostering large-scales projects, it is unwise to bet against the country gaining dynamism again in the future.

Mining industry leaders almost universally remain bullish on Chile and view the current downturn as a cyclical event that will correct itself in the near future, perhaps as early as 2015. However, future gains must be driven as much by productivity improvements as by relying on the country's blessed abundance of minerals and liberal government policies. Moreover, local communities are raising concerns about the environmental impact of mining, placing some new projects on hold. These protests indicate that Chile's democracy is growing more mature but they will hinder the country's quest for GDP growth. In this regard, Chile makes a test case for the global mining industry. If the country can increase productivity and mine with greater environmental responsibility, it can present an excellent model for countries around the world not only in how to manage the sector but to balance the needs of industry and society. •

GLOBAL REAL GDP GROWTH RATES (%)

Source: International Monetary Fund

	2007	2008	2009	2010	2011	2012	2013	PROJECTIONS 2014	2015	2019
Advanced Economies	2.7	0.1	-3.4	3.0	1.7	1.4	1.3	2.2	2.3	2.1
Commonwealth of Independent States	8.9	5.3	-6.4	4.9	4.8	3.4	2.1	2.3	3.1	3.2
Emerging and Developing Asia	11.5	7.3	7.7	9.7	7.9	6.7	6.5	6.7	6.8	6.5
Emerging and Developing Europe	5.3	3.3	-3.4	4.7	5.4	1.4	2.8	2.4	2.9	3.4
Latin America and the Caribbean	5.8	4.3	-1.3	6.0	4.6	3.1	2.7	2.5	3.0	3.6
Chile	5.2	3.2	-0.9	5.7	5.7	5.4	4.2	3.6	4.1	4.5
Sub-Saharan Africa	7.1	5.7	2.6	5.6	5.5	4.9	4.9	5.4	5.5	5.4
Middle East, North Africa, Afghanistan, and Pakistan	6.0	5.1	2.8	5.2	3.9	4.2	2.4	3.2	4.4	4.5

POPULATION AND WORKFORCE INFORMATION

Source: CIA World FactbooK

0% Population: **17,363,894 (July 2014 est.)** 100%

Unemployment Rate: **6%** (2013 est.) • Labor Force: **48.19%** (2013 est.)
Youth Unemployment Rate: **16.3%** • Literacy Rate: **98.6%**

Dr. Hernán de Solminihac

Former Minister of Mining
GOVERNMENT OF CHILE

GBR conducted this interview in September 2013, when Dr. Hernán de Solminihac was the Minister of Mining. Aurora Williams replaced Dr. Solminihac in March 2014.

What have been the ministry's main achievements since you took office in 2011?

The Ministry of Mining in Chile works around four key areas: (1) the promotion of investment in the mining sector, (2) small- and medium-sized mining companies, (3) safety and sustainability, and (4) fostering a closer relationship between the industry and general public. Since 2011 we have seen significant achievements in all four areas. With regards to investment, total predicted investment in the sector amounted to $45 billion in 2012, but in 2014, we registered an investment portfolio of $112 billion in projects to be developed in the next eight to 10 years. This increase resulted partly from Chile's reputation as a serious mining jurisdiction, but also from the government's actions.

We have also taken steps to improve compliance regulations at the mine sites of smaller producers. For example, in 2011, only 3% of small mines in Antofagasta were operating in accordance with regulations, but today that figure is 100%. We achieved this by developing a specific safety code for small mines and by training 6,000 dedicated safety monitors to ensure that standards are being maintained. In term of safety, the rate of fatal accidents fell by 55% between 2010 and 2012. This is in large part due to the new regulations. In terms of sustainability, we passed a law that lays out clear steps to be taken when a mine comes to the end of its productive lifespan and guarantees the resources.

Finally, we have introduced several initiatives to demonstrate to the Chilean people the benefits that mining confers upon the country and to motivate them to participate in the sector. Since this government came to power, the number of students enrolled in a mining related university course has increased by 1500%.

How have you seen the role of small to medium mines develop in recent years?

In Chile, the major mines deliver approximately 90% of total production, while the small- to medium-sized operators produce 10%. However, if we consider non-majors as a separate entity, they are the fourth largest export industry in Chile. They are important job creators for some local communities and play a valuable role in exploration, as they are more willing to take risks with grassroots exploration. These discoveries have led to many of the largest mines in operation today.

Can you explain the relationship between Codelco and the other public sector bodies involved in its governance?

In March 2010, Codelco's corporate governance law came into force, which gives complete independence to the company. Codelco now functions in the same way as any other private corporation, even though the owner remains the Chilean state. Both the Ministry of Mining and the Treasury oversee Codelco's operations and their role can be likened to that of majority shareholders. The government upholds a commitment to Codelco's administration to ensure that projects are taken forward, but the first priority is to guarantee that these projects will be profitable. That being said, Codelco has the responsibility to first look outside of state support to find the necessary finance to ensure that their investment grade does not fall. Only in the case that Codelco's investment grade risks being lowered will the state provide financial assistance.

What measures is the government taking to increase the competitiveness of Chilean mining in the face of inadequate energy supplies and falling copper prices?

The energy supply is certainly one of the most serious challenges facing the country, not only for the mining industry. It has been estimated that as the country is growing at a rate of 5% to 8% per year, capacity must double in the next 10 to 12 years to meet demand. The government has developed a 20-year energy strategy, spearheaded by the Ministry of Energy. The first is to improve efficiency by 12% per year, a target that the mining sector has been a leader in addressing. The second is to expand the role played by renewable energy sources in the country's power generation capacity. For instance, there is great potential to install photovoltaic plants in the Northern region. Third, we hope to increase production of conventional energy but in a way that minimizes the environmental impact. Fourth, we will also pass legislation to promote greater competitiveness. Finally, we will improve the transmission network by integrating the country's two principal power grids and working together with energy suppliers in Peru, Ecuador and Colombia. As for falling copper prices, there is little that we can do, as they are defined by a huge variety of external factors, but we can work to make the industry more efficient.

What does the future hold for Chile's mining industry?

We are optimistic about the future of the Chilean mining industry, and believe Chile will play a key role not only in terms of mineral production, but also in developing technological innovations that will be of great benefit to the whole worldwide industry. In recent years, research into new applications for copper, for example as an antibacterial agent in hospitals, fish farms, and even textiles, offers growth potential. •

Chilean Mining

An Overview

Since the late 1990s, Chile has been cementing its much-deserved reputation as a model of stability in a region that has been prone to economic turmoil. In 2013, the country was ranked seventh in the Heritage Foundation's annual Economic Freedom Index, with special mention being made of the efficient judicial system, prudent public finance management and attractive investment code, which encourages entrepreneurial ventures. In 2009, Chile became the first South American country to be granted full membership of the OECD and in the intervening five years it has seen solid GDP growth of 5%, whilst inflation and unemployment levels are the envy of struggling European nations.

Image: Shutterstock

Image: Shutterstock

The role that mining, and particularly copper mining, has played in this development cannot be overstated: "It has been estimated that for every dollar invested in mining, between seven and 13 dollars are spent on infrastructure and associated support services. The upshot of all this is that Chile now has one of the best-developed infrastructure systems on the continent," said Colin Becker, partner at PricewaterhouseCoopers.

Whilst the economy is gradually becoming more diversified, with important roles played by the forestry, wine and tourism industries, there is no denying that copper is king. The red metal now makes up some 20% of GDP and 60% of total exports, and with over 28% of the world's reserves, Chile has prioritized the copper trade above all other areas. The country now accounts for 32% of world production, with a major proportion of output finding its way to the Chinese construction industry.

State-owned miner Codelco remains the largest copper producer in Chile, although their production has been in decline recently as they are struggling to deal with ever-lower ore grades in their mature mines. In spite of this continued dominance of global copper production, the picture is not entirely rosy for Chile's mining sector: total mining exports in 2013 declined by 6.2% from 2012 levels, and for the first time in many years the country has dropped out of the Fraser Institute's top 10 most competitive mining jurisdictions.

The reasons for this fall from grace are various, and the weight that should be assigned to each is debatable. To some extent, Chile has been the victim of its own success. The decade-long commodities boom that has led to Chilean mining engineers and technicians becoming some of the best paid workers in the world has also caused a sharp rise in production costs, with some estimates putting the increase at 40% in the last five years.

As copper prices continue to retreat to lower levels, the industry is also being confronted by the twin threats of rapidly increasing energy prices and a glaring lack of freshwater supplies. The mining industry is the single largest consumer of electrical energy in the country, and today it is facing a supply crisis, whilst in all areas north of Santiago demand for water now exceeds supply.

At the time of publication, Chile is still adjusting to life under a new government led by President Michelle Bachelet, who enjoyed a landslide election victory last year. While it is still early to gauge what impact her new policies will have on the sector, major upheavals are highly unlikely. Aside from a hike in corporation tax from 20% to 25%, which will be applied across all sectors, there has been no mention of an increase in royalty payments or any suggestion that her administration will be taking a particularly harsh line with mining projects. In fact, Bachelet has emphasized the strategic nature of mining for Chile and has stated repeatedly that the industry must recover its competitive edge. Whilst the details of her political program remain vague, she has issued statements claiming that the government plans to help the domestic industry by bringing down electricity rates and taking measures to stimulate exploration activity.

Today, Chile is, without doubt, one of the most well-developed and exciting mining jurisdictions in Latin America, boasting enormous proved and probable reserves of copper and precious metals that are still awaiting development. Whilst there is a constant need for qualified technicians, the country is home to a high concentration of expertise in almost all aspects of mining, and domestic service providers are able to compete with the largest multinational firms. Nevertheless, the high price of copper that the country has enjoyed in recent years has led to unfeasible operational costs and has propagated a culture of complacency. Now that the boom times have come to an end, miners, service providers and government bodies must work together to rationalize the price environment to ensure that Chile continues to enjoy its status as one of the world's leading mining destinations. •

ANNUALIZED NOMINAL COPPER PRICES (2005-2013, ¢US$/LB)

Source: Chilean Copper Commission, based on LME data reported by Reuters

STOCK	2005	2006	2007	2008	2009	2010	2011	2012	2013
Copper, London Metal Exchange	167,087	305,295	323,246	315,316	234,217	341,978	399,656	360,593	332,120

Thomas Keller L.

Former President and Chief Executive Officer
CODELCO

GBR conducted this interview in September 2013. In June 2014, Codelco's board of directors voted to remove Thomas Keller L. and had not named a replacement when this publication went to press.

What have been Codelco's main achievements since you took over the presidency in 2012?

During my presidency, we have continued the strategy that we defined for Codelco in 2010. Mining is a long-term business and continuity in implementation is essential, particularly at a time when we are launching the company's largest investment program to date. We have identified five structural mining projects for development: our greenfield mine, Ministro Hales; the transition to underground mining at Chuquicamata, which is now in its first year of construction; the development of a new mining level at El Teniente, now in its second year of construction; the phase two expansion of Radomiro Tomic; and the large expansion of Andina. It is an ambitious program, but critical in order to meet our medium- and long-term profitability targets.

Would you agree that a certain tension exists between Codelco's long-term investment needs and the government's short-term budget requirements?

This tension has always existed. This situation has attracted more attention recently because of the sheer size of Codelco's current investment program. The board of directors has defined a clear financing strategy, which is centered on preserving our investment grade and thus maintaining a reasonable debt level. While actual profits retained have from time to time fallen short of our expectations, government authorities have generally supported our investment program.

In this time of depressed metals prices and rising production costs, how will Codelco boost productivity and increase efficiency?

We were unsurprised by the slowdown in the mining industry. For the past 15 months, we have been working to improve Codelco's competiveness. In the near-term, we seek to contain cost escalation by increasing asset utilization, improving our contractual arrangements with third parties, and boosting productivity. In the medium- and long-term, our structural projects will allow us to introduce new technologies, modify business models in some divisions, and implement more market oriented labor relations models.

It has been predicted that there Chile's skilled labor shortfall could be as high as 64,000 people in the near-term. How does Codelco plan to combat this shortfall?

The size of the skilled labor shortfall is being grossly overestimated because many planned projects will be either postponed or shelved. The industry did not fully anticipate the impact that the mining boom would have on the labor market, and labor costs have risen, but the major companies are now addressing the issue. Perhaps the most significant measure being taken at an industry level is through the Consejo Minero's Consejo de Competencias Mineras scheme, which follows the Australian educational model and will have a positive impact. The number of students enrolled in courses at technical institutions in geology, mining engineering, and metallurgy has also grown exponentially over the past year. Admittedly, we are still catching up.

What are the serious issues facing Chile in providing reliable and reasonably priced power?

It is clear that Chile is facing a serious energy problem. The main hurdle to expand energy capacity and lower prices has been securing environmental and regulatory approvals to carry out power-generation projects. The energy problem is not the same throughout the country. Operations in the north that are connected to the Northern Power Grid generally have access to energy at competitive prices, but this may change if installed capacity is not increased. The issue is more pressing in the Central Grid, where the marginal costs of power generation have risen above $200 per megawatt hour. In the near-term, there are no planned large-scale power generation projects under consideration that might address the problem.

New capacity will come predominantly from gas-fired stations, which are less economical than coal-fired plants. There is a role for renewable sources, but it is still restricted to a limited number of power-supply requirements.

Will greenfield exploration in Chile be affected by the depressed market conditions?

Codelco's exploration policy is based on maintaining our resource base. As we use up existing resources they must be replaced, either through an expansion of reserves at our existing ore bodies or the incorporation of new areas. Still, the mining sector must face the challenge of securing funding for exploration work at a time when the industry is cutting costs.

How do you evaluate the threat posed to the international copper trade by substitution from other substances?

Copper producers have faced the threat of substitution for many years. In fact, other materials have already displaced copper, such as in the case of high-tension electricity cables and radiators. The challenge is to defend our markets by improving performance in existing applications and identifying and promoting new uses for copper. For example, Chile has been a leader in developing the use of copper's antibacterial properties in hospitals and metro stations. •

Pascual Veiga & Juan Carlos Olivares M.

PV: President
JCO: General Manager
APRIMIN

panies, all of which operate in the realm of capital goods and related services. To become a member, there are basic requirements: candidates must have a clear focus on the mining industry, record sales of at least $15 million per year, and have permanent staff presence at the mining site. Although there are over 4,000 service providers in Chile's mining sector, our 90 member companies represent 82% of the total market share. There are several benefits to becoming a member; professional networking is important but we also work on sector wide issues. For example, we are currently working with Codelco to standardize requirements for working at the mine sites and remove some of the barriers to working on site.

What initiatives is APRIMIN currently involved with?

JCO: Within APRIMIN we have our own education corporation, which partners with the Ministry of Mining, SONAMI and the Consejo Minero to evaluate what skills are lacking in the industry and what kind of curriculum should be adopted at technical colleges to fill these gaps. We will also be part of the certification board for these newly qualified electricians, mechanics, welders, operators and general maintenance staff.

How have the large service providers been affected by the end of the mining "super-cycle"?

PV: Until 2012, Chilean mining saw sustained growth for nearly a decade, except for a short downturn in 2009 during the global financial crisis. As such, many service companies devised budgets and future plans based on continued growth in 2013, but these will not be realized. Most companies will maintain 2012 sales levels or suffer a slight decrease. Mining is a cyclical business, and this is another cycle, although it has been longer and more dramatic than any previous one.

What are the factors that have allowed Chilean mining to remain so stable?

PV: One of the strengths of the Chilean mining sector is that it is heavily geared towards copper production. While more diversified mining countries such as Brazil were hit harder by the fall in commodity and precious metal prices, copper prices have remained remarkably stable. However, the country also presents challenges: high energy prices, opposition from local communities, and scarce water supplies, which has forced miners to pump seawater to mine sites at altitudes of over 4,000 meters. This is of course energy intensive and pushes prices higher.

How would you evaluate existing safety and environmental regulation in Chile insofar as they relate to equipment providers?

PV: Chile has some of the safest mines in the world. The much-publicized accident that occurred in the San José mine in 2010 was not representative of the industry, as it was a small operation that was far behind normal safety standards. Most Chilean mines are by large multinationals, which has kept safety standards on par with jurisdictions such as Australia and Canada.

Environmental regulations are a little more complicated. No single body exists that can provide clear information about the environmental requirements, guidelines and tests that must be carried out in order for a project to be approved. Even after a project has received approval, it can be halted indefinitely if a private citizen lodges a complaint with the courts. As a result, many projects are now on hold.

Chile has a reputation for staying ahead of the curve in terms of adoption of new technologies. Would you agree?

JCO: Chile has always been an early adopter of new technologies. This is partly because of Chile's uniquely harsh climate, which makes it a preferred testing ground for original equipment manufacturers keen to prove that their products can withstand the toughest of conditions. If a product works in Chile, it will work anywhere.

Do you foresee any diversification away from copper production in the Chilean economy?

The economy would certainly benefit from greater diversification, but at the same time Chile will never be a manufacturing country because its population of 17 million cannot provide an internal market large enough to sustain economies of scale. Copper will continue to be the driving force of the economy for some time, and now the emphasis should be on improving production and finding new applications for the metal. •

Could you explain the rationale behind founding APRIMIN?

PV: APRIMIN was founded in 2003 to bring together all the largest service providers in Chile so that they could adapt to the influx of multinational mining companies entering Chile. Before the association was created, the mining companies had the upper hand when negotiating contracts with the providers, but by working together we were able to level the playing field and make the industry fairer for all parties.

Around this time, the Chilean government introduced a royalty payment for all mining companies, and within this law there was talk of introducing a clause that would have made any expenditure on equipment and related services no longer a tax-deductible expense. This would have put an immense amount of pressure on our sector, but after two years of negotiation we were able to have the clause removed. The association now serves as an ideal forum for sharing best practices and educating technicians, as well as discussing the challenges that service providers face.

How does APRIMIN's membership break down?

JCO: APRIMIN now has 90 member com-

Joaquín Villarino

Executive President
CONSEJO MINERO

What is the mission of Consejo Minero and how does it seek to further the interests of its member companies?

Consejo Minero is an association that brings together the voices of the 17 largest mining companies in Chile, with participation from producers of copper, gold, silver, and molybdenum. To qualify for membership, a candidate must produce at least 50 million metric tons per year in copper or its equivalent. The majority of our members are foreign corporations, with the notable exception of Codelco and Antofagasta Minerals, which are owned by the Chilean state and a Chilean holding firm respectively.

