accenture

consulting | technology | outsourcing

Achieving high performance for mining in 2020

Six strategies for safe, sustainable and superior operations

High performance. Delivered.

Despite short-term volatility, strong demand for mining commodities is anticipated over the long term. Economic growth and increasing urbanization—particularly in India and China—are driving demand, which requires extensive infrastructure investment and access to mineral resources. This strong up cycle, along with continued economic uncertainty and cost pressures, will drive miners to be more selective about their investments and to improve cost management.

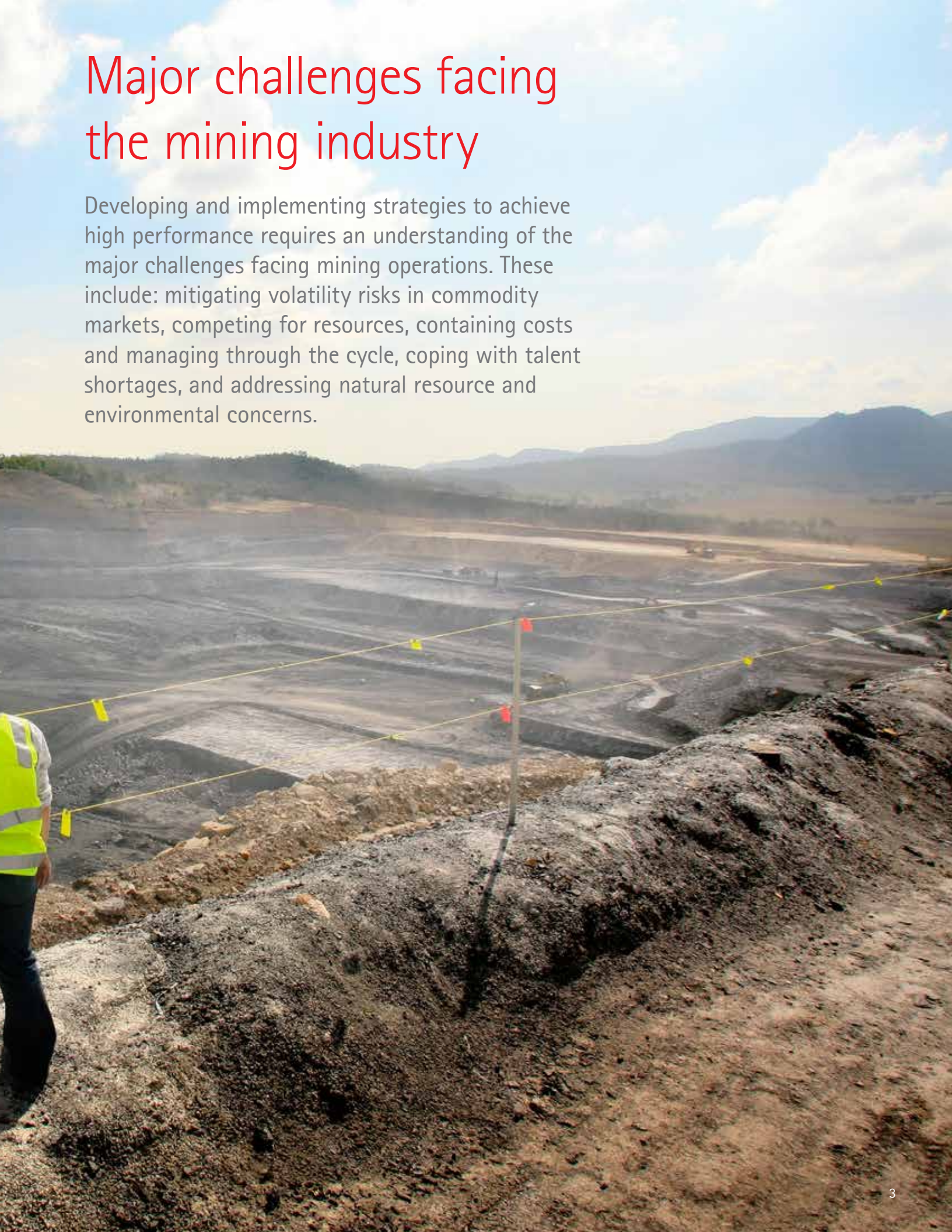
Competition in the mining industry will remain fierce for asset rights, people and capital, as will pressure for improved safety and sustainability. Mining businesses looking to achieve high performance will need to successfully execute six strategies:

1. Run an agile, global business.
2. Become the developer of choice.
3. Excel at innovating end-to-end mining processes.
4. Earn a reputation as an employer of choice.
5. Take the lead as an effective user and allocator of capital.
6. Develop fully integrated commercial and trading capabilities.

Safety and sustainability will be recurring themes within many of these strategies as industry leaders move toward 2020.

Major challenges facing the mining industry

Developing and implementing strategies to achieve high performance requires an understanding of the major challenges facing mining operations. These include: mitigating volatility risks in commodity markets, competing for resources, containing costs and managing through the cycle, coping with talent shortages, and addressing natural resource and environmental concerns.



Mitigating volatility in commodity markets

Measured by the change in standard deviation relative to price, the volatility of major commodities between 2001 and 2010 increased greatly—on average by 4.1 times—compared to the prior decade (see Figure 1). This trend looks set to continue.

There are many reasons for the increasing volatility. Lackluster equity markets encouraged investors to look to commodities. Additionally, pricing terms have been moving from business-to-business transactions to shipped commodity prices based on published price references. Volatility tends to increase with greater price transparency enabled by publishing quotations. The high flow of funds associated with financial trades has also added to volatility.

