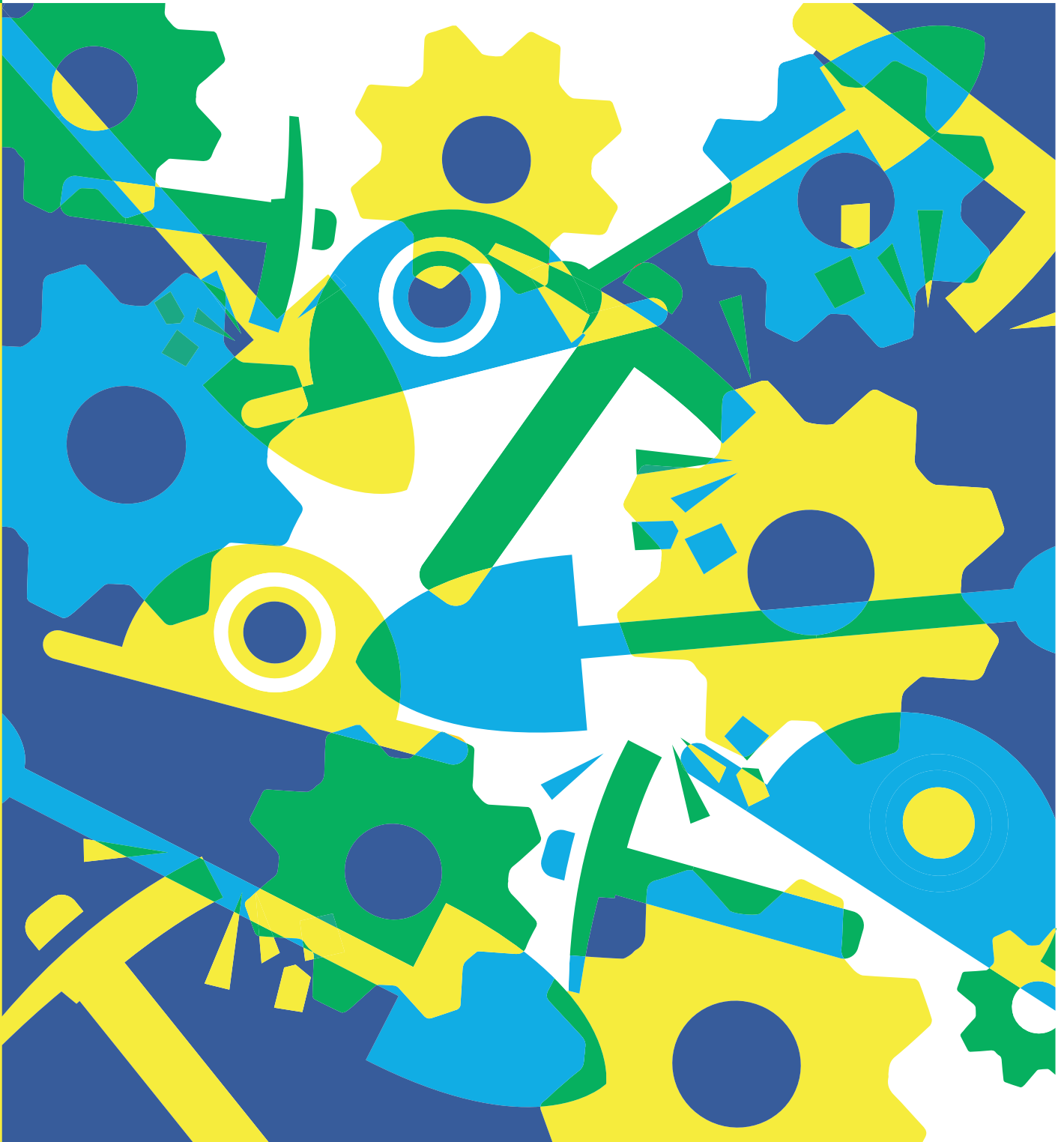


BRAMIN 2016

OFFICIAL INVESTMENT GUIDE
24TH WORLD MINING CONGRESS



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Dear Reader,

On behalf of the Brazilian Mining Association - IBRAM and its associates, we would like to offer a warm welcome to all the participants of the 24th edition of the World Mining Congress - WMC 2016. This is the first time that the WMC, recognized as one of the most important mining events worldwide, is being held in Brazil. The central theme of this congress is "Mining in a World of Innovation", one of the most current and important issues in the management of mining businesses.