Our organization has three main roles: to provide space for high-level discussion among members about issues affecting the sector. Our second task is to produce position papers and studies that we distribute to the market, the press and to members of congress to inform principal stakeholders about the needs of the mining sector. Our third responsibility is to promote public discourse about mining and to educate the public and politicians about the benefits that the industry brings to the country so that they can construct an informed opinion.

Could you provide details about Consejo Minero's recent restructuring?

We have created six committees to investigate the major issues facing the country. The first issue is water, as mining consumes 5% of total Chilean consumption and 35% of northern consumption. A balance needs to be struck between the water needs of the industry, cities, agriculture and local communities. Energy is the second challenge. Development of new capacity has been paralyzed and electricity prices are very high. A study carried out with McKinsey demonstrated that only the Democratic Republic of Congo has higher energy price than Chile. Consejo's members are investing in non-conventional renewable generation capacity, which needs to become a larger part of Chile's energy mix. The third issue is the lack of skilled labor. We are currently working on an initiative known as the New Skills Council, which is based on a program in Australia. Member companies estimate the number and quality of new workers they will need in the next 10 years. This information is then passed on to educational institutions, which tailor their curricula to meet the market's future demand. The fourth is competitiveness. Chile has grown less competitive over the last 10 to 20 years, so we are looking at other mining countries to learn how to boost our competitiveness. The fifth committee is public relations. Many Chileans now believe that our economy is based more on agriculture than on mining and metals, so we are trying to spread awareness of the contributions that the industry makes to society. The sixth issue is improving relations between the mining companies and local communities. In recent years several projects have been held up or cancelled because the owners did not respect the concerns of the local people.

As grades across many of Chile's flagship mines are falling, does Chile have the expertise to develop underground mining?

Chile's lack of expertise in underground mining is not a problem. While projects such as Chuquicamata are moving underground, the majority of Chile's most important operations will remain open pit for at least another 50 years. During the coming years, Chile can gain experience from working with contracting specialist engineers from other countries and develop a skills base.

There is a lack of investment in Chile's exploration sector from both juniors and majors. How should this be addressed?

There are ongoing conversations about how to address this, and there is talk of a possible change to the law that would prevent large companies from retaining huge tracts of land without developing them. However, any such law would require Codelco to open up some of its land to private investors, and the government would be accused of privatizing a state asset. The balance we have struck between public and private sector mining has worked well so far. If Chile operated a closed mining sector, and Codelco were to exist in isolation then it is inconceivable that it could operate at such a high level, and the industry would be not be as advanced as it is today.

What is Consejo Minero's position on Cochilco's claims that Chile will receive $113 billion in mining investment over the next 10 years?

This figure has been hugely inflated and created false expectations. It has propagated the idea among political circles that there is more money coming into the country than is the case. If long-term budgetary decisions are made with this figure in mind, there will be a shortfall in government revenues, and spending on education, healthcare or infrastructure will be cut. Most of this new investment will only maintain current capacity rather than increase it, and investment in greenfield projects is closer to $30 billion, which is still an immense sum. There are further projects under consideration beyond this $30 billion, but they are not guaranteed.

How do you evaluate the increasing power of the environmental authorities in Chile?

Environmentally sustainable mining in Chile is necessary for the sector to thrive in the long-term. On the other hand, applying new rules to old mines without giving them time to change their procedures is folly. A transition period is necessary to introduce new regulations. •

Colin Becker

Partner
PWC

Could you give us a brief overview of PwC's operations in Chile?

PwC in Chile runs on the model similar those found in smaller countries: rather than one large practice that is split into a number of different sub-sectors, we all focus on a variety of sectors. That being said, mining has always been an important economic driver for Chile. This includes not only the mining houses, but also the legions of service companies catering to them. Aside from the traditional services of auditing and tax services, we are growing our consultancy arm, which includes cost reduction, strategic services in the mining cluster, environmental services, climate change, organizational structures and human resources, and IT systems. Clients want to improve productivity, and optimizing existing systems will realize larger gains than introducing new technology. PwC plans to shift its consulting practice to a regional model that will have five industry focuses, one of which will be mining.

In the wake of the large fine levied against Barrick Gold this year, environmental compliance has become a key priority for miners. What services does PwC offer in this arena?

Any discussion of environmental concerns cannot be separated from social concerns. In fact, the social aspect is probably of greater importance than the environmental, unlike in Peru. A small environmental issue can quickly become a serious social problem and close a mine. PwC works on three fronts in this area: social management, for which we engage with local communities to understand their needs and concerns; environmental consulting, for which we help companies understand environmental risks and draw up mitigation plans; and compliance, for which we analyze a mine site and determine whether it meets existing regulations. Demand for this service has risen in the past year.

Could you provide an explanation of why the mining industry is so important to Chile?

When I first came to Chile several years ago there was a clear sense of pride, which is still felt today, stemming from the fact that the country enjoyed a much higher level of social and economic stability than anywhere else in Latin America. After 21 years here, I firmly believe that the differentiating factor that has allowed for such stability is the mining industry. Mining provided the opening for Chile to become a part of the international community. This process started in the 1970s and 1980s when the government invited foreign companies to develop Chile's mineral resources. The first major players to arrive were Exxon and BHP, both of which made large discoveries. Their presence attracted the interest of other miners, which created a ripple effect in the broader economy. It has been estimated that for every dollar invested in mining, between seven and 13 dollars are spent on infrastructure and associated support services. Therefore, Chile has one of the most developed infrastructure systems on the continent, and financial stability. Once a country has achieved financial stability, social stability follows naturally; it is a much more challenging objective to establish democracy in a desperately poor country.

Some commentators have suggested that the industry is now in decline. Do you agree?

To a certain extent the past success of the mining industry has also been its biggest enemy. This created a perception that the industry was impervious to external forces. This situation has changed dramatically and in a relatively short period. Lower and volatile commodity prices, aging mines, unchecked cost inflation, spiraling construction costs, increased taxes and royalties, and a slew of more onerous environmental and social factors, have all contributed to the Chilean mining sector losing its competitive advantage. The industry has proven to be historically resilient and weathered the past challenges such as the Asian and Financial crisis. This is different and the mining sector desperately needs more political and social support to help it find return to a more sustainable and equitable balance.

Chile's mining sector has an investment portfolio of $113 billion scheduled for development over the next 10 years. Will these new projects help bring the industry out of its current situation?

This much-quoted figure of $113 billion is misleading: beyond the fact that the vast majority of the registered projects will be brownfield expansions rather than new mines, we are skeptical about how much will actually be realized. Chile is primarily a copper producing country (with significant gold production coming from combined copper/gold mines) and there are now alternative destinations for investment in copper. Economists argue that there will be a global oversupply of copper for several years now, so investors will be much more selective. Simply put, Chile is no longer where the most competitive conditions can be found, and there are other opportunities to develop lower cost projects in Peru, and further afield in Africa and Asia.

How do you see PwC's mining practice developing over the coming years?

We are very optimistic about PwC's future in the mining sector: the shift to a regional practice will give us the ability to bring a new level of sophistication in our services. Looking at the example of strategic sourcing, which is now a major concern for the industry, we will be able to draw on expertise from across South America, but also from the USA and Canada. In addition, we will also be investing in hiring new professionals from the top echelons of mining companies and consulting firms to consolidate our position as leading industry experts. •

Sergio Hernández Núñez

Executive Vice President
COCHILCO

How would you respond to claims that the official figure of $113 billion for mining investments coming online by 2020 has been substantially inflated?

In July 2013, Cochilco published the official Chilean Mining Investment Portfolio, which included all projects with potential to come online between 2013 and 2021 and encompassed 49 separate initiatives that had a combination valuation of $112,556 million. Of this total $86,718 million was to be invested in copper, $21,718 million in copper and gold, and the remaining $4,050 million in iron and base metals. After we released the Portfolio, a number of companies announced that they would be revising their plans and postponing several projects. This affected roughly 40% of the total investments, including one third of planned copper projects, the majority of which were brownfield expansions of existing mines. When the Portfolio was released, many of these projects were in the prefeasibility stage but many of these studies were suspended until market conditions improved, capital costs declined, and energy supplies obtained. Other projects are looking at different expansion models that would be carried out more gradually.

Gold projects have been proportionally hit the worst. Only 15% of the original listed projects are going ahead as planned, while the remaining projects have been temporarily suspended. Approximately one half of these suspensions can be attributed to poor market conditions, and the remainder to permitting issues or disputes with local communities. We are now updating the Portfolio and will be releasing the revised version shortly. We will remove the projects that have already entered into operations, add all new projects and adjust the capital expenditure of those that remain in development. The total value will remain similar, but the predicted timeline for investment will be extended to between 2020 and 2023.

In this climate of falling copper prices, are miners less likely to follow through with planned investments?

The drop in copper prices has led producers to revise their investment plans throughout the world. However, Chile's strong geology is a competitive advantage that will always work to its advantage. The crucial factor that might dissuade new miners is uncertainty over the electrical energy supply, but the government has set out a clear strategy to remedy the issues and will improve the energy supply situation in the medium-term.

Cochilco has lowered its price estimates for copper to $3.15 per pound (lb) for 2014. Are you concerned that the slowdown in China's growth could produce a drop in demand for copper in the long-term?

At present we are not seeing any particular deceleration in China's growth. In June the World Bank published an updated growth forecast for the country that predicts 7.6% GDP growth for 2014 and 7.5% for 2015. This translates to a decrease of 0.1% and 0.2% for 2014 and 2015 respective to previous estimates. In 2013, China's GDP increased by 7.7%. This suggests that if China is indeed entering a phase of deceleration, it will be fairly mild and should not have any sharp impact on the price or consumption level of copper. Furthermore, the Chinese government has the goal of growing by 7.5% this year, a target that it has exceeded in recent years. Preliminary figures published by World Metal Statistics demonstrate that during the first trimester of this year consumption of copper rose by 11% compared with the same period in 2013. Approximately 88% of this increase came from China.

One worrying trend is the growing use of copper stored outside of official warehouses as a guarantee for obtaining finance in China. In March, the CRU estimated that it could amount to 820,000 metric tons (mt). If this copper were to be released on the market when such loans are paid off, it would have a negative impact on prices. An even greater risk to price levels is new operations that have come online in the second semester of this year, which have created a surplus in refined copper that could reach 373,000 mt in 2014 and 439,000 mt in 2015. As such, Cochilco predicts that copper prices will continue to drop in the coming months, reaching a level of $3/lb in 2015.

For the first time in many years, Chile has dropped out of the top 10 in the Fraser Institute's annual ranking of mining jurisdictions by competitiveness. How should Chile redress this situation?

The Fraser ranking is a well-known and highly respected indicator, but it is susceptible to a range of factors, and Chile's energy situation is the most significant drag on the country's ranking in the survey. The Ministry of Energy has established a set of policy initiatives to help overcome these hurdles and boost Chile's competitiveness. The government is also working to increase labor productivity, develop the mining cluster, and promote innovation. These measures will ensure that Chile holds its position of mining leadership.

What does the future hold for Chile's mining sector?

In the coming years, Chile's mining sector will confront a series of challenges, such as declining grades and aging deposits, changes in its environmental laws, and fluctuations in the prices of supplies. In the short-term, several miners have begun to renegotiate contracts with suppliers to control costs. However, in the long-term, the industry needs to implement broader, strategic changes. The private sector must forge closer links with universities and other institutions to encourage the adoption of new technologies, provide better education to students, and boost productivity. •

Copper Rules: Exploration and Production in Chile

"Mining is of course a cyclical industry, so the lack of new projects will inevitably produce a shortage and prices will rise again, triggering new investments, but it seems unlikely that this will happen for several years."

- David Gallagher, President, Asset

Image: Shutterstock

The Great Investment Discrepancy

New Copper Projects in Chile

The exploration and production of minerals in Chile has a long track record of success. Traditionally, large-scale projects have driven this success, with foreign investors providing the capital. During the decade of the 2000s, this formula helped Chile enjoyed a mining boom. However, this scramble seems now to have subsided, as world prices for minerals have declined and investors have grown reluctant to place new money into the sector.

There is also considerable debate regarding the next decade's investment projections. According to the official project portfolio published by Cochilco and frequently referred to by government figures, total investment in the mining sector between 2013 and 2021 will amount to $112.6 billion. However, closer examination reveals that several projects included in this estimate have been put on hold indefinitely or even cancelled, while several more are still at the discussion stage and have not been given the green light by the boardroom. This impressive figure also masks the fact that these investments will not serve to increase Chile's production capacity by any significant margin. In fact, the next wave of investment projects will only be sufficient to maintain the sector's current capacity.

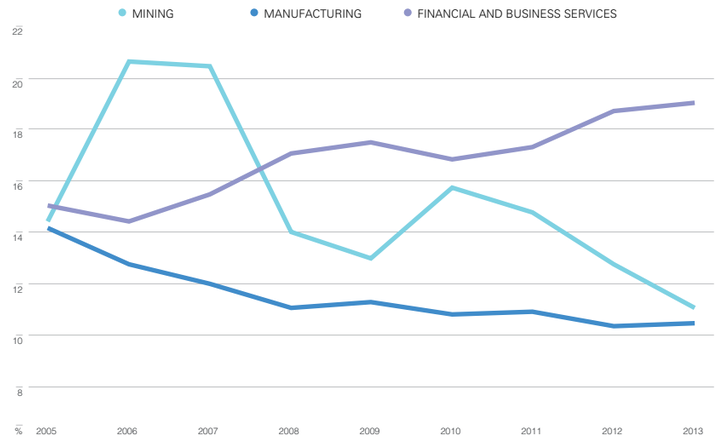
"When we look at new greenfield projects, the total level of concrete investment is closer to $30 billion, which is still an immense sum and a considerable achievement for the sector. Beyond this initial $30 billion it is true that there are further opportunities under consideration, but to refer to them as guaranteed investments is highly misleading," said Joaquín Villarino, executive president of Chile's Mining Council.

Image: Shutterstock

> Forecasting copper prices in the long term is very much a guessing game. Some analysts predict that it will not fall below $3/lb, whilst others confidently assert that we will soon be seeing levels of $2.70/lb. What is clear is that if the price continues to fall, some projects will not be able to continue. One mine in Chile is operating at a cash cost of $4.71/lb, and this is just not sustainable in the current climate.
>
> - Ricardo Glade, General Manager, JRI

MINING AS PERCENTAGE OF CHILEAN GDP

Source: Chilean Central Bank



Part of the reason for this drastic difference in opinion is the tendency for projects to overrun and deadlines agreements to be broken. "Look at the recent personnel shifts in the top echelons of the major mining companies around the world and you will see that many of these were the result of poorly executed projects… As an industry, we can do better than this," said Claude A. D'Cruz, senior vice president Americas at WorleyParsons. This is partly a result of the heightened levels of activity, which left engineering contractors stretched to the limit and without time to carry out adequate front-end work. However, some blame it on the prevailing EPCM model of project management: "It is true that this approach gives the client an overarching guarantee for their project, but it is unclear if it can really help save time and cut costs. In the long term I believe we will see a return to the old way of doing things, with a variety of specialized contractors working together to deliver the total project," said Andres Osorio, commercial manager for STM.

Codelco has already returned to this model and now divides projects into a series of component parts that are subcontracted to a range of different firms. The state-owned copper giant is embarking on an ambitious $27 billion dollar investment package comprising five so-called structural projects: the greenfield mine, Ministro Hales, the transition to underground mining at Chuquicamata, the development of a new mining level at El Teniente, the expansion of Radomiro Tomic and the large expansion of Andina. "It is an ambitious program, but given that the company has perhaps suffered from under-investment in the past, we believe that in order to meet our production and profitability targets, the best course of action is to carry out all these projects simultaneously," said Codelco's president and CEO, Thomas Keller L.

Perhaps the most closely observed of these projects is the Chuquicamata Underground Project, which will see one of the country's oldest active mines make the transition from open pit to subsurface operations. The $3.83 billion project is the most expensive underground transition ever attempted and will require the services of over 3,000 workers during the construction phase, adding another 50 years to the mine's useful life, eventually generating some 4,500 long-term jobs. Although the initial investment may be high, the eventual payoff will be significant: the pit is now 850m deep and trucks are using over 3,100 liters of fuel per day on the 11km route to the surface. The shift to block caving will instill a new level of operational efficiency and prevent transport costs from escalating any further.

Named after Alejandro Hales, one of the architects of Chile's modern mining industry, the Ministro Hales mine is located in Chile's II Region and has been under construction since 2011. The pre-stripping operation, which was carried out between April 2011 and August 2013, was the largest undertaking of its kind ever seen and entailed the removal of 228 million mt of waste material. Over its initial 14 year lifespan, the mine is expected to produce an average of 170,000 mt/y fine copper and a further 300 mt/y of silver. There is further potential to develop an underground operation at the site that would extend the mine life by 50 years.

Staying in Region II, one of Chile's largest greenfield projects in development is the Sierra Gorda copper project. A joint venture between KGHM International and Japanese companies Sumitomo

> Chile has the largest endowment of copper in the world, with at least 29% to 30% of the world's reserves located under Chilean soil. In order to best take advantage of this privileged position, the first step needs to be more investment in exploration, because right now it is true that there is a huge imbalance between expenditure on exploitation and exploration.
>
> - Joaquín Villarino, Executive President, Consejo Minero

Image: Shutterstock

Metal Mining and the Sumitomo Corporation, the mine will be the Polish copper producer's first major operation in Latin America. "Initial production is set to be 110,000 mt/d, which will then rise to 190,000 mt/d in 2017, with the opportunity to carry out several further expansions and bring in an SX-EW plant as well. We then hope to develop some other deposits on the property that will increase the mine life by another 10 to 15 years," said Derek White, CEO of KGHM International.

In addition to the primary copper production, the operation will also deliver a significant secondary production of molybdenum, opening the door for KGHM to become one of the world's leading producers of the metal. Seawater will be pumped to the site via a 143km seawater pipeline running from the coast to the pit. The saltwater will be used for first-stage processing and will then be passed through a reverse osmosis plant to create fresh water for use in the molybdenum plant.

Another interesting project that is fast approaching production is the Pampa Camarones copper mine near the northern city of Arica. Although it is a relatively small mine by Chilean standards, its shareholders make it a noteworthy development: the project represents the first foray into mining by Korean technology giant Samsung, which owns 51% of the operation and plans to integrate the copper production into its existing supply chain. Once the mine goes into production there are plans to rapidly increase output to 12,000 mt/y and eventually to 24,000 mt/y.