Price movements are tied increasingly to global events. The geographical broadening of markets and the entry of emerging market players have increased risk exposure. Leaner inventories and just-in-time deliveries have unintentionally decreased price buffers. In iron ore, the annual benchmark price has been replaced with a quarterly system linked to spot prices. With such a system, producers aim to reap the benefits of the upper spot price rather than being constrained by annual contracts.

Some large miners have reduced the risk of concentrated volatility by diversifying across mineral types and geographies. Because prices in base metals have been closely tied in recent years, however, results have been limited. Managing volatility through portfolio diversification has also been attempted through mergers and acquisitions (M&A), but results have fallen short due to uncoordinated strategies.

Any market that presents the best available liquidity pool—for example, downstream metals futures, iron ore or coal swaps in most miners' cases—should be considered as a means of protecting future earnings.

Containing costs and managing through the cycle

Long-term success in mining requires leaders to contain cost increases and to manage through the cycle, scaling up for growth and ramping down during short-term dips in demand and pricing. Leaders who position themselves in the lower quartile of the industry's cost curve gain competitive advantage regardless of the stage of the cycle—boom or bust.

In the past, ad hoc cost reductions yielded relatively minor savings that were difficult to sustain. Efforts to control costs, particularly during short-term down cycles, will become more intense leading up to 2020. Mining costs, which rose by 32 percent between 2003 and 2010, are expected to rise another 40 percent or more in the next 10 years.[1] [2]

A substantial proportion of mineral production costs are linked to energy. Energy costs are estimated at more than 15 percent of the total cost of mining production in the United States.[3] Electricity prices are rising in most countries—up 20 to 25 percent on average.[4] Additionally, power supplies at many sites are unreliable due to aging infrastructures and lack of planning. In South Africa, for example, miners are coping with a mandatory 10 percent cut in electricity usage due to a lack of national energy planning.[5]

Despite short-term volatility, operational costs are increasing, partly due to lower grades and because more mining is moving underground. Due to the discovery of fewer surface deposits, companies are digging deeper. Freeport's Grasberg mine, for example, is scheduled to cease open-pit operations and move underground in 2015.[6]

If commodity price levels return to historic heights, new territories will become more attractive, such as the ocean floor. In January 2011, Toronto-listed Nautilus Minerals Inc. secured a lease from the government of Papua New Guinea to develop the Solwara mine 1,600 meters underwater in the Bismarck Sea. Solwara has an estimated 74,000 tons of copper and 166,000 ounces of proven gold reserves.[7] Brazil has also been prospecting underwater. Some adventurers are looking to mine in outer space.

Governments are also increasing levies—export taxes, value-added taxes, taxes on profits and mining royalties—all of which put further strain on the bottom line. Additionally, even though the mining industry produces only 3 percent of global emissions of carbon, it has attracted increased attention from regulators.[8] Australia's Clean Energy Future policy, for example, proposes a broad-based carbon price as of July 2012.[9] The impact of carbon taxes on production costs at some mines are significant. Cash costs are estimated to increase by 28 percent at the Palabora mine in South Africa and by 21 percent for the Zaldiuvar mine in Chile.[10]

Competing for resources

The issue all industry players face is competition for, and access to, increasingly scarce minerals and other mining inputs, such as labor and equipment. Despite short-term volatility, the demand for mined commodities such as iron ore, steam coal and copper are destined to rise as long as rapidly growing economies track the trajectories of economic development (see Figure 2).

China exemplifies the point. At the end of 2011, slightly more than half of China's population resided in urban areas.[11] This share is expected to continue to rise, boosting spending on infrastructure, transport, energy and durable goods, thereby increasing demand for mined commodities. China increased its iron ore imports by 22.2 percent per year during the past decade, reaching 687 million tons in 2011.[12]

Figure 1. Market volatility is on the rise.

	Standard deviation relative to price		Multiple increase in relative standard deviation
	1990 to 1999	2000 to 2010	1990s vs. 2000s
Coal, Australian	14%	58%	4.1
Aluminum	15%	27%	1.7
Copper	20%	59%	3.0
Lead	22%	66%	3.0
Tin	8%	58%	7.0
Nickel	22%	61%	2.8
Zinc	17%	56%	3.2
Gold	11%	53%	4.7
Silver	13%	56%	4.3
Iron ore	8%	58%	7.1

Source: Accenture Research analysis of World Bank data.

Figure 2. Demand for minerals is forecast to grow through 2020.

Commodity	Unit	2010	2011	2012	2015	2020	CAGR (2010-2020)
Copper	kt	19,220	19,890	20,190	22,815	27,068	3.5%
Aluminum	kt	40,900	45,200	48,000	59,200	82,465	7.3%
Zinc	kt	12,030	12,760	13,400	15,000	17,752	4.0%
Nickel	kt	1,494	1,595	1,693	1,940	2,430	5.0%
Iron Ore	mmt	1,025	1,090	1,145	1,401	1,919	6.5%
Met Coal	mmt	266	256	281	320	374	3.5%
Thermal Coal	mmt	713	774	810	919	1,136	4.8%
Gold	t	4,261	4,090	4,324	4,188	4,274	0.0%

Notes
1. The consumption forecast for iron ore and coal is in seaborne demand. Historically seaborne demand for iron ore has been approximately 40 percent of the total global demand for the commodity.
2. Kt = kiloton; mmt = million metric ton; t = ton.

Sources: Macquaire Report[13], Oxford Economics and Accenture analysis.

Yet, the discovery of world-class greenfield deposits has fallen substantially since the late 1980s. Since it can take up to 10 years to develop a new mining operation, the industry will be slow to develop replacements for major operations, such as the Escondida copper mine in Chile and the Grasberg gold and copper mine in Indonesia.

Coping with talent shortages

Replenishing the workforce with qualified talent will remain an immense challenge. High rates of turnover erode consistency and quality, and undermine execution of long-term programs to improve performance.