The world is changing dramatically in all aspects, thus this is the time to push for innovation in mining. Innovation may be complex but it is not always complicated. Moreover, it can occupy one of the three "ambition levels" that define its purpose or result: a) Core innovations optimize existing products for existing customers; b) Adjacent or incremental innovations expand existing business into "new to the company" business and c) Transformational or new innovations are breakthroughs and inventions for markets that do not yet exist. An additional perspective on this is that innovation is not only related to technology upgrades. We can also innovate in the way we relate to the industry's stakeholders and the rest of the society. So, this is the proposal of the 24th edition of the WMC, amongst others. We also intend to technically and scientifically promote and support cooperation, with the goal of having sustainable operations and processes in the mining sector.

Mining has been extremely important to the world's economic growth and prosperity for centuries. We know that the last few years have been challenging for the mining industry. In this context, "innovation" is the key word for new business and the future of the sector itself.

At IBRAM, during our almost 40 years of existence, we have strongly contributed to the Brazilian Mining Industry's development and consolidation, with an optimistic view of the prospects of the sector.

With regard to Brazil, the country has huge mineral potential. Despite having practically all mineral goods, per capita consumption is lower than the world average. As such, the internal market should grow consistently in the next decades. We already have a historic vocation for mineral extraction activities and the mining industry has become one of the country's most important pillars. The mineral sector promotes local, regional and national development.

We wish everybody an excellent World Mining Congress!



José Fernando Coura
CEO of the Brazilian Mining Association - IBRAM

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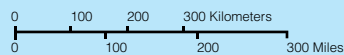
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Brazil

- International Boundary
- - - Province Boundary
- ★ National Capital
- Province Capital







INTRODUCTION TO **BRAZIL**



“There are three reasons that make Brazil very attractive for investors: first, there is a massive domestic market with 200 million consumers. Second, Brazil is blessed with natural resources, both for extractive industries and agribusiness. Finally, the infrastructure gap is quite massive, which provides a huge upside.”

- Hector Gomez,
Country Manager,
IFC

Brazil's Miners Navigate Political and Economic Uncertainty

■ Brazil is facing dark days. Political and economic instability caused by the impeachment process of president Dilma Rousseff amidst the globally publicized Petrobras scandal, known locally as “lava-jato,” (“car wash”) has shaken the country at its roots. The once strong Brazilian Real today is valued at more than 3 to 1 against the U.S. Dollar. Former President Lula da Silva’s detention in March 2016 may signal the end of a rather ugly era in Brazil’s history that is seeing the country dragged through its worst economic crisis since it emerged as a powerhouse among developing nations.

No sector has been left unscathed, including Brazil’s mining industry, which has also suffered from the consequences of external factors, namely lower commodity prices. Fluctuation in prices is a well-known phenomenon in the industry, but the current low ebb has reached crisis levels. Prices for some metals have reached lows not seen in six to eight years, as supply and demand play a constant game of catch up. China’s economic boom meant a dramatic increase in the need for steel for its industrial development. Brazil, as one of the largest iron ore producers in the world, benefitted from this hugely and mining companies flocked to the world’s ninth largest economy to capitalize on the rising price of iron ore and the country’s vast unexplored mineral deposits. But as with all things, what goes up must come down. As an example, Vale’s total revenue from iron ore sales (excluding pellets) was cut by more than half in the two-year lapse between 2013 and 2015, even if actual production went up by more than 11% during that period. China’s growth slowed the most in 2015 since 1990, with Beijing affirming that a multi-year slowdown was hitting the Eastern power. World supply of iron ore gradually caught demand. The price of iron ore averaged \$140 per dry metric ton (mt) from early 2010 and most of 2013 before sliding to less than \$50/mt by the end of 2015. Today, the global mining community faces an international commodities glut that is affecting not only iron ore producers, but also those involved in mining copper, bauxite and platinum, to name a few. Even gold, which is Brazil’s second largest mineral export, has seen its price fall from an average of \$1,572/oz in 2011 to \$1,160/oz in 2015, although it has shown some recovery, along with silver, during the first half of 2016.

But for Brazil the problems do not stop there. Political turmoil and uncertainty over potential regulatory reforms have landed Brazil’s mining industry in the throes of a perfect storm.