> "As there is no obligation to develop the land and no real incentive to sell it, many properties remain idle, and smaller companies, which might be more willing to take the risk, are unable to get a foot in the door. There is now talk of reforming this area of the law in order to encourage more participation from junior companies, but lawmakers have yet to take concrete action."
>
> Pablo Mir, Partner,
> Bofill Mir & Alvarez Jana Abogados

This is still a fairly modest figure by Chilean standards but is perhaps representative of the shape of things to come. From a geological standpoint it is unlikely that there are many deposits of the scale of Collahuasi or Escondida left to discover, whilst the prospects for mid-size mines are far more promising. "There are a great number of companies developing projects in the range of $10 million to $100 million whilst many of the multi-billion dollar projects are now on hold," said Pampa Camarones' vice president for operations, Daniel Berrios. •

Daniel Berrios

Vice President for Operations
PAMPA CAMARONES

The two main investors behind Pampa Camarones are Korean giant Samsung and local conglomerate Arrigoni. How did this partnership first come about?

In early 2012 Arrigoni came to an agreement with Samsung to develop the project that was divided into three distinct stages: preliminary drilling campaigns; the feasibility study and early engineering; and final construction. Today we are in the third stage, with approximately 70% of the plant completed, and at this point Samsung maintains a 46% stake in the project, with an option to increase participation to 51% that should be exercised next year. The current plan is to finish construction in early January 2014 with production commencing in February. We are also carrying out a third drilling campaign to reevaluate the total resource and next year we are considering embarking on another. To date, the total investment for the project, including the additional drilling, has been roughly $70 million.

Could you tell us a bit more about the site itself? How advanced is the local infrastructure?

The infrastructure at Pampa Camarones is very good: we extended an existing minor road by 14 kilometers (km) and this now gives us direct access to Route 5, which forms part of the Panamerican Highway. As part of the off-take agreement that we have, all the copper produced at the site will go to Samsung and it is their responsibility to export it to Korea. For this purpose they will be using the nearby Arica Port. With regards to energy supply, we constructed a dedicated 7km transmission line connected to the SING that will serve the mine's needs. We have a long-term supply contract with E-CL, one of Chile's largest generators, and we are also building a solar plant of our own. In the first stage of production Pampa Camarones will be producing 8,400 million tons per year (mt/y), using approximately 6 megawatts, but output will soon increase to 12,000 mt/y and in the mid-term this will double to 24,000 mt/y. This will of course bring a corresponding increase in the amount of energy that we consume. Opex at the plant is approximately $0.80 per pound and for the mine we are looking at $0.70 so the combined production cost is somewhere around $1.60. Pampa Camarones' resource is an oxide ore so we will be using a typical process model based on crushing, leaching, solvent extraction and electro-winning.

Pampa Camarones is situated in Arica, one of Chile's driest regions. How will you be meeting your water supply needs?

Although Pampa Camarones is located in a dry area, it is only 12km away from the sea so we willuse stations to pump seawater to the site. The engineering for this pumping system has been made slightly more complex by the fact that there is a 1,000m high cliff at the water's edge. We will be using untreated seawater for the leaching process, but as the electro-winning and all the other steps of the processing require fresh water, we will be building a desalination facility at the plant.

Small to medium-sized mines often serve as an important job creator for remote communities. What kind of impact will Pampa Camarones have on the surrounding area?

During the construction phase, we are employing around 700 people, but when we start production we will be providing approximately 300 direct jobs in operation and services and potentially another 300 in indirect positions. We have set ourselves the target of making sure that 60% of our workforce comes from Chile's Region I. Aside from serving as source of employment, we are heavily involved with the community in other areas, collaborating with them on several educational activities.

Although Chile has historically been seen as a country of large mines it seems unlikely that any more deposits of the scale ofEscondida or Collahuasi remain undiscovered. In this context how do you see the importance of medium-sized mines developing?

We will see the role played by small to medium-sized mines increase dramatically in the coming years. There are a great number of companies developing projects in the range of $10 million to $100 million, while many of the multi-billion dollar projects are now on hold. Looking specifically at the Region I, we are the first metallic mine that will go into operation, because much of the area was previously a military training zone. We believe that it now constitutes a highly prospective region and we are confident that several more exploitable deposits will be discovered in the near future.

Do you have a final message about the future of Pampa Camarones that you would like to share with our readers?

For now we have the challenge of exploring the rest of our land. Pampa Camarones, as we are developing it now, only constitutes a tiny proportion of the total property that we own (approximately 200 hectares of over 2,000). We have found some interesting new structures in the area and are now considering several different drilling programs to find out more about the geological model that we have. Even though we are unclear about the details of the ore body that we are working with, the potential for future expansions is clearly enormous. •

Derek White

CEO
KGHM INTERNATIONAL

KGHM has operations in various locations around the world including Poland, the USA and Canada. What is the importance of Chile within this mix?
KGHM is a Polish mining company with headquarters in Lubin, Poland. Our facilities in the Americas are run by KGHM International, which is a wholly owned subsidiary with headquarters in Vancouver, BC.KGHM is primarily a copper producing company, although it is involved in several other metals. We believe that Chile represents the best place in the world to mine copper: aside from its experienced workforce and high-level services sector, the country boasts some of theworld's largest deposits on the planet.

As a diversified resources company how important is copper to KGHM and where are your main export markets?
Copper is our most important metal but we also have significant production of a number of by-products including precious metals, nickel, molybdenum and silver. Today KGHM isthe world's largest producer of silver, although production volumes are nowhere near those we see for copper.Our production is geographically divided between Europe and the Americas.In Poland we operate an integrated production chain consisting of five large mines, a major concentrator and three smelters, which produce finished copper for the European market. Our operations in Chile, Canada and the USA produce both copper concentrate and copper cathodes through SX-EW processing. The concentrate is usually sold to smelters in Japan and China whilst the cathodes go to American and Asian markets. Additionally, KGHM runs an underground mine in Sudbury, Ontario, which does not have its own processing facilities, but its materials are processed by Vale and distributed around North America.

Sierra Gorda is a large and significant project under development in Chile. Can you explain the benefits of Sierra Gorda for the company and the local area?
Sierra Gorda is a massive project. KGHM is gaining a low-cost, long-life asset that will deliver vast quantities of copper with a significant secondary production of molybdenum, making it one of the world's leading molybdenum producers. Moreover, it will raise KGHM's profilein Chile. We are well known in Europe but fairly new to Latin America. We have over 10,000 people working at the construction site, and when the mine goes into production, it will provide jobs for nearly 2,000 people, the vast majority of whom will be Chileans.
The project benefits the local area in three ways: first,it develops the town of Sierra Gorda with direct employment opportunities and fosters the growth of new businesses to service the mines and miners. Second, community initiativeswill be carried out with some of the mining companies.For example, a consortium of miners is renovating the historical theater in Antofagasta.Third, it will help bring another landmark mine to Chile's flagship industry.

What is the timeline for Sierra Gorda to come online?
Sierra Gorda is currently in the construction phase, and we expect to begin production in 2014. In the first phase we are looking to mine just one pit, which should last for 20 years. Initial production is set to be 110,000 tons per day (mt/d), which will then rise to 190,000 mt/d in 2017, with the opportunity to carry out several further expansions and bring in an SX-EW plant as well. We then hope to develop some other deposits on the property that will increase the mine life by another 10 to 15 years.

Given that water resources are so scarce in the Atacama region, what strategies are you adopting to ensure water supplies?
When we first started working on the project, KGHM acquired the rights to several water sources in the region, but these turned out to be insufficient to meet expected demand. Therefore, we decided to build a 143-kilometer (km)seawater pipeline from the coast to the pit. We were fortunate to partner with a coal-fired power plant, from which we could take approximately 1500 liters per second. Saltwater will be used for the first stage processing at Sierra Gorda and will then be passed through a reverse osmosis plant to create fresh water for use in the molybdenum processing. This strategy will become more common amongst new projects as fresh water reserves are squeezed.

How will you manage your power requirements?
Our electrical energy strategy is split into two phases: for the first two years, we will use the national grid but after 2017, we will draw power from a coal-fired thermoelectric plant in Mejillones over a 140km transmission line.

Copper prices have dipped a little after recent highs of over $4/lb. How is KGHM adapting to this new global scenario?
In general, the situation for copper is complicated. China accounts for approximately 40% of global demand, but Chinese growth isunpredictable. Metals prices in general are lower today than they were one year ago, but $3.30 per pound for copper is still fairly robust and we do not see the price falling much lower than this level.

Do you have a final message for our readers?
KGHM may be a new company in Chile but we have been around for a long time. Our hope for the future is to be seen as a global company, and we believe that Sierra Gorda marks the beginning of a long and fruitful relationship in Chile. •

José T Letelier

Vice President for External Affairs
South America
KINROSS

Kinross is a global gold producer with activities in Canada, Brazil, Africa and Russia. Where does Chile fit into this panorama?
Kinross' mines in Chile have been operating since the 1980s. We started to grow significantly after acquiring participation in the Maricunga gold mine in the late 1990s and eventually became the sole owners in 2007.In the same year, the company took over 100% control of the La Coipa mine, which is also on the Maricunga gold belt, in Chile's third region. Over the years, Chile has represented an important segment of the Kinross portfolio, providing clear advantages from operating in a mature, well-understood, and politically stable mining jurisdiction.

Could you give us some more details on the Maricunga project?
Maricunga is a low-grade open pit mineand in 2012, it produced approximately 236,000 gold equivalent ounces. There are approximately 900 workers employed at the site. The site is locatedat an altitude of approximately 4,300 meters (m) above sea level, which presentssome operational challenges, not only for human beings but also for mechanical instruments, and for the leaching process used to extract the ore. While Maricunga has been a relatively high cost producer in the Kinross portfolio, the company recently put a new management team in place to improve operating performance and reduce costs.

It has been reported that the La Coipa mine will soon cease operations. What are the reasons behind this decision?
La Coipa is a very old mine that has been in operation since the late 1980s and has produced over 3.5 million ounces. At 3,500 m, the site is substantially lowerthan Maricunga and boasts a higher average grade. The mine actually has more silver reserves than gold reserves, and the final product that we export from the site is doré, which is produced through a flotation process. As planned, Kinross suspended mining of the existing ore body at the end of October 2013. However, we discovered a new deposit very close to the plant and have handed La Coipa over to our Projects team to assess its future potential.

The Lobo Marte project was set to be one of Chile's major new gold projects, but now the feasibility study has been delayed indefinitely. What factors led to this delay?
In the current capital constrained environment, Kinross set clear priorities among its potential development projects, and Lobo Marte is not a priority at this time. Future decisions about the project will depend on a range of factors, including progress on developing other projects in the company's portfolio, projected capital and operating costs, and market variables such as gold price.

As environmental laws in Chile have become stricter and more rigidly enforced, do you believe that the mining industry will suffer?
We believe that it is only natural for a nation such as Chile, which wants to be considered a developed country, to develop a stricter environmental regulatory framework and strong institutions capable of enforcing it. The problem is that now we find ourselves in a position of regulatory and institutional change, and it will take time for companies to adapt. In the past we have seen cases where new regulations have come into force, the responsible institutions are not prepared to implement them, they are not well implemented, and the result is a lengthy process of litigation. The first environmental tribunals have only just been created over the past year; we are in fact still waiting for two more to come into play in Antofagasta and Valdivia. Our hope is that since these bodies will have representation from both lawyers and scientists, they will provide more balanced verdicts on environmental matters.

How have you found the situation sourcing skilled labor in Chile?
In the past it used to be difficult to recruit new workers quickly, but since the first quarter of 2013 this situation has changed. Since many projects have been cancelled or postponed, it is much easier to find qualified laborers. Today, if we put out a recruitment advertisement in the newspaper, we are likely to receive 16 or 17 replies within the week.

What measures will Kinross be taking on a global scale to remain profitable in this time of depressed metal prices and increased production costs?
Well before the gold price fell, Kinross brought a new level of discipline to its capital spending, and re-set the focus of its operations to cash flow, cost control, and quality over quantity.That has positioned the company to take proactive and considered decisions to maintain its balance sheet strength.Since the drop in gold price earlier this year, we have identified $200 million in capital spending reductions from our original 2013 forecast, and expect a further reduction in capital expenditures in 2014. We also completed a thorough review of our overhead and identified $20 million in annual savings. Finally, thanks to a focus on operating costs, we expect to complete 2013 at the low end of our guidance range on production costs per ounce – while we have increased our production guidance for the year. Overall, we believe our track record and our strategy have positioned us to weather the current volatile environment. •

Pablo Mir

Partner
BOFILL MIR & ALVAREZ JANA ABOGADOS

What kinds of services does BMAJ offer its mining clients?

We provide a full range of legal services. The majority of our clients are foreign companies so we often help them set up operations in Chile. Although we work with some mine operators, most of our clients are international exploration firms involved in the preparatory stagesof building a mine. We advisethem on acquiring properties, either through agreements with other parties or by staking claims to land. Acquiring mining properties is a highly technical process, so we have a separate company, LANDMAN, to advise clients. We alsohelps clients gain permits, and, for those that advance to the stage of building a mine,obtaining construction and procurement contracts. Additionally, BMAJ is heavily involved in the financial side, primarily addressing the local aspects of fundraising with companies listed on the international mining markets.Outside of Chile, we assist clients in other Latin American countries, such as Argentina, Peru, Colombia and Ecuador, where we collaborate with local counsels and serve as a kind of legal coordinator for the whole project.

Could you describe how the mining property system works in Chile?

Chile's mining property system comes from the early 1980s when the Pinochet government issued a series of liberalizing reforms. As such,the lawtends to favor private mining companies.The underlying principle is that the state owns all mineral rights and then issues a mining concession to a mining company, which can be sold, transferred or mortgaged with no intervention from the state. Unlike in other countries, the Chilean government does not issue concessions; rather,concessions are issuedthrough a court procedure by which a mining company presents the coordinates for the land they wish to explore or exploit and, as long as the land is free, the company receives the rights. The company may apply for an exploration concession: theseare valid for two years, after which time can be renewed for two more years or converted into an exploitation concession. It can also apply directly for an exploitation concessionthat lasts indefinitely.

Chile's mining law has been criticized for favoring a small number of major companies at the expense of junior actors. Do you agree?

One of the more controversial aspects of Chile's mining law is that once a company owns a concession it has no legal requirement to develop it. Itssole obligation is to pay an annual license fee of approximately $2 per hectare for exploration or $7 per hectare for exploitation. Thissystem helped the industry to develop in the early days but is now holding it back. There is very little unclaimed property remaining in Chile's most geologically prospective areas: approximately 70% of the concessions are owned by a handful of the largest mining companies.

Several landmark projects such as Barrick's Pascua Lama and Goldcorp's El Morro are on hold pending approval for mining permits. Do you believe that the legal system is turning against the mining industry?

In recent years, the courts have played a more predominant role in the permitting process and operated outside of their remit. In the case of El Morro, the courts overturned a permit that had already been technically and legally analyzed and granted by the government. This type of populist sentiment is worrying but in Chile court resolutions only apply to the specific case and do not constitute a precedent for future cases. As for the fine levied against Barrick, we see it as a unique case in which most of the responsibility should fall on the company for not managing the project professionally. Many commitments stipulated in their environmental impact agreement were not upheld, and there seems to have been a lack of oversight. It is telling that when the $12 million fine was issued the company did not even appeal the charges.

Given that it is a very difficult moment for exploration companies to raise funds are you seeing more juniors looking to private financing options?

Raising money on the public markets is not an option for juniors today, whether inside or outside of Chile. The situation in Chile is somewhat unique in that we have a very sophisticated and well-developed financial industry and mining sector, but there is almost no interaction between them. Chilean banks do not lend money to mining companies and, generally speaking, they have no expertise in mining or how mining projects are financed. Only one mining company is listed on the Santiago stock exchange. Nevertheless, we have started to see a trend of wealthy private equity firms investing in mining over the last three to four years.

In Brazil, where Congress is now debating a new mining code, there is a level of mutual mistrust between the private and public sectors. How do you rate the level of cooperation here in Chile?

The Chilean government and Congress tend to be fairly sensitive to the needs of the mining industry, although they are not always as supportive as we might hope. However, Chile is unique because Codelco unites the private and public sectors. Codelco brings in huge revenues for the treasury, and pubic sector actors are careful not to pass legislation that might damage imperil the state's finances. •

David Gallagher & Felipe Swett

DG: President
FS: Partner and Business Director
ASSET

What circumstances led you to found Asset?

DG: We started Asset in 1984, when there was little investment banking activity in Chile. My background was with a British investment bank, and we believed the time was right to start a business and help develop the sector. We now have a team of 20 specialists dedicated to mergers and acquisitions and advisory services. Within this niche,we are as big as any of the major players in Chile. We also work with big name international banks. For instance, we worked with Rothschild last year for Codelco's option with Anglo Sur.

Large players dominate Chilean finance, with 55% of assets held by three institutions. As a smaller bank, how does Asset fit into this scenario?

FS: We are a boutique firm and see our principal role as advisory: we do not have a balance sheet and do not lend money. Although mining dominates the Chilean economy, there is a serious disconnection between Chilean finance and Chilean mining, and mining projects rarely secure financing from Chilean banks. Asset is one of the few – if not the only – local investment banks with real expertise in mining.

DG: This disconnection is reflected in the lack of mining firms on the Chilean stock market and existsin part because the largest miner, Codelco, is state owned and has no third party shareholders, and in part because the major private mining companies are foreign. The only exceptions arePucobre, CAP, and SQM, of which only Pucobre could be described as a typical mining company.

Could you tell us about some of Asset's standout projects?

FS: We tend to get involved when companies are doing something unusual. We have tried to introduce Chilean finance to big mining and carried out a local bond issue for Escondida a few years ago, but these were exceptional projects. Generally, Asset works with international project finance and helping companies to solveparticular difficulties. For example, we assisted Anglo American to draw up a 330MW power supply contract for the expansion of the Los Bronces project. One of our major projects was the non-traditional financing Codelco entered into with Minmetals. Minmetals wanted to invest in Codelco or one of their mines, but of course this was impossible as Codelco is a state company, so the concept was to create a virtual or synthetic mine. Asset structured a dealso that Minmetals would pay Codelco $550 million in advance to acquire 55,000 mt/y of copper at cost.