Lack of manpower is affecting miners' ability to execute their capital projects. Barrick recently announced the cost of its Pascua-Lama project jumped from $3.6 billion to $5 billion due to labor costs.[14]

The aging workforce limits the industry's ability to satisfy global demand. It is not unusual to encounter retirees—in their 60s, 70s, even 80s—called back to work. Australia illustrates the challenge: The median age in mining in Western Australia is 38 years, with more than half of workers in the 24 to 54 age range.[15]

The Canadian Mining Industry Human Resource Council estimates that more than a third of the industry (61,000 to 71,000 workers) may retire in the next 10 years. The council estimates that the industry will need more than 140,000 new hires by 2021 if growth continues to accelerate.[16]

At the same time, graduate enrollment in mining engineering has been dwindling. A survey by the National Center of Education Statistics in the United States, for example, shows a 41 percent decline in graduate mining enrollments from 1995 to 2007.[17] In South Africa, with chronically high levels of unemployment, fewer people are registering for mining degrees.[18]

Global perceptions of the industry are low for a number of reasons, including lifestyle choices of skilled workers and reaction to safety and environmental reports. Difficulty in balancing career demands with personal relationships and balancing work with parenting commitments come up as the most negative aspects of working in the industry.[19]

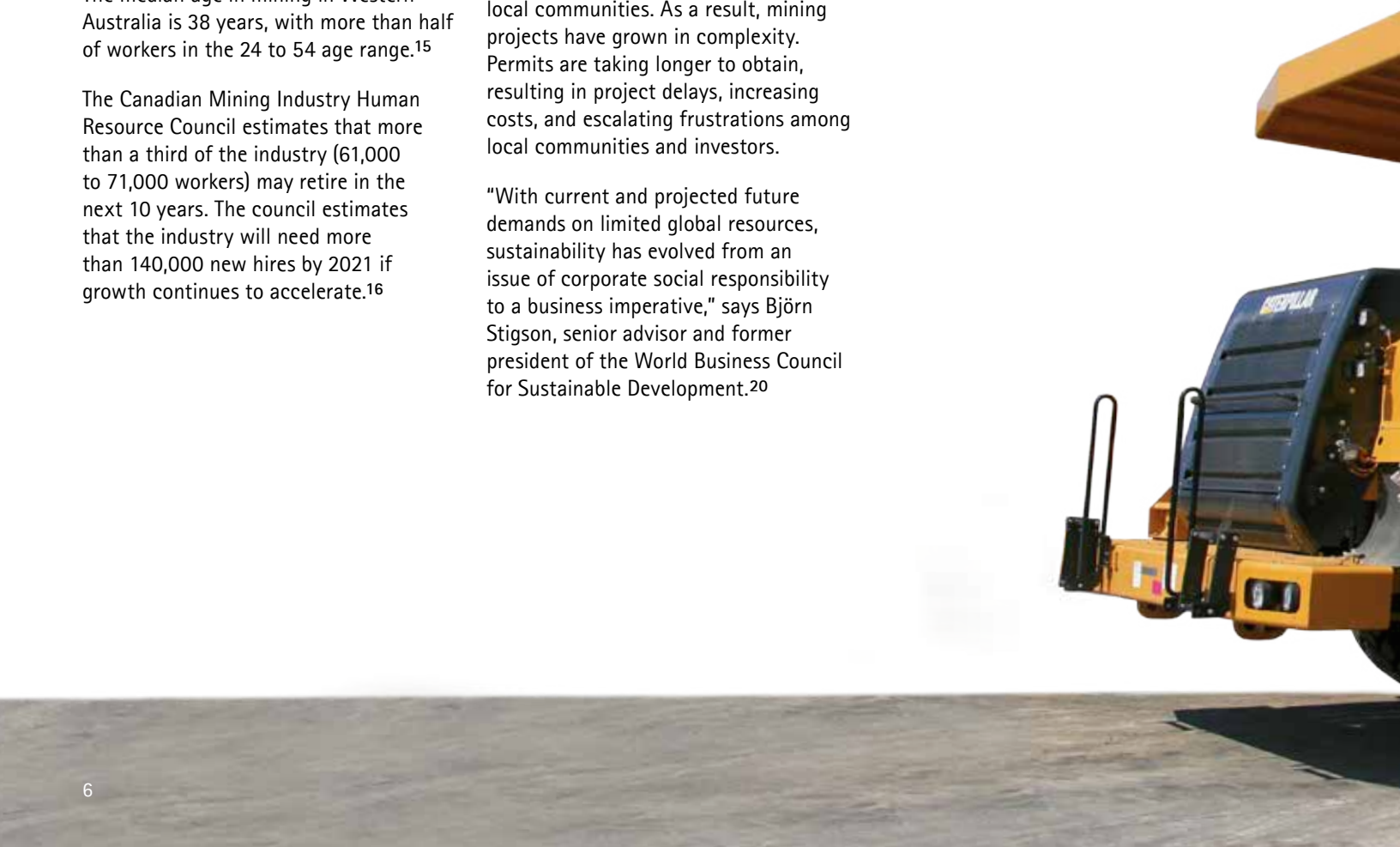
Addressing environmental concerns

"License to operate" is under scrutiny as countries emphasize the environment, health and safety. Nongovernmental organizations, as well as socially conscious stakeholders and governments, are advocating stronger social rights for local communities. As a result, mining projects have grown in complexity. Permits are taking longer to obtain, resulting in project delays, increasing costs, and escalating frustrations among local communities and investors.

"With current and projected future demands on limited global resources, sustainability has evolved from an issue of corporate social responsibility to a business imperative," says Björn Stigson, senior advisor and former president of the World Business Council for Sustainable Development.[20]

Concerns about water availability are growing. If present trends continue, nearly half the world's inhabitants will reside in areas of acute water shortage by 2030.[21] Virtually every mine seems to have water-related issues—too much or too little.

Aspects of rehabilitation and mine closure, along with costs of contributing to the economic development of districts in which mines operate, are important long-term issues.



Six strategies for high performance

Given these challenges, Accenture believes superior execution of six strategies will help mining companies achieve high performance. To excel, companies should: run an agile, global business; become the developer of choice; excel at innovating end-to-end mining processes; earn a reputation as an employer of choice; take the lead as an effective user and allocator of capital; and develop fully integrated trading capabilities.

1. Run an agile, global business.

Scaling operations and expanding geographic coverage can help mining companies fulfill global demand for minerals. The challenge is finding an optimal balance between global and local control to enable safe, sustainable mining and improve overall financial performance.

Companies wishing to expand their footprint but lacking global structure will need an effective operating model to compete profitably outside their home region. The major mining companies have operated globally for decades, but complexities arise due to merger integration and increasingly remote operations.

The debate over centralized versus decentralized management misses the mark. Ideally, a global operating model provides for consistency while enabling flexibility at local levels. Companies need common approaches to realize synergy, and to improve controls, efficiency and visibility throughout the enterprise. The bottom line: Companies must deliver value beyond the worth of their individual assets.

Accenture believes mining companies can improve their global effectiveness by harmonizing select measures in three broad areas: operational processes that cover core mining and support services, management processes for corporate and governance activities, and leadership and culture processes, which include organizational and people elements.

The scale of global companies, coupled with advances in information technology creates opportunities to share leading practices, boost output and control costs. As costs are shared globally, promising opportunities lie in automation (see strategy No.3 for more detail) and industrial IT. Opportunities also abound in pursuing excellence in operations, maintenance, supply chain management and business support.

Standardizing roughly 80 percent of business processes, for example, can promote global consistency while allowing for variations in commodity and country requirements. BHP Billiton, Vale and Rio Tinto have developed global business process models, along with enterprise resource planning systems and shared service organizations.[22] As a result, these companies are strengthening controls and gaining greater visibility across operations and geographies. However, mining companies in general lag behind their upstream energy peers in leveraging the power of global synergy while achieving local differentiation where it adds value.

Companies in other industries pioneered global business-services models by integrating stand-alone services into multitowered service organizations; the result is end-to-end support. These models are applicable for core mining activities, such as mine planning and customer order management, pricing and risk management.

Experiences from other industries also indicate global models need refinement as business conditions change. Consequently, to avoid remaining static while others move forward, senior mining executives need to revisit their operating models. The leaders will be those who have mastered the management of global organizations for safety, efficiency and sustainable growth.

2. Become the developer of choice.

To extract valuable resources throughout the world, mining companies should convince governments they are the developer of choice. Companies should demonstrate an understanding of local cultures and anticipate a broad range of safety, health, environmental and community issues.

One of the biggest issues, sustainability, is not only a Western preoccupation. Asian chief executive officers, from China to Singapore to India, are intent on closing the gap with industry veterans. China, for example, is seeking global leadership in several areas of clean technology. "The material aspects of sustainability give a big competitive advantage to corporations that have long practiced and built up competencies at the strategic and operational level," notes Georg Kell, UN Global Compact executive director.[23]

Leading companies will standardize processes for the Global Reporting Initiative™ (GRI), which encourages disclosure of environmental and social factors.[24] Along with GRI metrics, sustainability requires good corporate governance. Whereas sustainability had been separate from growth planning, leaders will include it in scenario planning and long-term strategic planning. Some companies will link executive remuneration to sustainability objectives.

Industry leaders need to develop holistic, country-facing strategies that cover infrastructure, social investment and other issues. Environmental, health and safety operators need to balance multiple factors: production optimization, preservation of ecosystems, safeguarding health and safety, and addressing socioeconomic needs.[25]