Chile's exploration market has contracted by 60% since 2012, but some argue that low prices for land and services make this a good time for juniors to enter Chile. How is Asset poised to aid junior firms?

DG: Chile's junior exploration industry is in a depressed state. To address this, the government has developed the so-called Fenix fund program to promote grassroots exploration. This is an initiative by which the Chilean Economic Development Agency (CORFO) lends non-recourse money, in the form of debt, at an attractive interest rate to fund managers at a ratio of 2:1. In other words, for every dollar of equity raised, CORFO lends $2, creating attractive incentives for investors. There are six Fenix funds in total, and Asset has been managing one $25 million fund for the past year.

FS: Each Fenix fund is run according to a different business model. In our case, the model is to co-invest with junior companies that own good tenements or highly prospective development projects in return for a stake in the project. We prefer to invest in projects that have progressed beyond the discovery stage and need funding for further exploration to define the reserve or resource.

Do you think that the recent downward trend in copper prices will affect the availability of project finance to Chilean mining projects?

DG: The large mining companies have been postponing their projects for some time, in Chile andelsewhere, because falling prices have squeezed margins and production costsremain the same.There is also growing anxiety among shareholders, who are calling for dividends and share buybacks. Eventually, costs will drop and the situation will stabilize, but investors are reluctant to commit new funds, particularly for greenfield projects.

How do you see Asset developing to meet the changing demands of the market?

As the demand for electrical energy and water grows more acute, more opportunities will arise to structure deals between mining companies and power generators, much as we did for Anglo American.New projectsarealso going to require more offsite infrastructure, including desalination and power plants, and the Chilean financial market can get involved either as lenders or even as owners. Asset is also open to working outside of Chile: we are already in Peru and hope to expand into other Pacific Alliance countries. •

The Struggle to Regain Momentum

Junior Explorers Operating in Chile

Whereas large explorers and producers have enjoyed success and currently are well positioned for the future, the outlook for junior explorers in Chile is less auspicious. 2013 was a historically bad year for juniors hoping to raise capital on the markets, and this translated into a climate of inertia amongst Chile's exploration community. Juniors, after all, play a critical role in the sector. They are willing to explore risky mines, whereas majors tend to be less prone to commit themselves unless deposits are guaranteed. After rising steadily for the best part of a decade, exploration activity in the country dropped by some 60% between 2012 and 2013.

Even before the current downturn took hold, Chile had long been seen as a jurisdiction that favored larger companies. According to Pablo Mir, partner at the law firm Bofill Mir & Alvarez Jana Abogados, the roots of the current situation can be traced back to the establishment of the country's mining property system, which was introduced in the 1980s as part of a series of reforms enacted by the Pinochet government. "One of the more controversial aspects of Chile's mining law is that once a company owns a concession they have no legal requirement to develop it. Their sole obligation is to pay an annual license fee. Whilst this highly liberal system helped the industry to develop in the early days by encouraging investment from large foreign corporations, it is now holding the sector back," said Mir. As there is no obligation for concession holders to develop their concerns, it is in the interests of the majors to buy up extensive tracts of land even if they have no intention of exploring them. This has led to the situation today whereby approximately 70% of concessions are owned by a handful of large companies, making it difficult for juniors to get a foot in the door.

"Most of the majors are unwilling to sell as they prefer to explore their own claims, and although land in the hands of smaller firms and private holdings is easier to get hold of, the prices they are demanding are often exorbitant," said Timothy Beale, president and director of Canada-based Iron Creek Capital Corp, a Chile-focused junior explorer that has recently entered into an agreement with Kinross to prove up their 50,000 ha Las Pampas project.

A second underlying factor that has hindered the development of a local exploration industry is the lack of finance available in the country for mining operations. "Although it might seem counterintuitive given the predominant role played by mining in the economy, there is a serious disconnection between Chilean finance and Chilean mining," said Felipe Swett, partner and business director at Asset Chile, one of the few local financial institutions with a high level of mining expertise.

As a result of this, there are no wholly owned Chilean exploration companies and unlike in Peru, where the Lima Stock Exchange is developing into a dynamic center of mining activity, the Santiago stock exchange is almost entirely devoid of mining companies. "This situation exists in part because the largest miner, Codelco, is state owned and has no third party shareholders, and also because the major private mining companies in the country are foreign corporations," said Asset's president, David Gallagher.

Nevertheless, for those companies that have been able to secure financing, now is certainly a good moment to be planning new exploration campaigns as the drop in demand has pushed down drilling prices by up to 25%. There is renewed optimism in the industry that a similar effect will be observed in property prices. •

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Alejandro Palma J.

General Manager
SRK CONSULTING

Can you give us an update on new developments in SRK Chile since we last met in 2008?

Since 2008 SRK has grown substantially in terms of headcount and revenues and hasintroduced several new technologies with a focus on thickened tailings management, tunnel boring machine (TBM) applications, rock mechanic and mine design for surface and underground mines. We see ourselves as a one-stop-shop for miners, but our principal area of expertise is on the mine operations themselves. We are involved with practical and engineering work throughout the mine life to ensure that our clients extract maximum value. We also work in the niche of providing advisory services to financiers and private investors, who are interested in investing in Chilean mining and writing NI43-101 reports. A significant portion of investment capital today comes from China and Canada, but there is greater participation from local investors, as Chilean groups are recognizing the opportunities.

What type of clientele do you see in Chile today? What are some of SRK's noteworthy projects?

We work with a wide spectrum of clients: in addition to the majors, we work with several mid-tier firms, some juniors, and several engineering companies. As the industry is experiencing a lull in large projects, it is a good time for junior companies to come to Chile, as the land prices are fairly low and many service companies have reduced their costs. However, these conditions have also damaged investor confidence, and many junior companies are struggling to attract funding. As a result, most of our work is for the largest companies. To highlight two particularly interesting projects: we designed and oversaw construction of a 7.9km tunnel at Anglo American's Los Bronces mine, which was the first project in Chile to make use of a double shield TBM. We were also involved carrying outthe prefeasibility study for the Andes Iron Dominga iron oxide-copper-gold project in Region IV of Chile having the full scope i.e., mine and plant to port.

Has SRK been affected by the recent downturn in mining activity?

SRK has been remarkably unaffected by the depressed state of the industry, which we attribute to being a dedicated consultancy rather than a de facto engineering company. Whereas a large EPC or EPCM firm works on a project-to-project basis, bringing on large numbers of staff, as they are needed, we are more flexible and able to adapt to changing situations. For example, if a major project is cancelled or put on hold, we can simply transfer our people to other projects, whereas some of the larger engineering houses are forced to lay off staff because they do not have the resources to keep them on.

How do you see Chile addressing the twin threats of a shortage of usable water reserves and an insufficient power generation capacity?

The solution for water shortage is simple: seawater. Chile has a long coastline and there are ample water reserves in the Pacific Ocean. Many complain that pumping seawater to high altitude mines is costly and complicated, which is true, but it is the best solution. Profit margins will fall, but if the alternative is to write projects off altogether then it is an easy decision.

As for energy, the situation is more complicated. There is not enough installed capacity to meet requirements for all the mining projects that are scheduled to come on line in the coming years. Something has to change or the country will eventually go out of business because nobody will be able to afford electricity. Politically it makes sense to support these projects and invest in new power plants because they will create jobs and contribute to the economy. On the other hand, Chile has advanced since the time when those in power could build whatever they wanted without regard for the environment or other stakeholders' points of view. Now,Chile must strike abalance between the need for infrastructure development, the imperative of good environmental stewardship, the valid concerns of the Chilean people as well as the use of renewable energy sources.

What measures do you take to ensure that you have the right people working for you?

Finding highly qualified, highly skilled operatives in Chile has always been a challenge because Chile is a mining state that has grown rapidly and created an enormous demand for talent with a finite pool of suitable talent. However, SRK has always found top quality professionals and takes care to train and develop them. When I first started working here in 2002, we had a team of 20 people, but today it is 140. We evaluate all our personnel yearly, identify their skills and weaknesses, and work to boost their skills and address their weaknesses by providing experienced mentors and promoting attendance at relevant technical courses.

What does the future hold for SRK in Chile?

We are optimistic about the future of Chile's SRK office. In the coming years we will build on ourpast successes, and it is my hope to be involved with all the major projects in the country, but more importantly with the interesting projects, which will challenge us to innovate and to come up with new and exciting ways to add value to our clients' operations. •

Timothy J. Beale

President and Director
IRON CREEK CAPITAL CORP.

Iron Creek is a Canadian based company that develops exploration prospects in Chile. Could you explain the company's focus on Chile?

The company was set up in the mid 2000s with the express purpose of looking for projects in Chile, and this focus remains. We are looking into investing in other jurisdictions, but all of our current projects are in Chile. Chile remains one of the most attractive mining nations for exploration: beyond the huge geological potential and the friendly business environment, the fact that the north of the country, around the Atacama desert, is so sparsely populated means that there are few obstacles to overcome in terms of gaining environmental permits and securing community approval. The lack of water reserves is a drawback, but, on the whole, the advantages outweigh the disadvantages.

Could you give us some information about theproperty exchange deal behind the Las Pampas project?

Before April 2013, Iron Creek owned two large pieces of property: Victoria, a joint venture with Hochschild mining, which is located along the main porphyry copper belt in northern Chile between Escondida and El Salvador; and Pampa Buenos Aires, a precious metals prospect located further to the west, held in joint venture with Andina Minerals. Hochschild completed a corporate takeover of Andina Minerals in early 2013 and so became our joint venture partner in two projects. In order to simplify matters, we effected a property exchange: Hochschild became the sole owner of Victoria and Iron Creek of Pampa Buenos Aires. This agreement also carried a mutual royalty exchange clause so that Iron Creek would gain a proportion of revenues if Victoria were ever taken into production, and vice versa. The total acquisition of Pampa Buenos Aires was a strategic move for Iron Creek, as we already owned another contiguous property and could incorporate both into one large land package: Las Pampas. Today, the project covers an area of approximately 50,000 hectares (ha) immediately south of Yamana's El Peñón mine, which is one of the most productive gold and silver mines in Chile. We have carried out a lot of geophysical and geochemical surface work as well as some drilling. We believe that we are close to making a discovery hole, as we have had strong indications of gold and silver mineralization from some of our intercepts. These findings and the project's location attracted Canadian producer Kinross to enter into an agreement with Iron Creek to develop the prospect further.

What other projects do you currently have on the books?

We recently entered into a renegotiation of the joint venture terms with AngloAmerican over the ownership of the Exploradora project, so work there is currently on hold. Our second most important project is the wholly-owned T4 deposit. The site is approximately 5,000 ha and has never been drilled. It is geographically close to Las Pampas but geologically it forms part of the coastal cordillera system and is an iron oxide copper gold deposit. There is a considerable amount of surface alteration and several covered areas where the geology is obscured, but we have positive geochemical and geophysical results. We are not actively developing the site but are looking to bring in a partner to carry out some more advanced exploration work.

Can you explain yourapproachwhen you are looking for a new project to work on?

Districts with a history of mineral and mining work are always a good starting point, and there are numerous databases and historical records that help usidentify areas with potential. In the end, the most important step is to examine the surface geology in person. Chile is challenging for juniors because the majors have staked out most of the available land in the north. Juniors are therefore forced to negotiate with an underlying landowner to gain access to land. Most of the majors are unwilling to sell as they prefer to explore their own claims, and although land in the hands of smaller firms and private holdings is easier to acquire, the prices theydemand can be exorbitant.

Iron Creek recently underwent a new round of fundraising. What were the results and where do you plan on investing the money?

We raised $1 million during our May 2013 round of fundraising, which will be invested in our current holding. However, we are also carrying out reconnaissance work, both inside and outside of Chile, to acquire new properties. Moreover, we are always looking to bring in competent partners to help us develop our properties. It is eminently possible to raise modest sums of money when necessary, but with share prices at an ebb, we run the risk of over-diluting our existing shareholder base.

How would you like to see the company develop over the next five years?

During the current market downturn, we have learned that being a small, agile company is advantageous in good times but more challenging in bad times. In order to be able to weather difficult economic conditions, we are looking to grow, either through significant property acquisitions that could help to attract finance, or through entering into partnerships with other companies. We will remain inventive, flexible, and alert for the right opportunity in this regard. •

Power Supply Shortfalls: Electricity and Water in Chile

For the moment, we are only developing onshore wind farms, as Chile's geography makes the installation of offshore turbines complicated. The majority of the coastline is abrupt, and it is difficult to find the type of shallow coastal platforms that are best suited to offshore developments. In the extreme south the seabed is not so deep, but then you have the issue that it is far removed from any connection to the national grid. As such, we do not see offshore wind power becoming a reality in Chile until the technology used in building floating platforms becomes more advanced and cost-effective. However, given the level of research and development that is going into this area, it could become a possibility in a matter of just 10 years.

- José Ignacio Escobar,
General Manager,
Mainstream Renewable Power

Image: Shutterstock

The Rush to Meet Demand

Electricity in Chile

Ask any miner in Chile what the single most serious challenge they are facing today is and they will invariably reply "energy costs". Whilst Chile may be a world leader in copper production, its power generation capacity has struggled to keep pace with growing demand, resulting in extremely high electricity rates. A recent survey commissioned by the Mining Council demonstrated that amongst fellow mining countries, Chile's energy prices are second only to those of the Democratic Republic of Congo. With a minimal endowment of fossil fuels, the country has long relied on hydroelectric generators powered by its many rivers to meet demand in the South, and thermal plants that burn imported coal and, increasingly, natural gas in the North. NCRE sources account for just 1% of total installed capacity. There are four operational electricity systems in Chile, the two most important of which are the Central Interconnected System (SIC), which accounts for 75.8% of total installed capacity, and the Greater Northern Interconnected System (SING), which accounts for 23.3% of installed capacity and supplies the majority of the country's large mining operations.

The difficulties are by no means shared equally between the two grids, with the SING currently in far better shape than its southern cousin. Energy costs in the north have actually stabilized somewhat over the last year thanks to new power stations coming online, although it is unclear how long this will last: "The situation is still quite precarious, and we believe that a small increase in demand could cause a sudden spike in prices," said José Ignacio Escobar, general manager of Mainstream Renewable Energy, which is currently developing 3,300 MW worth of wind and solar plants that will supply both grids. However you choose to interpret current investment forecasts, several major mining projects are going to come online in the north in 2014, and these will constitute more than just a small increase in demand. Yet, there are no corresponding power-generation projects scheduled for the development over the same period. In recent years, a number of power projects in Chile have in fact been suspended or put on hold, generally because of difficulties securing environmental permits, although in some cases community resistance has been the deciding factor.

Some, such as the colossal HydroAysén dam in Patagonia, have attracted international attention. However, it is not only these headline-grabbing mega-projects that have been halted. In Chile's III Region, which is seeing the fastest growth of mining activity in the entire country, 80% of conventional energy projects slated for development have been stalled, creating an extremely delicate situation. The previous government's failure to implement a coherent energy strategy has had a tangible effect on foreign investors' perception of the country: "The inability to accurately project energy costs when developing a multi-billion dollar investment is a huge stumbling block for the sector, and is resulting in a slowdown in the flow of new projects," said Sebastián Pinto, general manager for Latin America for blasting and rock fragmentation experts, Orica.

Over time, a certain distance has arisen between mining companies and energy providers: the former accuse the latter of charging exorbitant prices, whilst the latter berate the former for their unrealistic expectations and refusal to accept market rates.

This has led some mining companies to take matters into their own hands and experiment with developing their own in-house generation capacity. This year, the solar plant at Antofagasta Minerals' El Tesoro mine came on stream. The plant, Chile's first Concentrating Power Project (CPP), was developed by Abengoa Solar and reduces the amount of fossil fuels used in processing by 50% whilst reducing CO2 emissions by 10,000 kg/y. Elsewhere, Barrick's Punta Colorada wind farm in Coquimbo generates 20MW for the SIC, and Collahuasi is now developing the country's largest solar plant, which will eventually provide 13% of the mine's needs during the day.

Although these projects have an obvious appeal to mining companies with the necessary capital to bring them to fruition, many in the energy industry are skeptical of their long-term value: "They served as a good example of the possibilities that exist for mining companies to make use of renewable energy, but in the future the industry will need large-scale projects capable of supplying multiple consumers. We do not see private plants for own-consumption playing an important role in the future," said Escobar of Mainstream.

Hidromaule is a developer and operator of small hydro plants that currently runs three operations in the San Clemente region, which provide a total of 41MW for the SIC. General manager, Carlos Weber, believes that what is really needed is a greater level of cooperation between miners and smaller energy suppliers. "We believe that the best form of collaboration is to enter into long-term supply contracts with [the mines]. Unfortunately, most of the miners are not willing to pursue this option as they are not willing to pay the market value of electricity," said Weber.

Given that most of the sites suitable for large-scale hydroelectric projects are already taken or, in the case of HydroAysén, blocked by the courts, it makes sense for heavy users to start negotiating with the smaller providers. Whilst no single generator would be able to provide a mine with all the energy it requires, by coming to arrangements with a spread of different power companies, miners would be able to control their costs in the long term. "

If Hidromaule could enter into a 10-year contract at a fair price, then we would be in a strong position to develop our next 40MW of capacity and thereby increase our overall level of supply. If this process were replicated with a great number of similar size producers then we would start to see much more investment in developing new capacity and in the long term that would help to bring prices down. However, today this is not happening and so prices will remain high," said Weber. •

FACTSHEET

> "Today, what usually happens is that when a mining company makes the decision to develop a large project, the oversight of the total project is given to one of the global EPC companies, but these engineers then subcontract out large parts of the project to smaller service providers with more concentrated expertise, such as EECOL. Today we are involved in the bidding process for all the e-houses and electrical bulk material that will be used in Escondida's new water supply system. Our role is to manage all the electrical goods used in the construction, making sure that all components are in stock, and are standardized to a quality level accepted by the clients.
>
> - Erwin Conn, Regional Manager, EECOL"

Image: Shutterstock

Claude A. D'Cruz

Senior Vice President,
Business Development,
Minerals & Metals (Global)
WORLEYPARSONS

Could you talk us through Worley Parsons' history in Chile?