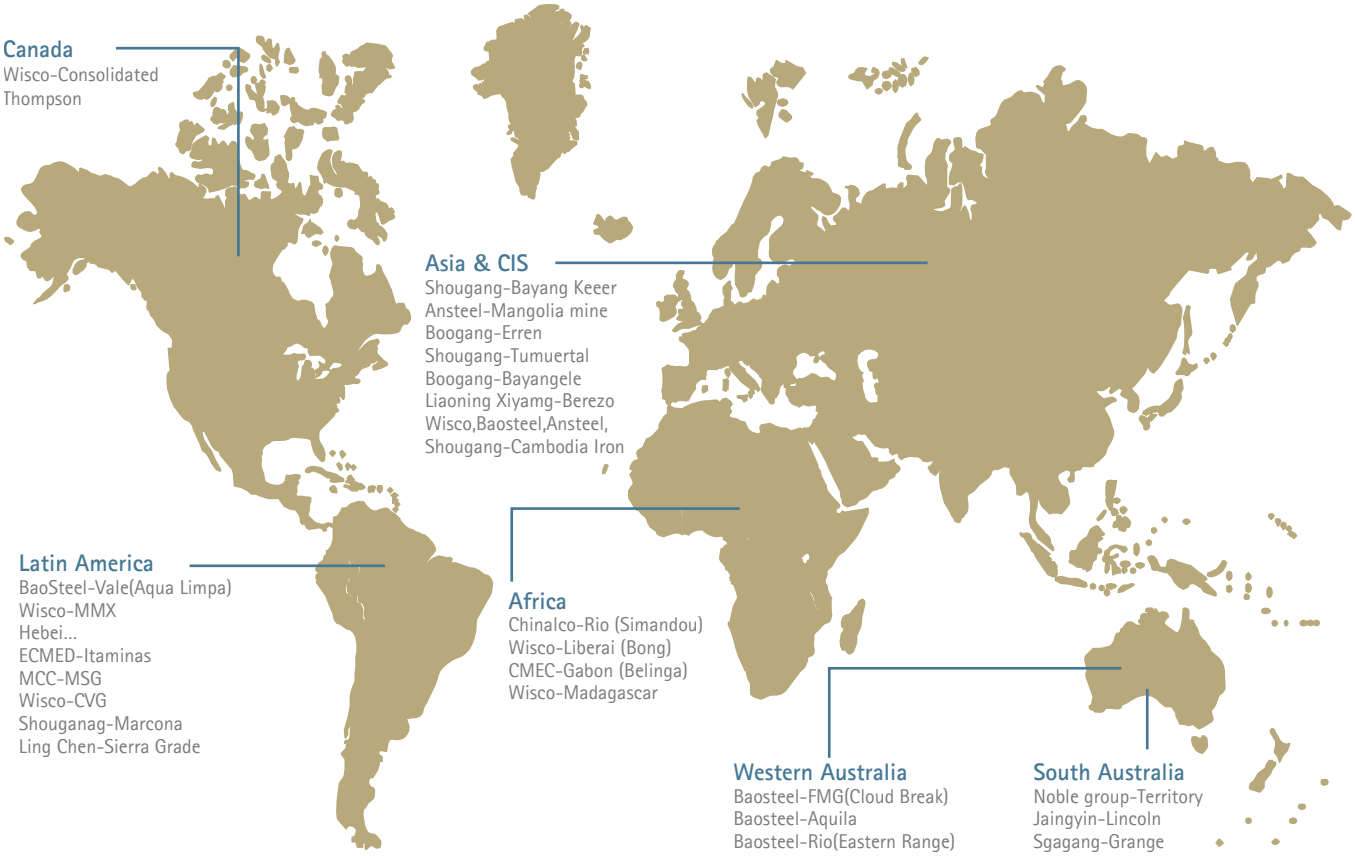
From 2005 to January 2012, Chinese companies have bid on nearly 579 projects throughout the world (see Figure 3), successfully closing 52 percent.[26] China has vast capital, but country leaders worldwide are also looking for ways to improve infrastructure, boost local employment and transfer skills. In return for copper and cobalt concessions, for example, Export-Import Bank of China pledged a nearly $9 billion loan to build and upgrade 4,000 kilometers of roads and 3,200 kilometers of rails for the Democratic Republic of Congo's mining sector.[27]

To build a reputation as a trusted developer, however, mining companies will need to provide more than capital. High-performance organizations grasp the full range of issues: risk and compliance management, efficient use of energy and water, as well as innovation in areas such as green supply chains, and transferring skills to local workers. They will maintain continuity in relationships to gain permission and access to develop local resources. The leaders in 2020 will also be able to manage the rising expectations of governments that rely on taxes obtained from mining production and exports.

Mining has traditionally been a hazardous profession, and the degree to which companies can prove they are reducing the risk of loss of life is especially important.

Figure 3. Chinese companies are expanding operations throughout the world.

Selected iron ore operations outside China with Chinese ownership



Top transactions by Chinese steel companies

Acquirer	Target	$m	Year
Chinalco	Rio-Tinto (Simandou)	1,300	2010
China Minmetal	Itaminas	1,220	2010
Hunan Valin	FMG	404	2009
Wuhan	MMX	400	2009
Wisco	Consolidated	240	2009
Nanjinzhao	Pampa	200	2009
Delong	Mt. Anketelle	200	2008

Source: UNCTAD[28], Cap IQ

3. Excel at innovating end-to-end mining processes.

Miners have the opportunity to achieve major gains in productivity—and safety—through innovations in automation and industrial systems. Industry leaders will pursue advances in operational excellence, in particular, the productivity improvement from managing their supply chains from end to end.

The potential for combining lean production with selective automation is promising.[29] Solutions for remote operation centers and conditioned-based maintenance are maturing and proving their worth. Rio Tinto's West Angelas iron ore operation in Pilbara, Australia, is widely regarded as an example of the future of the mining industry. By building a sophisticated control center in Perth, roughly 1,500 kilometers from 14 mines, the company has improved controls, boosted productivity and had less difficulty attracting talent. Software enables machinery to be controlled from Perth.[30]

Rio plans to spend more than $500 million to introduce the first automated train in 2014, which is expected to help boost output 60 percent by the following year.[31] Overall employment, however, is not expected to decline. Automation is helping boost output and earnings by 26 percent, and the company hopes to lift production to more than 350 million tons by 2015.[32] [33]

Other companies are investing in research and development to take mining far beyond its traditional roots. The Centre for Process Monitoring, a collaborative venture between Stellenbosch University in South Africa and Anglo Platinum, supports automated monitoring and control of operations at Anglo Platinum plants.[34] Automated monitoring of operations will also serve as a basis for continuous improvement.

In Brazil, Vale has inaugurated a remote control system for port stockyard operations, now used at Ponta da Madeira Port Terminal in Maranhão and the Tubarão Complex in Espirito Santo. Vale has invested more than $3 billion in the past few years in science and technology to develop futuristic mining.[35] Using autonomous mining intelligently helps miners with one of their biggest challenges—attracting and retaining talent in remote areas.

Reinventing mining requires leadership on multiple fronts besides automation. Rising costs increase pressure for operational excellence—realizing greater productivity for equipment and labor. To improve results and control costs, companies will likely pursue supply chain excellence that covers inbound logistics as well as sourcing. High-performance organizations will also adopt a strategic approach to procurement, going beyond traditional relationships with suppliers to unlock greater cost efficiencies. Supply chain analytics will be tapped to identify improvement opportunities from "pit to port." Predictive analytics, for example, will help mining companies with vehicle and equipment maintenance. The most advanced miners will also aim for a more demand-driven, customer-focused fulfillment model to improve inventory management and delivery reliability, and to reduce exposure to price and exchange-rate shocks.