WorleyParsons first set up in Chile in 2006, when it entered into a joint venture with domestic engineering firm ARA, and for several years the company traded as ARA WorleyParsons. In April 2012, we increased our ownership of ARA WorleyParsons and began operating as WorleyParsons in order to introduce the WorleyParsons global brand to Chile, a strategically important market. The country's main attraction was its long-term plansfor major copper projects and we are very optimistic about the future of the industry. That being said, whilst the country has registered an impressive investment cadre of new projects slated for development in the next eight to 10 years, we believe that the timescale will probably be nearer to 15 or 20 years. Nevertheless, we want to be positioned with a strong brand to take advantage of these opportunities when they come to fruition.

What are the main services you offer the mining community?

We are a professional services company, able to provide all aspects of delivery. We understand the necessity of good quality front end engineering, but what sets us apart is that we can offer EPCM and EPC services for an entire greenfield project. We also have a strong capability in brownfield projects, working with our customers on their existing assets to help them to squeeze more value out of their production chain and advise them on capex reduction, opex management and ensure that they are making the most of their mine facilities.

Our total solution approach is very beneficial to the mining sector, to help customers address the current problems associated with project fragmentation. The recent personnel shifts in the top echelons of the major mining companies around the world demonstrate that many of these were the result of poorly executed projects that came in over budget and missed all deadlines. As an industry, we can do better, and one of the simplest ways to improve performance is to minimize the number of interfaces that a given project has.

How have Chilean clients taken to your total solution approach? What projects do you have lined up for the future?

We have found that it depends on the level of maturity of the company: some companies tend not to be open to new ideas and have to follow certain internal protocols that prevent them from opting for just one service provider. On the other hand some of the mid-tier producers have been receptive to our approach. We have already been involved in projects developing ports and have a three-year contract with Escondida to provide sustaining capex delivery, but in Chile the best is yet to come.

What kind of technical solutions can we expect to see for Chile's water and energy shortage issues?

In terms of sourcing water supply, we will see two main trends: the construction of more desalination plants and increased use of seawater as process water. The former is a great but expensive solution: aside from the energy costs of pumping water from the sea to the mine site, the processing itself is costly and then there is the issue of what to do with the brine outflow, which is environmentally damaging. As for the use of untreated seawater in the plant, we are looking into technical details of pursuing this course and developing solutions to get around the corrosive effects of saltwater.

Another less frequently cited challenge is that Chile will be soon transition from a predominantly open pit country to an underground country, and the industry needs to prepare itself. WorleyParsons is ready to provide assistance, having recently acquired the South African firm TWP and welcomed over 1,000 new staff members to the ranks, among which is concentrated an exceptionally high level of expertise in underground mining.

How does the company differentiate itself from the plethora of other EPCM firms already established in Santiago?

Chile is a well-established mining jurisdiction and it goes without saying that the competition here is strong, with most of the major engineering firms present as well as some domestic companies. However, there are few companies other than WorleyParsons that can deliver large projects between $1 billion and $5 billion.Our main differentiator is our local-global approach, complementing our local personnel and capacity with our global capability and experience to deliver the best possible results to our customers on a local level. We recognize the importance of being close to our customers, unlike other companies that serve the Peruvian market remotely from a base in Chile.

What does the future hold in store for Chile and for Worley Parsons?

While the mining industry is in a trough, this is a cyclic business and the projects will come back again and, so we need to strategically position ourselves to be ready when that time comes. Customers are the center of all we do, and while customers cantake advantage of the current market to demand the best people and price, this will change to favor of the service providers. WorleyParsons,is focusing its attention on developing markets in Latin America and Sub-Saharan Africa, where it sees the greatest potential for growth. •

Raúl Chaparro

Business Development Manager
CEMENTATION

In Chile Cementation has been known in the raise boring field for several years but you are now looking to expand your services. Could you tell us why you are shifting strategy?

Cementation began its Chilean operations in the 1990s through the establishment of Terracem, a company owned jointly by Cementation and local drillers, Terraservice.Terracem provided services in small to mid-size raise boring for a variety of mines in Chile. In 2013, Cementation took control of Terracemand has introduced new capabilities, such as blind hole operations and large diameterraise boring, which refers to shafts of over 4m in diameter.

With regards to engineering and construction, we first came to Chile in 2010 to work withCodelco on the Chuquicamata underground expansion project. We conducted an engineering study for a 1-kilometer (km) deep large-diameter ventilation shaft, which was a relatively uncommon type of project for the region. Since then we have carried out a number of smaller studies into vertical excavations for private companies. We are currently bidding on a large tender for Codelco for a lateral development project.

Cementation also has activities in Peru: we finished an engineering contractin July 2013 and were awarded a second contract to review the plans for a large shaft construction. The Peruvian operations are directed from the Santiago office, but we also make use of our network of experts, bringing in resources from Canada, the USA and South Africa when required.

What range of services can Cementation offer within your specialization of underground mining?

Cementation has the capacity to take a project from the initial scoping study to construction. Our contract with the Resolution copper project in Arizona involved working on a shaft with a diameter of 8 meters (m) and a depth of 2km, for which we carried out everything from the conceptual engineering to the construction, which included a highly specialized freezer unit to accommodate the high temperatures found at the site. Right now we have four raise boring machines in country and are in the process of preparing a more diverse range of rigs to be brought over in the first quarter of 2014. If we are successful with the Codelco construction tender, we will bring two complete sets of lateral development equipment, including jumbos, scoops, dumpers and mixer trucks.

Given that Chile is still predominantly an open pit country, do you foresee sufficient demand from underground projects to justify such a large expansion?

It is true that the majority of mines are open pit,but we should not overlook the importance of existing subsurface sites. Codelco's El Teniente is still the largest underground mine in the world and there are many otherunderground mines of all sizes. Smaller mines are also evolving their operational strategies, as they move from conventional vertical excavation to mechanized processes. These new technologies are becoming more widely adopted, cheaper, and more accessible to smaller operations.

The reputation of underground mining in Chile suffered a blow as a result of the San José incident in 2010. How do you evaluate current safety standards in the country?

When it comes to safety regulations,Chileis strong compared to other countries in the region. Over the past 10 to 15 years the industry has witnessed a systemic change in its attitude towards safety, and worker safety has become an absolute priority. In this period, despite the inherent risks involved, underground mining has actually produced a better safety record than civil construction. The San José collapse was a complete anomaly. It was a small mine with low operational standards and few resources. Incidentally, it was one of Cementation's rigs that spearheaded the rescue efforts and contributed to the successful resolution of the accident. As for our own company policy,Cementation's slogan when it comes to safety is "zero is possible." We know it is possible because we have carried out many projects, including underground excavations, without an accident.

What are the main strengths that Cementation can bring to the Chilean market?

Our vast experience and broad knowledge base helps us in the conceptual stage, as we can incorporate our construction expertise into the early engineering and ensure that no serious issues ariselater. When pure engineering firms design this kind of highly specialized project, problems can emerge during implementation. Cementation's other strength is the fact that we design and build all our own technology, which allows us to use innovative approaches that can achieve better results than conventional methods. Our innovation and construction teams work together to overcome obstacles and search for ways to boost performance, improve energy consumption or lower costs.

What position do you see Cementation occupying in the region in the next five years?

My vision is very positive. We have capabilities to invest heavily in resources, and there are many exciting projects underway in Chile and in the region. Countries such as Argentina and Ecuador will become more mining orientated, and Peru will continue its trajectory towards becoming a mining giant. We believe we are on the cusp of a huge expansion and once we land the first big project, the company will grow exponentially. Within five years we anticipate having 10% to 15% of the region's market share. •

Gregg Hodges

General Manager
AUSENCO

Could you provide us with some background regarding Ausenco's operations in Chile?

In Chile, Ausenco is made up of two business lines: Process Infrastructure (PI) and Minerals & Metals (M&M). We employ from 350 to 400 people depending on demand from projects. Our involvement is focused on the main areas of expertise belonging PI and M&M: long distance slurry pipelines, water pipelines, tailings systems and heap leaching, with a lesser focus on other geotechnical work. Our aim now is to grow between these areas and to develop our capacities from these two bases. For example, we are currently expanding our capabilities from only heap leaching to include concentrators and flotation systems, taking advantage of both our Australian-based expertise and knowledge and local Chilean experience.

What kind of interaction does the Chilean office maintain with other Ausenco offices around the world?

With a global company such as Ausenco it is difficult to concentrate all your know-how in just one location, or to spread all areas of expertise among all places, so our office collaborate a great deal. We have strong relations with our colleagues in Peru and Brazil, and thanks to the close proximity and little time difference it is easy to coordinate. However, we also collaborate on a global scale, and it has been necessary on occasion to hold videoconference meetings between Chile, Vancouver, San Francisco and Brisbane.Vancouver, for example, is particularly strong on ports and marine engineering so we are working closely with them to develop the load-out facilities for Teck's Quebrada Blanca and Relincho projects. Overall we have found working with other Ausenco offices to be quite effective, especially with our in-house experts.

How has Chile's water shortage issues affected demand for your services?

For Ausenco, the lack of fresh water reserves in Chile actually serves as an opportunity, and in recent times we have seen demand for pipelines increase significantly: 10 years ago nobody even considered taking saltwater from the sea, and now it is coming to be regarded as the best solution for many mines. Nevertheless, such systems constitute a substantial investment as saltwater is not typically compatible with heap leaching systems nor concentrator facilities.It is usually necessary to desalinate the water, which is a very costly, energy intensive process, especially when you consider the quantities required for mining applications. Most of the pipes we work with to transport slurry are between six inches and 10 inches in diameter, but the seawater pipelines can range up to 42 inches or 48 inches in diameter. These projects require thousands of liters per second to be pumped up several thousand meters of elevation.

This is where our particular expertise comes into play. Several companies can design a simple system to pump fresh or waste water around a mine, but when it comes to pumping huge volumes of sea or desalinated water up the side of a mountain there are many more considerations that need to be taken into account, such as the piping layout, material specifications and pump specifications. Salt water is also extremely corrosive so it is necessary to line all the piping, but desalinated water too can be corrosive. To minimize this, it is necessary to chemically or mechanically deoxygenate the water.

At what stage in a project does Ausenco become involved in the development process?

We generally get involved very early on in the project because our pipeline systems forma vital part of any operation: Without adequate water supply and tailings management you cannot operate a mine. The pipelines we design can be up to 200 kilometersin length, and it can take a long time to conduct all the necessary surveying, design, and engineering work and then acquire all the required permits. We are involved with every aspect from conceptual studies, detailed design, commissioning, start-up and then ongoing operational and maintenance services. Ausenco Chile has also branched into EPCM projects with our Minerals and Metals teams, completing projects for Anglo American and Codelco.

Most of the projects slated for development in the coming years are brownfield expansions. What kind of services can Ausenco provide in this field?

In today's economic climate mining companies are focused on getting the most out of what they already have, either through expansions or process optimization. Operating mines eventually need to develop additional heap leaching capacity or to develop the deeper ore reserves and process the ore through a concentrator. There is difficulty in carrying out heap leaching expansion without interrupting the infrastructure that is already in place, such as conveyors and stackers. Our expertise is crucial in providing solutions of this nature without causing a negative impact on the current production chain. Ausenco can also provide concentrator designs that are smaller in footprint and more economical than those typically designed in Chile.

We have recently introduced our sister company, Ausenco Rylson, into the Chilean market. The company's focus is on improving the efficiency of maintenance systems and asset management, and so far the reception has been phenomenal. Some of the major operators spend hundreds of million dollars per year on keeping their systems running, so increasing operating availability or throughput can have a substantial impact on operating costs and profitability. We believe that the lack of greenfield projects in Chile is going to continue for several years and that there will be sustained demand for these services.

With regards to pipelines, we can help increase capacity through existing systems by adding additional pump stations rather than build new pipelines altogether.Today, some of our pipelines have been in use for nearly 15 years and there are concerns about the reliability of the older constructions. Ausenco is expanding our integrity studies services to reduce operating risks and provide increased operating availability. That being said, we design our pipelines for a lifespan of 20 years and to date we have never had an underground section of pipeline fail or wear out.

Several commentators have complained that there is a particular trend for mining projects in Chile to be delivered late and over budget. What do you believe might be the reasons behind this phenomenon?

I think the main reason for this trend is quite simply that the whole industry has been overstretched. This problem should resolve itself now that the rush to build more projects has slowed and the demand for new staff has shrunk. We hope that there will be more time to spend on preparation and front-end work and so the project teams should be able to come up with more realistic estimates. Another factor is the availability of experienced project management overall, on both the client and engineer teams. The rapid expansion of projects and operations has required experienced personnel to be promoted rapidly, while filling in behind them with less experience personnel. Managing a project requires different skills from designing the project systems and the control of project changes can greatly affect the final project costs.

In an effort to reduce the risk of cost overruns, Ausenco expects that the industry will gravitate towards more EPC type contracts, for at least portions of future project work, versus the predominant EPCM type contracts utilized over the last several years. •

Quenching the Thirst of Chile's Parched North

Water in Chile

In addition to the high cost of bringing electricity to Chile's mining sites, the industry faces the challenge of transporting enough water to maintain operations. The Atacama desert is a vast wilderness that covers some 40,000 square miles of northern Chile, bridging the gap between the coastal mountains and the Andes. The desert sees an average yearly rainfall of approximately 15mm per year, although in certain areas no rain has been recorded for over 400 years, making it the driest hot desert in the world. Yet, ironically, its vast metallic and non-metallic mineral wealth has made it a hub for water-intensive resource extraction since the 1880s, when British and American miners first flocked to the region, attracted by the rich nitrate fields.

Until recently, mining operations drew from aquifers high in the Andes or made use of salt lakes within the desert itself for their water, but as a result of the mining industry's meteoric growth over the past two decades, increased competition from other users and a prolonged drought, fresh water is fast becoming northern Chile's most scarce resource.

One option that has frequently come under discussion in recent years is the construction of a so-called "water highway" that would transport immense quantities of river water from the country's well-hydrated southern regions. Although attractive, the engineering challenges associated with moving water over such great distances are substantial and, as of yet, there has been little concrete development in this regard. The chances of such a project coming online before the next decade are slim.

The more practical alternative is to make use of Chile's extensive coastline and bring seawater to the mine via a high-volume pipeline and then construct an onsite desalination plant. There are already a handful of operational plants in the region, the first of which was BHP Billiton's Planta Coloso, which provides fresh water for the Escondida Mine.

However, desalination is not without its drawbacks: "It is a very costly, energy intensive process, especially when you consider the quantities required for mining applications. Most of the pipes we work with to transport slurry are between six inches and 10 inches in diameter, but the seawater pipelines can range up to 42 inches or 48 inches in diameter. These projects require thousands of liters per second to be pumped up several thousand meters of elevation," said Gregg Hodges, general manager of Ausenco Chile, an Australian EPCM contractor with a particular focus on pipelines, tailings systems and heap leaching.

Although miners may balk at the costs involved, salt water is often the only realistic option for greenfield projects. "The major companies are going to have to live with the increased cost. Their margins will undoubtedly suffer a reduction, but if the alternative is to write the project off altogether then it becomes a very easy decision to make between making slightly less profit or making no profit at all," said Alejandro Palma J., general manager, SRK Consulting Chile.

In this light, it is easy to understand why construction of desalination plants is booming: estimates from the Spanish water firm Aqualogy suggest that by 2016, Chile's total desalination capacity will have increased from approximately 120,000 m3/d to nearly 650,000m3/d.

The associated flurry of activity in pipeline development has also led to a high concentration of expertise within Chile's engineering community. "Given that energy costs are so high here, Chile is now moving into a position of worldwide leadership in the field of innovative, low-energy water pumping solutions, which combine large flow rates with very high pressures… The only other country in the world that has developed such large-scale water pipelines is Saudi Arabia, and they do not have to deal with mountainous terrain, so this is a good example of Chilean needs acting as a motor for innovation, said Roy Betinol G., P.E., president and general manager of Brass Chile, a company that works with the engineering and design of pipeline systems for transporting fluids with a specialty in handling slurry.

Although expensive pipelines and complex desalination facilities may be the standard for the mines of the future, many existing operations that acquire their water from more traditional sources are taking steps to decrease their current water usage and minimize losses: "Conventional tailings and waste-water systems can be immensely wasteful so we are often able to help our clients conserve and retain a significant amount of water through the use of thickening processes," said Maria Eugenia Parot, president of Golder Associates Chile.

It is true that the thickening process becomes considerably more complicated when applied to very large mines of the scale that is commonly seen in Chile, but recent developments in technology have rendered it a feasible option for all but the most extensive tailings ponds. Aside from using more efficient tailings facilities, miners should also seek to improve their on-site water systems: "By ensuring that there is no cross-contamination between clean and waste water it is possible to substantially decrease the amount of water that needs to be treated and cleaned," said Parot.

This relatively small measure has a direct impact on operational costs and can help a mine to make the best use of precious fresh water reserves. According to the company's general manager, Richard Araya, this is only one of the many areas in which Golder Associates can assist mines in controlling costs: "We have capacity in integrated management of mine waste, water management, ground engineering, environmental and social assessments and permitting, integrated monitoring programs and closure services", said Araya. •

Carl Weber

General Manager
HIDROMAULE

Could you start us off with a few words about Hidromaule's history?
Hidromaule was created in 2004 by our partners, the Italian company Sorgent.e, which had already developed eleven small hydro plants in their home country. In September 2005 they signed an agreement with the main irrigation association in Chile, Canal Maule, to use their irrigation channels for hydroelectric generation, which gave them access to over 3,000km of channels to work with. In 2006 they contacted us to work as their local partners and by 2007 we signed a deal. Today53% of Hidromaule is controlled by Sorgent.e, and the remaining 47% is in our hands.Initially we had no capital to develop projects and Chilean banks were not interested in funding the project, so we were forced to look elsewhere for finance. For our first project, the 19MW Lircay power plant, we secured $28 million from the International Finance Corporation (IFC), and since that time we have gone from strength to strength. Between 2007 and 2012 Hidromaule invested approximately $100 million and now operates three power plants in the San Clemente region with a total installed capacity of 41MW. We managed to construct all these power plants for a fairly low cost and within our predicted timeline, which has left the company with much lower debts than most of our peers.
The company has also had a very positive experience with acquiring its environmental permits, thanks in part to the good relationship we maintain with CanalMaule. We pay a royalty to the association and have also put more than $14 million towards an improvement program for the channels they operate. This means that the association members are guaranteed a good water flow and well-maintained facilities.

> "That being said, hydroelectricity is arguably the most competitive source of energy in Chile today. A lot of attention is being paid by the media to alternative sources of energy such as wind farms and photovoltaic cells, but although these are very attractive and help companies to present themselves as environmentally friendly, they are simply not competitive on cost."
>
> - Carl Weber, General Manager, Hidromaule

Would Hidromaule consider working in collaboration with mining houses to develop new power plants?
We are very open to the idea of collaborating with miners, but we believe that the best form of collaboration is to enter into long-term supply contracts with them. Unfortunately, most of the miners are not willing to pursue this option as they are not willing to pay the market value of electricity.Todaywe are seeing several examples of mining companies building their own power plants in an attempt to source lower cost energy, but these projects do not come cheap and I believe that they will end up paying even higher than the current market price. From a power company's perspective, it makes no sense to sell our energy to miners at the low prices that they are demanding when we can sell higher on the spot market. On the other hand, the spot market is not without its risks: for example today we are seeing prices of $80 KW/h, whereas two months ago it was closer to $200 per KW/h, just because heavy rains caused a surge in supply.

Do you see energy prices coming down significantly in the near future?
It seems very unlikely that the price of electricity will come down anytime soon. This is in part due to heavy users such as miners refusing to pay market price for their electricity. To illustrate this point, if Hidromaule could enter into a 10 year contract at a fair price, then we would be in a strong position to develop our next 40MW of capacity and thereby increase our overall level of supply. If this process were replicated with a great number of similar size producers then we would start to see much more investment in developing new capacity and in the long term that would help to bring prices down. However, today this is not happening and so prices will remain high.

How do you evaluate the role of hydroelectric energy in Chile's energy infrastructure?
First of all it is necessary to make a distinction between mega projects such as HidroAysén,and smaller plants such as those in which Hidromaule specializes. With regards to the larger projects, it is going to become more and more difficult to find suitable locations for them because there are very few remaining water rights to exploit in the country. In the far south there are still some opportunities, but these will be extremely expensive to carry out, as there are no transmission lines in place and it is still unclear who would pay for these lines.Furthermore, these large-scale projects tend to run into serious difficulties with environmental permits and there is an increasing hostility against them from local communities.
That being said, hydroelectricity is arguably the most competitive source of energy in Chile today. A lot of attention is being paid by the media to alternative sources of energy such as wind farms and photovoltaic cells, but although these are very attractive and help companies to present themselves as environmentally friendly, they are simply not competitive on cost.

What does the future have in store for Hidromaule?
Together with our Italian partners we have recently started exploring another valley further south of the region where our existing plants are situated. We have signed a deal with the owners that gives us eight months to investigate the potential to construct another series of small hydro plants. If the company does go ahead with these plans then we should see growth of 100% as the operation would consist of three new power plants producing another 40MW. That being said, when it comes to finding new prospects, the situation is getting more complicated as many of the sites that are most suitable for developing projects like ours have already been taken over by the large energy providers. Before finding this area we had already evaluated over 40 other locations. •

Richard Araya

General Manager
GOLDER ASSOCIATES

High salaries and a lack of skilled workers are seen as challenging issues in Chile. What strategies does Golder employ to make sure it attracts and retains the right people?

About 75% of our employees are under 40, which allows us to focus more on their true interests, which are not limited to a higher income. Employees enjoy benefits in terms of increasing their quality of life, flexibility, time to spend with family, and training and support to study and gain experience in Chile and abroad. Golder has an advantage because it can provide benefits that our employees value; in fact, we have become a learning place for new professionals in our industry. We were included in the Great Place To Work (GPTW) program, where we were rated 39 despite being our first year, making us the best engineering consultancy firm to work in Chile.

Mining operations in Chile are responding to lower grades and more complex mineralogy by increasing throughput and generating increasingly large tailings facilities. How is Golder looking to take advantage of this situation?

Golder Associates is a global company that behaves as such: "One Golder". This sets us far apart from our competitors, as it enables an ongoing internal exchange of experts and knowledge based on specific project requirements. For example, if South Africa currently requires geotechnical engineering experience and Chile has such experience, Golder in South Africa can alert us and one of our experts in Chile will move to the project site for the time required to provide the client with his or her knowledge.

We know that the mining boom has ended. Our clients are focusing their investments in expansion projects that will benefit their current operations more than investing in greenfield projects, thus changing their focus from growth, virtually at any cost, to maximization of value in existing mines as well as a disciplined allocation of capital to new projects.

Golder Associates in Chile has sought to grow within the mining industry. How? Focusing on integrating our services in order to support the entire life-cycle of mines; building our basic capacities to support investigation, design, construction, operation, closure, and post-closure phases. Particularly, this adds capacity in integrated management of mine waste, water management, ground engineering, environmental and social assessments and permitting, integrated monitoring programs and closure services.

Could you provide us with some details on some of Golder's recent standout projects?

Our Geophysics Group is leading the service delivery for the Collahuasi copper mine project in northern Chile. We are providing supplemental internal services such as engineering, structural geology and rock mechanics. The scope of the project includes geophysical borehole logging, surface geophysics within Rosario West and Ujina open pits and conventional exploration geophysics.

Codelco, a key client for Golder in Chile, also selected us to update their mine closure plans (CFM) for all their divisions, according to requirements contained in the new mine closure legislation in Chile. The study includes updating existing closure plans for each Division, standardizing them and ensuring that they include all facilities, as well as information on corresponding environmental assessments (DIAs or EIAs). In addition, a strategic report is to be prepared including securities required by law and information on gaps identified by the investigation on compliance with the new Closure Act as well as economic impact for Chile.

In Chile, as in the rest of the world, Golder faces stiff competition in the areas of mine waste and water management. What qualities help the company stand out?

An emphasis on ongoing training in our main business areas encourages us to perform our work with great care and at high quality standards, which are valued by our clients throughout the world. The possibility of transfers and internships allow us to share knowledge and experience from our experts in Golder's service areas. Our consultants are speakers in conferences and give technical lectures, where they stand out for their contributions to knowledge in the consultancy business.

Against the backdrop of Cochilco's predicted $113 billion investments in Chilean mining in the coming decade, what is your vision for the future of Golder Associates in Chile?

The last period has been one of uncertainty. Variables such as volatility in commodities; delays and cancellation of investment projects; issues with power supply; increasingly demanding and organized communities; as well as being in the middle of an election year, all have impacted on investment and made us seek tools and strategies to implement carefully.

We have focused on keeping our position as a strategic partner throughout the life-cycle of mining projects, which existing and potential clients value.

We have strengthened our Business Development group, taking specific actions such as maintaining visits to our clients or a "One Point Contact" for our clients in the region.

We have trained our Project Managers in internal workshops dictated by our Golder U program (Golder University), thus giving them the "know how" that Golder has gathered during years of practice in project management.

All of the above must be aligned with our value proposal, under which we have defined "excellence" as a combination of technical and client service quality. •

Ignacio Sánchez D.

General Manager
BERMAD ANDINA

Could you start us off with an introduction to Bermad Andina's history?

Bermad Andina was established in 1996 in order to cater to the needs of Chilean water companies. We started by providing pressure reducing control valves for the city's water distribution network at a time when nobody else in Chile was using this technology. We introduced what is now a standard way to work for this kind of company with the support of the world-leading Israeli control valves brand, Bermad. Afterward, we grew substantially and achieved significant market share. However, in 1999 we decided to move into new markets and focused on the mining industry, which today constitutes approximately 80% to 85% of our sales. Aside from our headquarters in Santiago, the company also maintains a branch in Antofagasta and employs sales representatives in Iquique, Calama and Copiapó. We have valves installed in almost every mid-sized and large mine site in Chile, including Collahuasi, Los Pelambres, Escondida and all of Codelco's various divisions.

What are the main product lines that you work with today? How do you choose your suppliers?

In addition to Bermad control valves, we offer a range of valves, including vent valves, butterflies, check, knife, gate and ball valves. We also sell other hydraulic equipment such as pumps and automatic filters from an assortment of producers, for which we are the sole Chilean distributors. We recently expanded to include a range of telemetry instruments that allow for the transmission of data between equipment and enable remote monitoring and operation.

When choosing our suppliers we look for brands with a reputation for quality, even if this means a higher price tag. We work with the Israeli company ARI, which is a world leader in vent valves technology; with Amiad, another Israeli company with vast experience in filtration, for whom we are the exclusive distributors for Chile, Peru and Argentina; with Saer, a recognized Italian manufacturer of pump equipment; and with the French company Lacroix Sofrel for telemetry.

Within the mining industry what services does Bermad Andina offer?

We provide services for all a mining company's needs in the area of fresh water transport, from clean water for personnel to process water for leaching. We can offer integral solutions that go from the hydraulic engineering, calculations and design, to the supply of all required equipment, technical support in the field and maintenance. We can also provide detailed analysis of a client's system. One of our competitive advantages is that we maintain a specialized test bench at our office in Santiago, which allows us to check, calibrate and test most of our control valves and to check the operation point for many pumps as well as the operation of the filtration equipment.

Given the number of large engineering firms operating in Chile is there much demand for your engineering services?

High quality hydraulic engineering has been a key feature of Bermad Andina's work, as the type of valves that we work with requires highly specialized knowledge. When companies like Bechtel or Fluor are using these types of valves, they tend to consult with us to ensure that they are using the optimum design. Our engineering skills are often called upon to resolve problems with end users. We have developed a particular expertise in hydraulic modeling, finding solutions for water hammer problems, and minimizing energy costs by using vent valves in pipelines. We now give seminars on how to address these issues.

As cheaper equipment suppliers from China and India are starting to gain more traction in Chile do you worry that Bermad Andina will lose market share as you are undercut on price?

Unlike customers in certain industries, mining clients are prepared to pay for quality. Their primary concern is not the initial outlay but operational security. Our products give clients confidence that their processes will not be disrupted by unscheduled maintenance and lengthy downtime. Clients are willing to accept a higher price if the product has a proven track record and is of high quality. In pumping systems we are yet to see serious competition from Chinese manufacturers, but in some of the simpler types of valves there are certain brands that are starting to roll out some decent products. We have in fact supplied Chinese valves for big mining projects in corrosive fluid applications, and our customers have been satisfied.

Bermad Andina is poised to embark on an ambitious restructuring plan. Could you give us details on the direction you want the firm to take?

Bermad Andina has two sister companies: Saer Andina, which specializes in pumps for industry, mining and agriculture applications; and Amiad Andina, which provides self-cleaning filtration systems, also for industry, mining and agricultural applications. We will be merging these three firms to create a more integrated company. This move will allow us to enter new markets including hydroelectric. Along with integration, we will be expanding our range of services. We already offer maintenance services for systems that we ourselves have installed, but now we plan to move into repairs, maintenance and operation for equipment installed by third parties. In order to reflect the more integrated nature of the new company, we are changing its name to BFS. •

Facing Forward: Innovation in Chile

"In Chile, a lot of land has already been surveyed in some detail down to a depth of 300 meters, so companies are looking to go ever deeper to find the more difficult deposits. This makes drilling costs far higher and so there is an even greater need to ensure that drill holes are properly targeted to avoid wasting large sums of money on disappointing results. Our services can help with this targeting and will help to provide better results and lower costs in the long term."

Mark Morrison, General Manager Chile, Quantec Geoscience

Image: Shutterstock

Preparing the Mines of the Future

Technology in Chile

On January 14 of last year, former President Sebastián Piñera declared 2013 to be Chile's Year of Innovation. This declaration formed part of a $1 billion public spending initiative spearheaded by the Chilean Economic Development Agency (CORFO), which seeks to promote innovation across key sectors, including mining.

Given the advanced age of many of Chile's mines, this focus on innovative approaches is of pivotal importance: "Mineral deposits are locked increasingly deep into the earth, bringing a whole new set of challenges to the mining community. We cannot keep moving entire mountains to recover small percentages of minerals, so there will have to be a systemic change in the way we look at extraction," said Rodrigo Undurraga, general manager of Prodinsa, Chile's only manufacturer of steel cables.

However, this philosophy is nothing new for Chile, which has long gone against Latin American mining's entrenched reputation for conservatism: "For decades Chilean mining has been an early adopter of new technologies, and you can find the latest innovations across all stages of the production chain in operation here", said Juan Carlos Olivares, general manager of Chile's Association for Mining Equipment Providers (APRIMIN).

For evidence of this, one need look no further than the mine sites themselves, where many operators are investing in automated transport solutions to boost operational efficiency. Codelco has advanced even further down this path and is currently in the early stages of integrating robotic solutions into its smelting and refining facilities.

> "Working in Chile certainly throws up interesting challenges in terms of climate, which has made the country an important testing ground for new products. As a result of tailoring our machines to work in conditions of freezing temperatures, high winds and serious snow cover, we have managed to improve strength, reliability and flexibility across the board. One of the most important developments to come out of Chile is the improvement of the engines we use to power our slope stability radar (SSR) system. In ideal conditions one unit can run for up to 14 days with no intervention from an operator. This is possible because the machines run on an engine-powered battery, so the only limitation should be the fuel supply. However, in the extremely low temperatures found at certain mines the engines struggled to start automatically, the batteries could not charge and the radar would inevitably stop working after only a few days. We solved this issue by implementing a pre-heating system that warms the engine up before it has to start and so now all our units are able to run reliably in temperatures of -45 degrees Celsius.
>
> - Andrea Magro,
> Business Manager for South America,
> GroundProbe

The technical knowhow behind these robotic systems comes from another Chilean company, High Service, which was established in 1999 to develop and commercialize new technologies for mining processes. "The mining industry has developed considerably over the years, but this development has always been rather linear, and has usually come in the form of improvements of existing processes rather than any fundamental rethink of how the basic steps should be carried out. The mines and plants have got bigger, but we still keep doing things in the same old ways… we feel that the time is ripe for a disruption of the established conventions," said general manager, Hugo Salamanca.

The company has carried out several pioneering projects, including a cathode stripping system for Anglo American that comprises three robotic arms working together to deliver a process capacity of 200 plates per hour, far more than any human worker would be capable of. This type of experimental research is admittedly rather rare in Chile, but the country is home to a growing culture of practical, grassroots innovation. Santiago based electrical engineering firm IDT is emblematic of this philosophy. The company started off as a small operation building rectifiers for the production of copper cathodes in general manager Patricio Lagos' garage, but, over 18 years it has grown into a $20 million operation that continues to invest 3% of revenues into R&D: "Today we have over 12 technologies registered under international patents in the USA, Argentina and South Africa. However, our research is not focused on cutting edge technical breakthroughs that only benefit a few people; instead we focus on developing solutions to real, everyday problems faced by the mining industry," said Lagos.

Their products have been well received on the Chilean market and now 42% of the country's copper cathodes are produced using IDT's rectifiers. This success has not gone unnoticed and in November 2013 the company was acquired by General Electric. Now GE plans to take IDT's patented technologies to far-flung locations and build the company into a worldwide market leader.

Chile's mining sector is adapting well to the possibilities presented by the convergence of high technology and heavy industry. However, there is much room for improvement, and a recent OECD investigation found that the number of Chilean companies dedicated to research is relatively low. This is perhaps unsurprising given that the study uses other OECD members such as Japan and Sweden as a benchmark. Nevertheless, the measures suggested by the researchers – the establishment of a dedicated ministry of innovation, forging closer ties between academia and industry, and a reexamination of current innovation policy – are sound. Hopefully, the report will serve as a stimulus for the new government to take concrete measures that will foster growth in this valuable area. •

Global Business Reports

> "Fraser Alexander's 2017 vision for South America is to have all our divisions from South Africa present and operational in the continent. In order to achieve this it will be necessary to expand rapidly, but rather than bringing in a crowd of engineers from outside the country, we are looking to build from within and create a truly Chilean company. Of course in the early days we will be making use of some of our professionals from Africa, but our long-term aim is for them to train up our local talent and then return to their home offices.
>
> - Pierre Griesel, Operations Manager,
> Fraser Alexander"

Sebastián Pinto

General Manager Latin America
ORICA

What is the strategic importance of Chile to Orica's global business and what facilities do you maintain in the country?

Chile is important to Orica for several reasons. Itis the coordinating center for our Latin American operations, which includes 10 countries from Central America and the Caribbean to Argentina. In 2013 Chile,constituted one third of total profits from the region, and it is where we have the largest exposure to metalliferous mining, and particularly copper mining, in the world. Chile is also integral to our corporate strategy of delivering differentiated products and services; it is such an advanced market and therefore receptive to the higher-level services that we offer.

In terms of facilities, we like to establish a presence within the client's operation so we establish infrastructure at the mine site. This usually consists of an office to carry out administrative work, a warehouse to store products, and operational staff to carry out the blasting work. In total, we have a presence in approximately 50 different mines in Chile, both open-pit and underground. Some of our clients are Codelco, Xstrata, Freeport McMoRan, Kinross and BHP Billiton. Aside from operational locations, Orica maintains two manufacturing assets in Antofagasta where it produces initiating systems and bulk explosives, and a third plant close to Santiago to produce packaged explosives. From these plants we export to other Orica business units in Australia, Peru, Argentina and other countries. In Chile alone, we employ from 1,000 to 1,300 people.

What is the balance between the sale of products and the delivery of services for Orica?

Generally speaking, we are trying to steer away from a product sales approach to develop a more service-based business model. We define our role in the mining industry asbeing the first step in the production chain: our job is to break up rocks for our clients so that they can more easily extract the mineral elements.In this scenario, the closer you can get to a consistent size and shape of rock, the more efficient the downstream processing will be, as crushers, mills and grinders will all be running at optimum level.

We also offer a range of software based services such as vibration monitoring for blasting in close proximity to communities, and dust control to minimize the enormous dust clouds that can be the result of prolonged explosive activity. We have also integrated other units into the main mining business: these include the mining chemicals arm, which has given us the capability to offer mineral processing chemicals, and the ground support unit, which increases stability in underground structures.

To what extent does Chile play an active role in product development?

Orica's main R&D facilities are not located in Chile, but the vast majority of products that we develop are trialed in Chile. A good example of this is at Teck's Carmen de Andacollo mine, where we are testing a new technique known as Ultra High Intensity Blasting. Developed in-house by Orica, the technique works on a system of dual layers. First, the top layer is detonated, creating a blanket of fragmented rock on the surface, then underneath this a much higher energy charge is set off, which breaks up a large volume of rock, but the blast is contained by the top layer. The beauty of this approach is that it delivers a uniform fragmentation without causing significant problems with vibrations and flying rocks.