Leaders will fundamentally alter their cost-base structures from largely fixed to more variable, thereby addressing the challenge of cost control and managing through the cycle. Leading miners will also assess the advantages of hybrid models for shared services. Pioneered by other industries, these models call for selective outsourcing to leverage capabilities of experienced service providers.

4. Earn a reputation as an employer of choice.

Becoming an employer of choice covers many issues, including leading on the health and safety fronts, and convincing people they have promising futures in the mining industry. Accenture offers four talent strategies to attract and retain talent.[36]

The first is to differentiate the employee value proposition, or EVP. Stated simply, the EVP is "get" versus "give." When employees believe their compensation equals or exceeds the effort being putting forth, retention increases.

The second strategy is improved retention through engagement. Rio Tinto, for example, recognizes employees want more than pay. Rio Tinto therefore focuses on providing people with "challenging work and development." Another retention method is employee share participation. In South Africa, Kumba Iron Ore offers a share of dividends declared by Sishen Iron Ore Company. In 2011, Kumba workers were expected to receive a payout of ZAR2.3 billion.[37] Miners also need to appeal to the preferences of younger generations, including flexibility, and opportunities to travel and gain wider experience. Particularly at remote sites, improved conditions—including recreational facilities, subsidized housing and educational opportunities—can help to retain talent. Miners need to look at whether their vision is distinctive and attractive enough to the next generation.

The third strategy calls for effective collaboration and improved processes to develop and diversify talent. Next-generation portals designed around a worker's role are ideal for collaboration, knowledge management and learning. To tap into a more diverse talent pool, miners can design strategies to target specific demographic groups, such as women and students. For example, in Australia, Oz Minerals (Prominent Hill) collaborated with New South Wales Technical and Further Education Commission to recruit from local and indigenous communities.[38]

Mining organizations should understand country-specific priorities. For example, as part of an agreement reached in the Democratic Republic of Congo, national leaders insisted only one in five workers could be Chinese.[39] Leading mining companies are likely to partner with universities and technical schools, governments and nongovernmental organizations to develop local skills.

The fourth talent strategy involves automation and technology to optimize available talent and improve safety. Technology applications, such as use of autonomous equipment and three-dimensional modeling, have streamlined operations and reduced talent needs in the area of ore extraction.

5. Take the lead as an effective user and allocator of capital.

Increased capital spending is needed to implement growth strategies worldwide, and the industry has announced new expansions to meet rising global demand.[40] Most new mining projects are occurring in iron ore and coal in Australia and Brazil.

Large and complex undertakings need to be managed as businesses, not projects. Executives in charge must focus on the capital projects life cycle to reduce risk, improve return on investment and support timely delivery.[41]

Leaders will move beyond boom-bust thinking to allocate capital more effectively as global competition intensifies. The long timelines and hefty investments required for new mines call for strategic business management and experienced project designers.

Development in less wealthy countries is complex due to the need to improve infrastructure and logistics elements, or even build from scratch. Examples include Simandou in Guinea, Moatize in Mozambique and the Rio Tinto copper project in Mongolia. Advanced tools can help managers of these new businesses remain focused on critical steps, including planning for infrastructure in high-risk zones.

Securing capital to propel growth will be a challenge. The options include further M&A, along with financing from private equity, hedge funds and joint ventures. Some organizations will pursue acquisitions for greater growth, while some incumbents appear to have reached their limits. Companies such as Anglo American and BHP Billiton are unbundling noncore assets[42] to unlock greater shareholder value. Sovereign wealth funds represent another source of financing support.

Some areas to consider to more effectively use and allocate capital:

- The strategy of joining Chinese capital with Western excellence in sustainability and stakeholder management could become a formula for high performance. One innovative example of pooling risk and capital—with customers—is the proposed Vale and Pohang Iron and Steel Company (POSCO) coal mine in Mozambique.[43] [44]

- Integrated information systems will give leaders a stronger handle on the costs of mine development from region to region and among product groupings. This data can lead to leading practices, supplier rationalization and cost reduction as needed.

- The most recent commodity boom resulted in high utilization rates of equipment. Assuming equipment life between five and six years, an estimated one-third of miners' haul trucks need replacement.[45] Leading mining organizations will use analytics to anticipate maintenance needs and spend capital more precisely.

- Some organizations will optimize current assets, seek to boost recovery rates, focus on ore bodies nearer to existing operations and closely manage capital expenditures. Others will be bolder, venturing where others fear to tread, developing risk management into a competitive advantage.

In the scramble for minerals, those with access to capital, a greater appetite for risk and different risk-return models will gain substantial advantage. In some respects, the miners from emerging markets hold an edge, particularly the Chinese state-owned mining enterprises. But emerging economies will be looking for developers of choice, not always the one with the deepest pockets. Being flush with capital can mean companies become less careful in allocating it, which becomes particularly problematic in down cycles.

6. Develop fully integrated trading capabilities.

Regardless of the method used to manage volatility, active risk management is vital to protect the value of future mined output, and to address concerns for consistent performance. Fully integrated trading capabilities, which align policies and strategies for risk management and commodity trading, will enable companies to use real-time data to respond to pricing fluctuations on the spot market and improve profitability.

Leaders will adopt more rigorous forecasting capabilities, and some will manage price risk via hedging and active commodity risk management, which is key to core operations. They will develop skills and acquire tools to manage a daily set of commercially high-impact tasks. Deeper capabilities will extend to energy and currency and treasury-related exposures. When a severe dip occurs because of the factors previously discussed, companies with effective trading capabilities will be positioned to benefit.

Leaders will harmonize operations and reporting, along with increasing the efficiency of managing techniques for shared price risk management across markets. Advanced capabilities will enable high-performance organizations to encourage members of the financial and investment communities to reduce the severity of profitability swings.