How do you evaluate current institutional safety standards in Chile?

Overall safety standards in Chile are high and rigorous measures are applied across the industry, which were sharpened in the aftermath of the San José incident of 2010. However, irrespective of national or state regulations, Orica applies its own safety protocols that exceed those demanded by the government. It is in our interest to take care of our staff because they are our most important asset.

What do you believe are the main challenges that Orica faces working in Chile?

Orica is not isolated from the challenges that affect the industry. Chief among these is that the government has not developed a coherent strategy to address the shortage of electrical energy, and miners cannot project energy costs, making it difficult to develop a multi-billion dollar investment. Sourcing adequate supplies of labor is also an issue, which is why we are seeing so many companies developing their own training programs and trying to foster links with educational institutions. Orica addresses this issue through its graduate recruitment program, which picks out 10 to 15 talented graduates every year to go through a three-year rotational period before being placed in a permanent position. Another issueis the growing role of local communities, and it is important that we bring them into the development process from the earliest discussions to ensure that their voices are heard.

How do you see Orica developing in Chile in the coming years?

Over the next few years, Orica will continue to help and support the mining houses, and we hope to play a pivotal role in the next wave of investment. Our position will change from that of a product provider to a full service provider that works in partnership with the companies and becomes a part of their production chain. •

Patricio Lagos

General Manager
IDT

What were the circumstances that led you to found IDT?

My background is as an electrical engineer in the mining industry. Prior to IDT, I worked in a mining company for 20 years, taking care of the production of copper cathodes. The 1985 earthquake caused one of two rectifiers to burn out, but we were able to rebuild the entire piece and restart operations less than 36 hours later. In 1990, a well-known private industrialist purchased a small copper mine in Northern Chile and approached me to build a rectifier for his operations. I constructed it in my garage at a cost of $100,000, but the mine was sold to a major company, and my rectifier was unsold. In 1991, Anglo American had started operations at their El Soldado mine and installed a European rectifier, but it burned out almost as soon as they set the plant into action. Their only option was to use my rectifier, and IDT was born. Last year, after 23 years of service, we modernized that original machine and today it is still running. As it stands, IDT now employs 100 people, 42% of all copper cathode production in Chile is carried out with rectifiers made by IDT, and it has recently begun to commercialize its services outside of the country, in Peru, Argentina and China. We have seen continuous growth since 2009 and today our sales figures are roughly $20 million per annum. Now that we have the support of General Electric (GE), our clear objective (and theirs as well) is to become the worldwide market leader in this field.

Could you give us some details on the different product lines that IDT works with?

Our main area of specialization is the development and production of rectifiers, but we have three distinct product lines. Our rectifiers are designed to produce direct current, but at the same time they also cause harmonic waves, which contaminate the grid. As such, we were forced to develop compensatory measures and now produce a range of harmonic filters, which we sell to other power generators including solar plants and wind farms. In addition to this, we also produce electrical rooms in conjunction with GE, which are sold as a complete electrical solution to a range of industrial clients.

In November 2013 IDT was acquired by General Electric, how did the relationship with GE come about?

In 2008 we started to look at diversifying our product line and developing our Eroom solutions, which were designed to incorporate our own brand of rectifiers as well as other pieces of electrical equipment from third party manufacturers. We realized that although many major players in the electrical equipment sector were involved in Chilean mining, GE was conspicuously absent. So, we offered to start selling their products within our Erooms. The relationship worked well, and we began to receive company visitors, who became increasingly senior as time went on. Eventually, GE expressed interest in acquiring IDT, and, in November 2013, IDT became part of the GE family. GE's CEO, Jeff Immelt, visited Chile for two days this year to meet with the president of Chile and me to learn about the story of IDT.

Chilean companies are not generally renowned for their commitment to R&D. To what extent does IDT buck this trend?

Innovation is a fundamental pillar of our corporate philosophy, and we are one of the few companies in Chile to develop and patent world-class technologies. Today we have over 12 technologies registered under international patents in the USA, Argentina and South Africa. We are also devising simpler and more frugal solutions to real, everyday problems faced in the industry. In order to continue developing these, IDT reinvests at least 3% of our revenues into R&D.

What kind of services does IDT offer in terms of maintenance and repair work?

First of all it is important to emphasize how costly any rectifier failure can be to an electrowinning plant: if the rectifier stops then production stops. As such, one single day of downtime can incur costs equal to or greater than the initial cost of the rectifier. Of course IDT's machines are built to ensure that failures are rare, and all the components are standardized, but we have a dedicated team of 20 engineers on call to solve problems. This team has the best equipment available and, if necessary, will fly by private plane to reach mining operations as quickly as possible.

Now that IDT has the full force of General Electric backing it, what does the future hold for the company?

I like to compare our 18-year journey to the great interstellar voyage undertaken by the Starship Enterprise: we set off into unknown territory in search of new discoveries and returned triumphant. Now in 2013 we begin the next stage of our adventure. Our ship's fuel is innovation; our weapons, the world-beating products we have developed; our crew, a crack team of engineers and technicians with unrivalled passion, dedication and knowledge of their field. With the support of the world's largest industrial conglomerate we are ready to move into any country where there is copper production, but we will continue to work with our clients to stay at the forefront of technical innovation in cathode production and to support the new wave of Chilean innovators. •

Hugo Salamanca

General Manager
HIGH SERVICE

What were the reasons that led you to found High Service in 1999?
The main behind the decision to set up High Service was a firm conviction that the mining industry presented a series of challenges and opportunities that were not well catered for by the existing service providers in the market. Looking at specific processes within the copper production chain there are several steps which still constitute a serious risk of accidents to personnel, and even more steps where there is a lot of room to improve efficiency and heighten productivity. Whilst it is true that the mining industry has developed considerably over the years, this development has always been rather linear, and has usually come in the form of improvements of existing processes rather than any fundamental rethink of how the basic steps should be carried out. The mines and plants have got bigger, but we still keep doing things in the same old ways. As such, we formed High Service to research, develop and commercialize new technologies that would have a real impact on the sector. Mining is a conservative industry, particularly when it comes to adopting new technologies, but now that producers are being faced by the combined threats of a lack of water reserves, very expensive energy and spiraling labor costs we feel that the time is ripe for a disruption of the established conventions.

Could you explain the role of the different business units that make up High Service?
Today the company is split into four different divisions. The first is focused on providing maintenance services to mineral processing plants, but our approach is different to that of many other service companies. Whilst many firms boast of the number of technicians they maintain on site, our ideal is to offer full maintenance with zero staff at the plant. Instead we focus on remote monitoring systems that allow us to keep track of several plants at once. All our clients have a direct hotline number that puts them directly in contact with the senior technician in charge of their operation, and of course if the problem persists then we will send a team out to the operation. If the site is far away then we will charter a private plane in order to resolve the issue as soon as possible and keep downtime to the absolute minimum.
The second unit is our innovation department, which was established shortly after High Service was first set up and is tasked with developing new solutions to aspects of mineral processing where there is a high risk of accidents or there is clear room for improvement in terms of improved efficiency and productivity. We also have a unit devoted to engineering and construction within the area of electronics and electrical instruments in small to medium sized process plants. The fourth unit is extremely specialized and deals exclusively with technical support and automation of ring motors for SAG mills. In this area we have been called upon to work outside of Chile, in Argentina, Australia, Mexico, Brazil and several countries in Africa.

What innovations have come out of High Service's R&D department? How does it fit in with the company's core business of advanced maintenance services?
High Service's core business is not to provide maintenance services per se; rather is to improve our clients' operations by looking beyond traditional methods and developing new technologies and service models. In fact our divisions are not so strictly compartmentalized and there is significant crossover between our services and our technological development because maintenance contracts always come with a technological element. Members of our maintenance team often sit down with our researchers and discuss problems that they believe could be dealt with better through new technologies. At the moment we have a strong focus on wireless technology, and today we have several products on the market which monitor and report wear levels on various components. These have been deployed with great success at MineraEscondida and are now being rolled out across several other operations.

High Service's introduction of robotics to the mining industry is a great example of technological convergence. How has uptake been amongst miners what are the different applications you are working with?
It has not been easy persuading the mining industry of the benefits that can stem from embracing this new technological frontier. When we first approached major producers some 10 years ago, they were skeptical to say the least, and simply wanted examples of where else it had been tested in Chile. However, since this time there has been a sector wide shift and now it is considered normal to see the words mining and robotics in the same sentence. In 2007, High Service formed an agreement with three other partners and created a spinoff company, Mining Industrial Robotic Solutions (MIRS), which deals exclusively with the development of robotic technology in mining. The companies involved in the consortium are Codelco, Nippon Mining,Kuka Robotics and, of course, High Service. In the intervening years we have carried out several high profile projects including the design and installation of a cathode stripping system for Anglo American's Mantos Blanco operation, which comprises of three robotic arms working together to deliver a process capacity of 200 plates per hour: far more than would be possible with conventional methods, and with a significantly reduced risk to health and safety. Other applications include the cleaning of roasting furnaces, punching and tapping slag passages in flash smelters, and even a fully automated cleaning system for mine vehicles such as haul trucks and bulldozers. Our capabilities have been recognized outside of Chile, and we recently defeated stiff competition towin a contract for a cathode removal and replacement system at acopper plant in Texas.

What is your vision for the future of the mining industry of tomorrow?
Automation is doubtless going to play a more and more important role in almost all aspects of the mining industry. Our vision for the mines of the future is one in which humans are not involved. The technology to achieve this goal already exists; all that remains is to develop the processes to a point where they can be commercialized on a large scale. Codelco already has fully automated haul trucks and loaders operating in Minera Gaby and Andina and, in light of the incredibly high labor costs the country is facing, the role of technology is only set to increase. •

Roy Betinol G., P.E.

Chairman and CEO
BRASS

Brass is an American company with operations in several countries around the world.What is the importance of the Chilean branch to the group as a whole?

Brass was founded in California in 2000, at a time when copper was trading at a historical low of around $0.70 per pound. This meant that it was somewhat difficult to gain traction and find clients in the North American market, so we decided to move into Chile. I arrived here in April 2000 with a team of four people, and we began carrying out some fairly minor studies and consulting activities. From this base we grew steadily, doubling our headcount every year for some years and cementing our reputation as providers of quality engineering. In 2012 we reached a peak of 150 employees, and today the Chilean operation remainsBrass' largest office.

What are the main areas of expertise that can be found among your staff?

When we began the business we focused primarily on consulting, but we have now grown to house an extensive multi-discipline engineering team. Our main area of expertise, and the area in which we remain largely unchallenged, is still in the hydraulics field. Simply put,our business is the engineering and design of pipeline systems for transporting fluids with specialty in handling slurry. However, in addition to our core of hydraulic engineers we now have a diverse team that includes mechanical engineers, electrical engineers, experts in civil and structural works, and specialists in layout design who can work with 3D modeling.

Who are some of the main clients you work with in Chile? What level of collaboration do you have with the mine operators?

We work with a broad assortment of clients that include some of the world's largest mining firms such as BHP Billiton, Barrick, and XSTRATA, as well as local producers such as Antofagasta Minerals and Compania Mineria Pacifico (CAP). Brass is also frequently subcontracted by some of the large EPC firms to take care of the specialized engineering for pipeline development. The pipeline is one of the most capital-intensive elements of any mine development, requiring investments of anywhere between $200 million and $500 million. Our task is to understand how we are going to be able to transport mine products in slurrified formacross distances of up to 200 kilometers (km) without causing blockages. To achieve this we work closely with the mine's process engineers to find out about what kind of rheology we should expect and how we can optimize our lines to deal with the grind size they are using. In this there is always an element of give and take: the finer the grind, the easier it is to transport, but on the other hand, fine grinding takes more time and ultimately generates a higher cost for the operator, so we must always work to find a balance. We then use cutting edge technology and our extensive experience to define certain flow parameters that must be followed to avoid the solid elements from settling in the pipeline and causing a blockage.

Brass Engineering was involved with Sul American de Metais' 480-km slurry pipeline in Brazil for the prefeasibility studies. Do you come up against many of the same challenges working in Chile as in Brazil?

The two environments are actually very different: most of Brazil is with relatively flat terrain, so the pipelines tend to cover longer distances at low elevations than in Chile. Here we have to deal with high altitude and mountainous terrain, so the pipelines are usually shorter and require more complicated engineering. When bringing slurry down from the mine site we have to develop measures to cope with the immense static pressures that can build up in the pipes: at the bottom of a 3,000 m decline, the slurry can reach pressures of up to 10,000 PSI. To combat this we divide the pipeline into a number of different sectors, thereby limiting pressure in each section. We always push the limits of available technology, designing our pipelines to make use of the maximum allowable pressures for pipe materials. This has clear benefits to our clients, because the more you can push the limits, the more money you save because you eliminate the need to build so many installations.

Alongside the slurry pipelines Brass also works extensively in water pipelines. Could you tell us about how you see this field developing now that water reserves are under such pressure in Chile?

For many years, Chile's mining companies drew their water from deep well facilities up in the mountains, but now these wells are starting to run dry so miners are taking water from the coast and pumping it up to the mine sites. This of course necessitates the use of large quantities of energy. Given that energy costs are so high here, Chile is now moving into a position of worldwide leadership in the field of innovative, low-energy water pumping solutions, which combine large flow rates with very high pressures. So again, we are pushing the limits of the available equipment and working closely with pump manufacturers to increase their capacity and bring down the number of pumping stations we need to transport water over a given distance. Nevertheless, with the best available pumping technologies, most long distance water pipeline in Chile still require three to five pumps stations in series. The only other country in the world that has developed such large-scale water pipelines is Saudi Arabia, and they do not have to deal with mountainous terrain, so this is a good example of Chilean needs acting as a motor for innovation.

Brass is now very well established in the pipeline-engineering field. In which direction do you plan on taking the company now?

Our main aim for the next few years is to expand into other fields. At the moment our role is to deliver the slurry from the mine down to the coast, at which point another company squeezes out the water and prepares the concentrate for shipping. The next logical step is for us to get involved in this process too. If we start working in filtration then this opens the door to the possibility of recirculating the filtered water and pumping it back up to the mine site to be used again. At the moment, most water is left in tailings ponds to be evaporated but we feel that this is a fairly inefficient way of dealing with it. Given that water is getting to be an expensive commodity, this type of integrated system could help bring our clients' costs down significantly, as well as improve their environmental impact. •

Rodrigo Undurraga

General Manager
PRODINSA

Can you give us an update on what is new with Prodinsasince we met two years ago?
In recent times we have been working to modernize according to the demands of a changing world, and investing to improve our products and production capacity in the sectors that we have chosen to focus on. One of these is mining; we manufacture spare parts for mining shovels, for mining drills and, in other countries, such as Canada, spare parts for dredges. Our goal is to double our capacity and become the best manufacturer of spare parts for shovels in the world. In Chile, Peru and Colombia there is a high concentration of open pit mines that use shovels, and our vision is to give service to all North and South American clients. We have 200 direct employees and around 100 more in external services such as maintenance.

How important is mining to the company's operations?
Mining is 40% of what we do; it constitutes our most important sector. As a company, we divide the business into two parts: the production of wire rope, andthe production of solutions and spare parts, which are of course based on wire rope. We make spare parts for all shovel models for every shovel manufacturer in the world. However, the reality in the mines is that all shovels end up being slightly different from oneanother, even if they are the same model. Thus, we cannot make standard spare parts; we have to make tailored pieces for each product and for each purpose. Our investment in these past years has been directed towards becoming faster, more flexible, and better ableto react tochanges of orders. As it stands,we export half of our total production, mainly to Canada and the United States, Peru and Ecuador.

Chile is not renowned for its heavy industry. Does this make it harder to acquire the necessary raw materials for your operations?
Our owner is Inchalam, an industrial group that manufactures high carbon wire, which we use as our main raw material. Approximately 90% of what we use comes from this sourceand the remainder comes from international providers. Inchalam is supplied by domestic steel producersCAP, sothe majority of our production is 100% Chilean and therein lies the beauty of our supply chain.The end product comes from an iron mine,which feedsthe localsteel industry, which supplies the local wire industry, which is integrated to our cable industry. It is always the same combination, we are not changing providers every time, and this makes the product homogeneous over time.

Prodinsa is also involved in the manufacture of several products outside the area of wire rope. Are these manufactured here too?
With regards to the lifting and cargo handling business and in cabletransmission, there have been changes in the way that products are manufactured. Today there arealternative products and alternative raw materials on the market.Instead of using purely metallic cables,we are now using synthetic fibers that can be twined in ropes to make slings. We are one of the few companies in the world authorized to use Dyneema® (produced by DSM in Holland), a fiber that is many times stronger and is also significantly lighter than steel.

Prodinsa has strategic alliances with other cable manufacturers. What is the benefit of entering into such accords with the competition?
Nowadays nosingle company can cover all areas of an industry and stillmaintain a high level of quality, so we decided to dedicate ourselves to a smaller group of products,and the rest we purchase from international providers to satisfy the complete needs of our clients. Our clients' needs are our top priority and we are always ready to provide answers and come up with solutions.

Chile is progressing towards moreunderground mining; will this translate into increased demand for cables?
The oldest and most recognized underground mining is based on shafts, which is a hole in the ground with an elevator moved by cables, at the bottom of which there are a network of tunnels through which workers and cargo move. This is the main type of operation that you see in Russia, China, Canada and also here. In this type of mining there is certainly a high demand for steel cables.However, we believe that this scenario is starting to shift. Miners are nowlooking into new technologiessuch as grinding the rock by means of ultrasonic waves, pulverizing the oreintodust so that it can be moved by compressed air instead of conveyers. Mineral deposits are locked increasingly deep into the earth, bringing a whole new set of challenges to the mining community. We cannot keep moving entire mountains to recover small percentages of minerals, so there will have to be a systemic change in the way we look at extraction.

What advantages do you offer to your clients? Why should they chooseProdinsaover another provider?
In markets such as Chile, Peru and Ecuador we have a privileged position in that we are from the region so we know the language, and the local markets.We have excellent technical personnel who are always on hand tolend support to our clients' needs. We have the necessary resources to resolve any issue or product failure within 24 hours. If necessary we will put our technicians on a plane to ensure that they arrive at the mine as soon as possible.

What type of development are we going to see in the Prodinsa during the next five years?
Three years ago we started on an ambitious expansion plan to double our company's size in five years, so today we have two more years to accomplish our goals. To achieve thiswe aim to mechanize and automate our productionwith better sensors and better instruments, but hopefullyretaining the same number of people as we currently employ. •

Image: Shutterstock

From Sales to Services

Equipment in Chile

After several years that were characterized by a philosophy of growth at any cost, the tide has turned for Chile's mining sector and the new name of the game is efficiency. As such, mining companies are increasingly demanding more from their equipment and from their equipment providers. "In Chile right now, the trend is to outsource any area that is not the core business so as to improve efficiency and reduce costs wherever possible," said Pablo Cruz, general manager of fleet management specialists, Empresas Relsa. It is no longer sufficient to simply sell machinery, equipment suppliers are now expected to provide optimization services, a range of tailored maintenance strategies and even investment consulting for their customers.

SKC Maquinarias, part of the Chilean SigdoKoppers conglomerate, is currently Chile's third largest equipment supplier and represents several leading brands including Volvo, Sandvik Mobile and Manitou. The company has carved itself out a substantial niche providing equipment solutions that specifically cater to the often-overlooked small and mid-size mines: "The larger equipment providers have to split their concentration between the large mining and the smaller operations, whose needs are often very different. In our experience it is difficult to achieve a good balance between these different requirements, and the larger providers tend to focus more on the big contracts and provide a lesser after-sales service to the smaller clients," said general manager, Marcial Larenas.

Given the growing role played by the small to mid-size operations, SKC Maquinarias is currently seeking to educate the market and bring the type of advanced maintenance services demanded by the major miners to the mid-size producers.

This focus on controlling costs does not, however, imply that miners are simply looking for the cheapest products on the market: "Unlike customers in certain industries, mining clients are definitely prepared to pay for quality. Their primary concern is not the initial outlay itself, but the promise of operational security. Through our products we offer miners the confidence that their processes will not be disrupted by unscheduled maintenance and lengthy downtime," said Ignacio Sanchez D., general manager for fresh water transport specialists, Bermad Andina.

This trait goes some way towards explaining why equipment providers that specialize in extremely basic, low-cost machinery have struggled to gain traction in the market. •

Andrés Osorio

Commercial Manager
STM

Could you explain the relationship that STM has with Edyce?

STM has its roots in another Chilean company, Edyce, which works in the design and construction of steel structures for various industries. About 40 years ago one part of Edyce'sengineering team began working on more complex projects for the mining sector and gradually developed a particular expertise in bulk handling solutions. This unit split from the parent company in April 2004 and STM was born. Today we are an independent company with different owners and a separate management structure, but our focus remains the design and supply of bulk handling solutions. STM works primarily with the mining industry but we also have a partnership with a Spanish firm to carry out projects in other sectors such as pulp and paper and cement handling.

STM's business is split into two units: Investment Projects and Terrain Solutions. What are the different roles of each unit?

Our Investment Projects unit installs new transports systems in both greenfield and brownfield projects.To give an example, last year we were subcontracted by Bechtel to design 10 conveyor belts for the new plant at Xstrata's Antapaccay mine in Peru. Although there was already an operational mine at the site, the plant itself was new so we classify this as an investment project.Our involvement in this type of large project usually extends from the detailed engineering to the delivery of the equipment. On the other hand, our Terrain Solutions unit works on smaller projects such as the expansion or re-routing of an existing conveyor belt. In this area STM can offer a turnkey solution, working with the client from conceptual engineering phaseto construction.Until last year, Investment Projects constituted 90% of our total sales but now so many of the large projects are on hold, and the balance will shift. Given that miners are looking to optimize their existing infrastructure and boost productivity at their sites, Terrain solutions will constitute closer to 40% of our business in 2014.

STM has built up considerable experience developing projects outside of Chile. What is the relative importance of overseas contracts to the company?

The balance between working in Chile and abroad depends on how the market is moving. In 2010, we worked exclusively outside of Chile: we delivered 10 conveyor belts for the Antapaccay mine in Peru, 31 pieces of equipment for the Pascua-Lama plant in Argentina and several belts for Minera Dolores in Mexico. Over the years we have also worked extensively with foreign EPC firms such as SNC Lavalin and Bechtel to produce detailed engineering for projects in a wide range of countries including Brazil and Iceland. We continue to look outside of Chile for opportunities and are currently providing 10 belt feeders for a uranium extraction project in Niger, but the home market remains important. We are currently working with Codelco's Salvador division and providing several belts for the expansion of El Teniente.

What kind of after-sales care does STM offer to its clients?

The most common time for problems to arise with a transport system is in the first two years after it is installed, so we offer close contact and support during this period. We are always on hand to provide spare parts and expert advice. STM does not provide maintenance services, but whenever we install a new system we train our clients' mechanics so that they can keep it in optimal working form.

It is becoming vital to have the latest technology available. How does STM stay ahead of new developments in the engineering field?

Two years ago, we conducted extensive research to ascertain what software our clients and competitors were using. Wethen changedour programs for calculating values for our transport systems and introduced new simulation programs. The most problematic parts of any transporter system are the transfer points, and this software has allowed us to more accurately model different designs, reduce loss and combat wear.

There seems to be two distinct approaches to project management in Chile: either a large EPC firm oversees everything or the mining house contracts a variety of different specialists. Which approach is more successful?

This tendency for one large EPC contractor to manage all aspects of a project is something that emerged in the early 2000s, when companies such as FLSmidth and Sandvik began taking over smaller engineering companies and increasing their specialist knowledge base. This approach gives the client an overarching guarantee for his project, but it is unclear if it saves time and cuts costs. In the long term I believe we will see a return to the old way of doing things, with a variety of specialized contractors working together because it is more efficient.

STM's main competition comes in the form of large, diversified engineering houses with a multinational footprint. How have you been able to remain competitive?

Our primary advantages are the flexibility that our size permits and our location in Chile, which allows us to remain close to the majority of our clients. This is critical during the basic engineering stages, when it is often necessary to introduce design changes. It is possible to stay in contact through video links and email, but there is no substitute for physical proximity. •

Marcial Larenas

General Manager
SKC MAQUINARIAS

Could you provide us with some background information on SKC Maquinarias and its relationship to the SigdoKoppers group?

SKC Maquinarias (SKCM) is part of the Chilean SigdoKoppers group, which was founded over 30 years ago to provide services in the area of large-scale industrial engineering and construction. Today the group is concentrated in three areas: commercial, engineering and investment projects. After the group was floated on the stock market in 2005, some important structural changes were implemented, and it began to focus particularly on the mining industry. The commercial area is comprised of two branches: SKBergé, which deals in cars, and SKC, which controls six companies that provide heavy vehicles for industry, trucks, and other equipment supplies.One of these companies is SKC Maquinarias. Mining constitutes around 50% of SKCM's total revenues, with the remainder coming from forestry and construction. Within mining, our focus is on small to mid-sized mines, sowe do not currently sell the very large trucks and excavators used in the biggest mines, however we can provide vehicles for both open pit and underground operations.We represent leading brands including Volvo, Manitou, Toyota, Sandvik Mobile,Timberpro and Waratah.Looking just at the mining industry, we have over 1,500 units operating in the field today. This year the whole SKC group will invoice some $500 million, of which SKC Maquinarias will contribute approximately $140 million.

Could you give us some information about your customer profile?

We work with many of the main mining companies, such as Codelco and Collahuasi, through contractors that are involved in construction or earth moving. However, in terms of direct production, we also work extensively with some of the most important mid-sized mining firms, such as Punta del Cobre, MineraCarola andMinera Cerro Colorado. If you look not only at production activity, but also at the whole mining sector including support services, SKC Maquinarias is the third largest equipment provider in Chile. In some particular applications, such as articulated dump trucks we are actually in first position.

What type of extra services do you provide to your customers?

Customer support is a crucial factor in our philosophy and we recognize that it is not enough to simply provide a machine to a customer. There needs to be a strong support system in place to ensure availability if a problem arises, and to achieve this we have 295 employees distributed around 10 branches throughout the country. Over 60% of our employeesare service technicians dedicated to working on maintenance both in the field and in our branches. Over the past three years we have invested more than $20 million in building new branches in Copiapó, Calama and Iquique with high-level facilities, and we are also updating our Antofagasta branch.

We offer various levels of maintenance contracts to our clients depending on their individual needs. If we sell a large fleet to a customer then we will actually send people to the mine site to train their operators and advise their maintenance staff, and ensure a minimum level of downtime for the machines. Unlike in large mining operations it is not so common in smaller mines for the equipment provider to offer a full maintenance service, so we are currently educating the market on the advantages of this type of service.

What is the balance between selling entire fleets versus individual pieces of equipment?

Most of the medium sized operations prefer to acquire whole fleets from us, buying up to 20 units at a time. We also have agreements with many of these customers whereby we replace their fleet with new equipment after a certain number of hours, which usually translates into a complete upgrade every two and a half years. These packages constitute the majority of our sales but other customers, particularly contractors, are sometimes interested in buying just one or two units, and we are able to cater to their needs as well.

What are the main qualities that have led SKC Maquinarias to achieve such effective market penetration against competition from very strong multinational players?

One of the main strengths we have is our clear focus on mid sized miners. The larger equipment providers have to split their concentration between the large mining and the smaller operations, whose needs are often very different.In our experience it is difficult to achieve a good balance between these different requirements, and the larger providers tend to focus more on the big contracts and provide a lesser after-sales service to the smaller clients. However, our strength goes beyond the level of maintenance services we offer. We work together with our customers to help them make the best possible investment for their business. Before making a sale, we carry out a study of the customer's operations in order to discern exactly the right equipment solution they need. The brands we represent are also a differential for the company. Volvo, for example is far ahead of the competition in terms of environmental impact and safety;they are also committed to improving standards for operators, which in turn helps to boost productivity for the operation as a whole.Since the second half of 2012 Volvo has introduced telemetry systems to its machines and has developed a simulator for their wheel loaders and articulated trucks, which is a useful tool for training operators.

Could you give us some words about your vision for the future of the company?

At SKC Maquinariaswe are going to continue fighting hard and we aim to become the second biggest equipment provider in Chile. We are not focused on just one brand, and want to see all our products. We believe that if we continue to build on our reputation as a serious company with excellent service, backed by strong international brands we will be able to grow much larger, and one day become the largest provider in the country. This will not be an easy battle, but we know we are on the right track and will continue to provide an excellent service to our clients, owners and the brands we represent. •

Global Business Reports

Industry Explorations

Into the Future: Final Thoughts, Company Guide, and Index

"We are optimistic about the future, Chile still boasts an enormous quantity of high quality mineral resources to be explored and exploited, and there is a very large investment portfolio slated for development in mining over the coming years. Nevertheless, the country as a whole faces severe challenges in terms of securing adequate energy and water resources, which must be addressed in order for the industry to reach its full potential."

- Dagmar Jara Seguel,
Mining Division Manager,
Intertek

Image: Shutterstock

Chile has a reputation for being a difficult country to work in because of its mountainous terrain, and whilst it is true that some of the mines are located at high altitudes, not all of them present arduous conditions. When you get above 3,000 meters, the situation becomes more challenging and in order to work at these sites all personnel must take medical tests to certify that they are fit enough to deal with the elements. Also, the way in which mining shifts are organized has adapted to make life easier: before most workers would work for two weeks and then take one week off, but now it is more usual to work for 10 days and take 10 days off.

- Ivan Luksic, General Manager,
Captagua

EECOL's different divisions can help to improve efficiency and reduce costs in a variety of different ways. Our power quality division can identify if a consumer has problems with their power factor and then suggest ways of curing this problem by installing harmonic filters or other power factor correction tools, which will improve power quality and bring a wide range of savings. We can also help to lower costs by using the most modern and most efficient components: to give you one example, we stock a range of fluorescent lighting that gives out 45% more light than a conventional bulb, whilst still using the same power. Another way that we can help in this area is through our motor control division, which is able to control motors of up to 60,000 brake horsepower. By developing the highest possible level of control for a motor, you can always run it at its optimum speed and therefore increase efficiency, reduce maintenance and eliminate downtime.

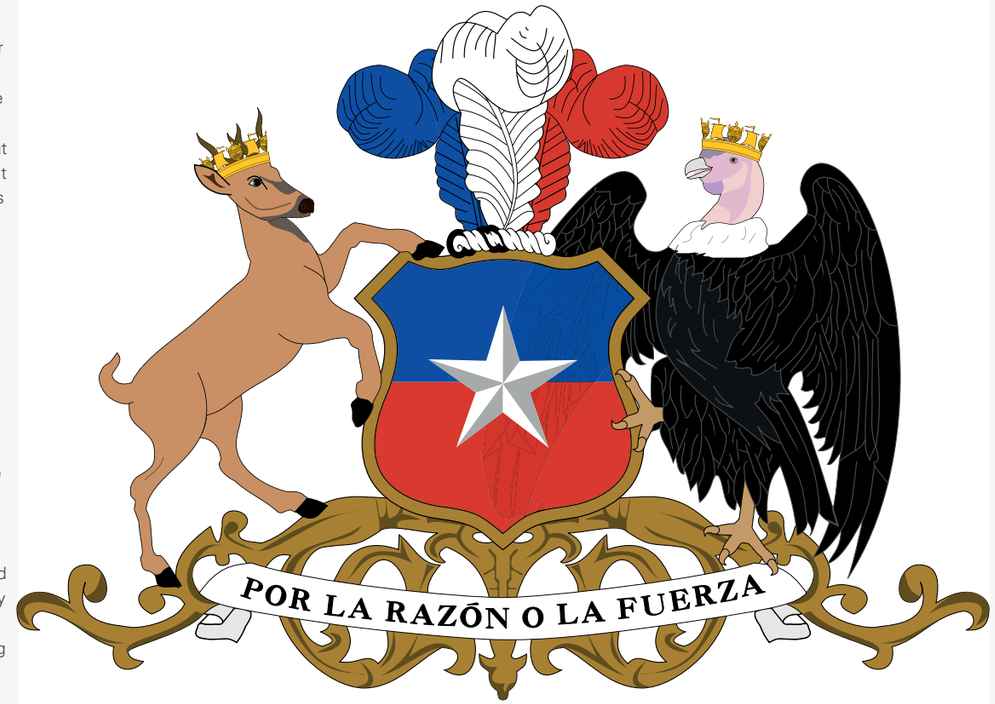
- Erwin Conn, Regional Manager,
EECOL

On the other side of the coin we have brownfield projects. All of these have already made their major investments and are running at a cash cost of between $1.20 per pound and $3.00 per pound, so they are still profitable, but in a time of falling prices they must become more productive to maintain the same margins. The most effective method of achieving this is by increasing the overall tonnage moved in the mine, and it is in this area that Finning is able to offer a range of services. For the next few years the name of the game will be efficiency, not growth, and we expect to see a lot of demand for equipment replacement and optimization, maintenance optimization and investment consulting. Needless to say, it is very difficult to deliver increased efficiency to your clients if you are not running your business in an efficient manner too, so to this end we will be streamlining our own business and seeking to boost productivity where possible.

- Juan Antonio Winter, Vice President for Mining,
Finning

We are extremely optimistic about the future of the company in Latin America. In Brazil we already have four projects lined up in deposition and re-mining, and in Peru we are busy with a project for Minsur and a proposal for Golder Associates, as well as early stage negotiations with several other clients. We will build on the reputation that we have as a company with very high standards of safety, and quality in the services that we offer to our clients. The mining sector is a world of constant change and so it is necessary to continue innovating and adapting in order to meet the demands of the whole sector. Our cutting edge technologies puts us in an advantageous position to stay ahead of the market and to deliver solutions to our clients that no other company is capable of providing.

- Luis Avalos Cespedes, Superintendent of Administration,
Fraser Alexander



Global Business Reports

Industry Explorations

Whilst laser mapping is a very effective system in certain circumstances, GroundProbe's slope stability radar (SSR) system has one clear advantage: deployment time. Whereas with a laser system you must first take the time to place reflective prisms around the monitoring area, the SSR can simply be placed in front of the wall and turned on. There is no need for a topographical study or any geo-referencing process; it is as simple as point and click. Furthermore, GroundProbe's products can cover a much wider area than our competitors and provide images of a much higher resolution, all of which is of key importance to delivering the best possible results and avoiding accidents.

- Andrea Magro, Business Manager for South America,
GroundProbe

The predominant role of brownfield expansions will definitely present a new range of opportunities for Outotec to support its clients, and we are well prepared to provide services in this area. Several mines such as Codelco's Andina and El Teniente will be requiring new concentrators, which is a niche that we have a high level of expertise in. Another important aspect of the new investments is in minimizing energy requirements for processes as electricity prices are rising and grades are falling, so we are always seeking out new ways to make our equipment more efficient. Building on this, there is also the possibility of gaining energy from certain processes such as acid processing plants, all of which means that we can add value to our clients existing operations.

- Carlos Freese Z., Smelting Solutions Sales Manager,
Outotec Chile

Innovation is a key focus for Kala and for the whole Master Drilling group, and this innovation is always geared towards minimizing the interaction between man and machine to make the whole process as safe as possible. To give you an example, we are now working on self-transporting rigs. Normally, underground scoops carry the equipment, but we are currently developing a system with caterpillar tracks that can be operated remotely from up to 50 meters away. This constitutes a great leap forward in operator safety and we expect it to be ready for deployment by November 2013. Another area we are concentrating on is automating the loading process for the drill rods, which will again guarantee a higher level of safety for the operating team.

- Camilo Salinas, General Manager,
Kala/Master Drilling

Mainstream is currently developing seven projects in Chile, which will provide a total output of 3,300 MW. Of this total generation capacity, approximately one third will supply the Interconnected Northern System (SING) with the remaining two thirds going into the SIC. Roughly 60% of the projects are in wind power, and the other 40% are solar plants. The first 600 megawatts (MW) of our projects are already in an advanced stage, and recently we announced a joint venture with an English investment fund, Actis, which has guaranteed the necessary capital for development. We hope to have this first round of projects in operation within the next four years. In fact, the first 33 MW of our capacity is already in construction in Los Angeles, in Chile's eighth region, and will come online in November 2013.

- José Ignacio Escobar, General Manager,
Mainstream Renewable Power

This list contains those companies interviewed during the course of research for this publication and as such represents only a selection of the companies operating in the mining industry of Chile. It should not be considered a comprehensive guide. GBR holds an exclusive and extensive mining database for Chile and the wider region. For further information on database access packages, please contact info@gbreports.com or call +44 20 7612 4511.

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