Many established groups should continue developing fully integrated capabilities. For example, Billiton Marketing & Trading (now BHP Billiton) and Alcan Metal Management have existed for at least 20 years. Some companies have gained knowledge through alignment with investment partners whose role for the past 10 to 15 years has been akin to a global physical trader. Glencore and the Japanese Shosha represent examples of traders who have become mining or smelting asset owners. Compared to peers, Glencore is the largest commodity trader with an advanced trading arm, and is well-positioned to extend its competitive advantage through its proposed merger with Xstrata.

China drives two-thirds of the global seaborne market for iron ore, and spot market players—in raw materials and finished steel markets—are exerting major influence. To strengthen its pricing power the Chinese launched a physical iron-ore trading platform in January 2011.[46] [47]

To harmonize core systems and trading operations, mining leaders will integrate and enhance their hedging and trading operations through cross-fertilization of capabilities within the organization. Examples include large diversified mining and metals groups sharing skills from one vertical operating company to another.

As companies integrate multiple information systems, they will have a stronger command of what grade of ore, for example, is harvested from each site and which blend is best suited for a ship for transport. Leaders will link data about output with trading and the way markets are moving, enabling them to command more for different grades of ore. The companies that integrate their end-to-end value chain first will be better positioned to profit.

In pursuit of high performance for 2020

With new industry entrants and additional domestic players going global, the mining industry will see increasing competition for both mineral resources and human resources. Emerging economies are increasing their global exploration, making it increasingly likely that relative newcomers will challenge established leaders in more regions of the world.

To grow profitably, mining companies should understand the key challenges and excel at becoming agile, global businesses. An emphasis on sustainability and becoming a developer of choice will be essential to thrive globally—and also for attracting and retaining talent to fulfill the increasing demand for minerals.

Increasing productivity will be immensely important, and the most advanced techniques will deliver much more at the same or reduced cost, while keeping safety in mind. Industry leaders will be more disciplined in allocating capital. Integrated management of supply chains will allow significant productivity gains, and integrated trading capabilities will deliver a strong advantage for the first companies to put these systems to use.

To compete against fast-growing newcomers—particularly companies receiving state support—established players will need to focus intently on strategy, productivity and cost control. Execution capacity will be key. Traditional industry leaders will aim to become partners of choice to governments, suppliers, employees and joint-venture partners. Newly emerging mining organizations will need to develop global operating models and effective strategies for greater productivity and profitable growth. Virtually all companies will need to build stronger capabilities on multiple fronts, most especially in their ability to rapidly execute, enabling them to take full advantage of global growth and ways to optimize operations for high performance.

Reference

[1] Accenture Research based on Bloomberg operating costs data of top 4 companies based on their respective market capitalization.

[2] William MacNamara. "Alarming costs damp good times for miners." Financial Times, July 24, 2011.

[3] Anne McIvor, "The mining industry is a major energy user and mining companies are increasingly focusing on both energy efficiency measures and cost effective ways of generating power – including fuel cells". Cleantech, Sept/Oct 2010. www.cleantechinvestor.com.

[4] William G. Meister, "Cost Trends in Mining", Marston, www.marston.com.

[5] Agnieszka Flak, "S.Africa platinum miners not worried about power cuts," Reuters, January 13, 2012. http://www.factiva.com.

[6] Michael Taylor, "FACTBOX-Vital information on Freeport Indonesia," Reuters, December 13, 2011. http://global.factiva.com.

[7] Nautilus Minerals. "Solwara 1 Project – High Grade Copper and Gold." www.nautilusminerals.com.

[8] "Global mining drives world economy-CEO." The Citizen July 05, 2012. http://thecitizen.co.tz/.

[9] Department of Climate Change and Energy Efficiency, Government of Australia, "Securing a Clean Energy Future - the Australian government's Climate change plan." Clean Energy Future 2011, www.cleanenergyfuture.gov.au.

[10] M.J. Farrell, "Carbon emissions from base metal mine sites," Mine Cost, April 2009. www.minecost.com.

[11] "China's Total Population and Structural Changes in 2011," National Bureau of Statistics of China, January 20, 2012, www.stats.gov.cn.

[12] Accenture Research based on Global Trade Statistics. www.globaltradestatistics.com.

[13] "Commodities Compendium," Macquarie Commodities Research, Capital IQ, January 18, 2012.

[14] "Barrick Reports First Quarter 2012 Financial and Operating Results," Barrick, May 02, 2012, www.barrick.com.

[15] "Mining in WA: 2011 labour market overview," Department of Commerce 2011, Government of Western Australia. www.commerce.wa.gov.au.

[16] "2011 Employment and Hiring Forecasts," Mining Industry Human Resources Council, MIHR Innovate, August 2011, www.mihrinnovate.ca.

[17] Accenture Research based on National Science Foundation graduate student data. www.nsf.gov.

[18] "South Africa down to only 500 mining engineers – Gold Fields," Mining Weekly, December 2, 2010, ©Creamer Media Mining Weekly, www.miningweekly.com.

[19] Barclay, MA., & Zhang, T., "What Students Want Career Drivers, Expectations and Perceptions of Mining Engineering and Minerals Processing Students," Office for Women, Minerals Council of Australia and CSRM, March 2007, www.csrm.uq.edu.au/docs/student%20expectations%20300407.pdf.

[20] "The Sustainable Organization: The Chief Executive Officer's Perspective," Accenture, January 2012, www.accenture.com/us-en/Pages/insight-sustainable-organization-ceo-perspective.aspx.

[21] "New UN report warns of increasing pressures on water," United Nations Environment Programme, March 16, 2009, www.unep.org.

[22] "Global Operating Models for Mining Companies," Accenture, November 2010, www.accenture.com/us-en/pages/insight-global-operating-models-mining-companies-summary.aspx.

[23] "The Sustainable Organization: The Chief Executive Officer's Perspective," Accenture, January 2012, www.accenture.com/us-en/Pages/insight-sustainable-organization-ceo-perspective.aspx.

[24] Global Reporting Initiative™, www.globalreporting.org.

[25] "Environment, Health and Safety diagnosis in New Caledonia for a global mining company," Accenture, December 2011, www.accenture.com/us-en/blogs/reach/archive/2011/11/30/ehs-diagnosis-in-new-caledonia.aspx.

[26] Accenture Research based on CapIQ Mining M&A data (January 2012).

[27] "China in Africa – Strategic Overview", Institute of Developing Economies – Japan External Trade Organization, October 2009, www.ide.go.jp.

[28] "Iron Ore Market 2009-2011," United Nations Conference on Trade and Development, June 2010, http://r0.unctad.org/infocomm/Iron/Flyer_2010_English.PDF.

[29] "Using autonomous equipment to achieve high performance in the mining industry," Accenture, 2010, www.accenture.com/us-en/pages/insight-automated-equipment-mining-industry-summary.aspx.

[30] "Rio Tinto backs 'driverless' train plan," The Age, February 20, 2012, © John Fairfax Holdings Limited, http://global.factiva.com.

[31] "Rio to invest $518 million in driverless iron ore trains," Edmonton Journal, 23 February 2012, http://global.factiva.com.

[32] "Annual Report 2011." Rio Tinto http://www.riotinto.com/.

[33] "Rio Tinto plans world-first driverless rail network," Dow Jones News, February 20, 2012, http://global.factiva.com.

[34] University of Stellenbosch, Department of Process Engineering, Centre of Process Modelling. http://sun025.sun.ac.za/.

[35] "Vale invests in science and technology to develop the mining of the future," Plus Media Solutions Pakistan, October 24, 2011, http://global.factiva.com.

[36] "Staking a Claim: Four Talent Management Strategies for High Performance in the Mining Industry," Accenture, August 2011, www.accenture.com/us-en/Pages/insight-staking-claim-talent-management-strategies.aspx.

[37] "Kumba workers to get R2.3bn payout," MiningMX, August 08, 2011, www.miningmx.com/news/ferrous_metals/kumba-workers-to-get-R2.3bn-payout.htm.

[38] "Staking a Claim: Four Talent Management Strategies for High Performance in the Mining Industry," Accenture, August 2011, www.accenture.com/us-en/Pages/insight-staking-claim-talent-management-strategies.aspx.

[39] "China in Africa – Strategic Overview", Institute of Developing Economies – Japan External Trade Organization, October 2009, www.ide.go.jp.

[40] "Managing Capital Projects as a Business in Australia," Accenture, October 2011, www.accenture.com/us-en/outlook/pages/outlook-online-2011-managing-capital-projects-mining-energy-australia.aspx.

[41] "Managing Capital Projects as a Business in Australia," Accenture, October 2011, www.accenture.com/us-en/outlook/pages/outlook-online-2011-managing-capital-projects-mining-energy-australia.aspx.

[42] "BHP Billiton may do an Anglo American," MiningMX, December 8, 2011, www.miningmx.com/news/markets/BHP-Billiton-may-do-an-Anglo-American.htm.; "Anglo sells Scaw South Africa for $440 mln," Reuters News, April 2012, http://global.factiva.com.

[43] "Resources development rush boosts revenue, fund investment," The Korea Herald, May 23, 2011, http://global.factiva.com.

[44] "POSCO, Vale seek to develop coal mine in Mozambique," Reuters News, January 29 2011, http://global.factiva.com.

[45] "Mining Equipment Quarterly," Morgan Stanley Research, May 23, 2011, Capital IQ.

[46] "CBMX to launch physical iron ore trading platform in Dec.," Metal Bulletin, November 25, 2011, http://global.factiva.com.

[47] "Promising start for China iron ore trading platform," Reuters News, May 8, 2012, http://global.factiva.com.

Contact

Accenture's global mining group includes approximately 4,000 industry practitioners in all major mining regions, including North and South America, Europe, CIS, Australia and Asia (including China), who are deeply experienced in operating models, finance, supply chain, human capital and talent management, automation and industrial IT, enterprise systems (SAP) and shared services. Our global Center of Excellence in India is staffed with approximately 1,000 people dedicated to developing and supporting our mining industry solutions.

For more information, please contact:

Rachael Bartels
Global Mining Lead
+44 20-7844-4601
rachael.bartels@accenture.com

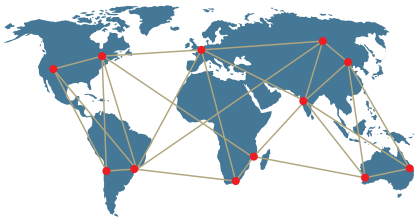
Rod Kerger
APAC Mining Lead
61 3-98387202
rodney.j.kerger@accenture.com

Duncan Sloan
Africa Mining Lead
+27 11-208-3077
duncan.m.sloan@accenture.com

Jose Suarez
North America Mining Lead
+1 416-641-3366
j.suarez@accenture.com

Miguel Zweig
Latin America Mining Lead
+55 11-5188-3297
miguel.d.zweig@accenture.com

Safe, sustainable, high performance mining from Accenture's Global Mining Centers of Excellence



About Accenture

Accenture is a global management consulting, technology services and outsourcing company, with more than 249,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. The company generated net revenues of US$25.5 billion for the fiscal year ended Aug. 31, 2011. Its home page is www.accenture.com.

If you have a QR reader installed on your smartphone, simply scan this code to be taken directly to the Accenture Mining page: www.accenture.com/mining

12-1337