“All these factors, added to the decrease of the commodities prices, have created a climate of low expectations in Brazil,” explained Fernando Coura, CEO of the Brazilian Mining Association (IBRAM). “However, it is important to think of the mineral activity as cyclical. We are confident in a revitalization of growth in the industry in three or four years.” ■

BRAZIL AT A GLANCE

Source: IMF (2015 data)

\$1.77 TRILLION
GDP

-3.8%
GDP growth (2015)

-3.3%
current account balance (% of GDP)

9%
inflation rate

\$8,670
GDP per capita

population



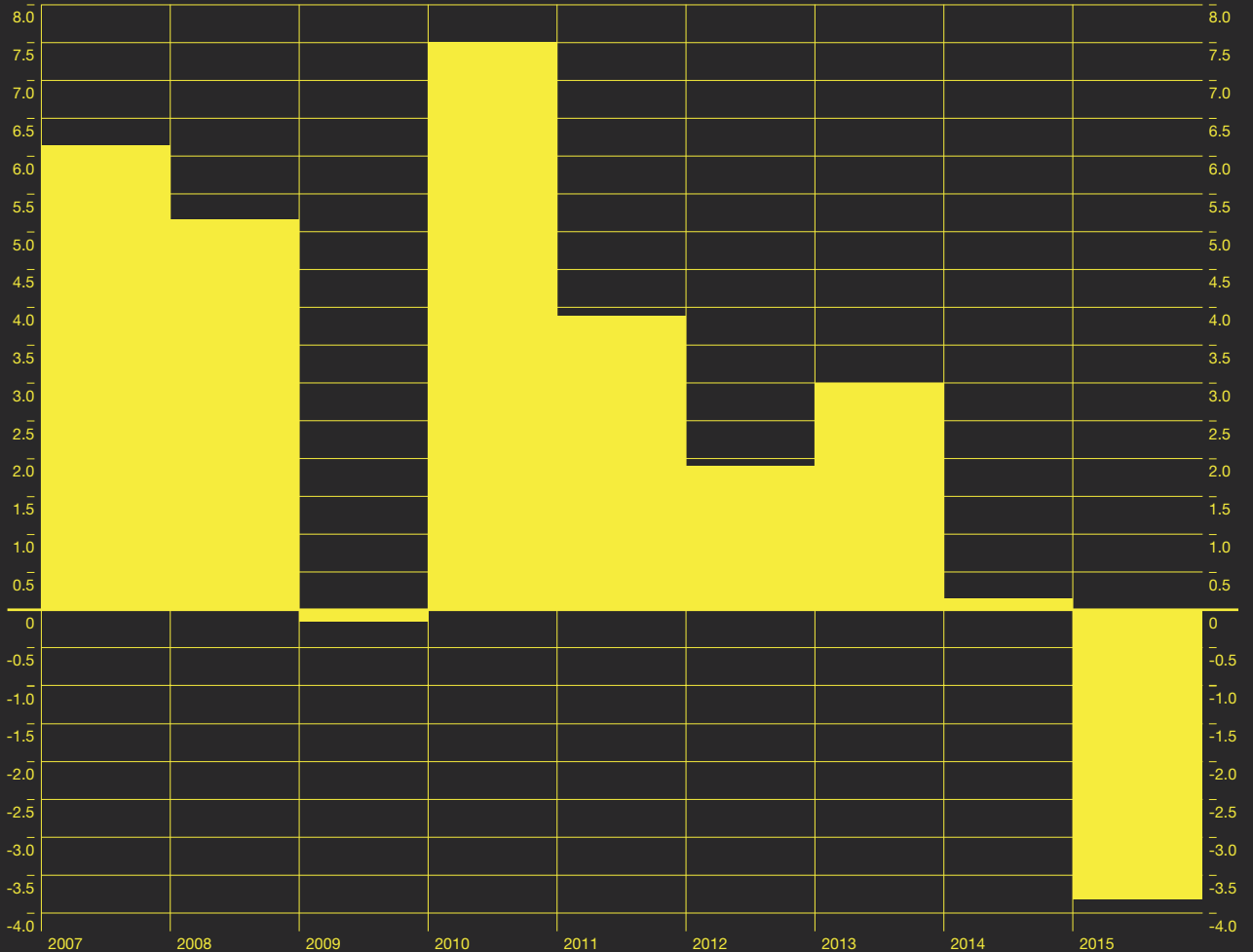
204.5 million

\$15,614
GDP per capita (PPP)

unemployment rate **6.8%**

BRAZIL'S GDP GROWTH

Source: IMF





José Fernando Coura

CEO
IBRAM

“

In addition to China, we should further explore new markets such as India and South-east Asian countries. China continues to be the largest buyer of Brazilian iron ore. Although the country's growth has dropped, at 6.8% it still doubles the world average.

”

What is being done to improve the mining environment in Brazil?

Now, more than ever and on account of the change in the market, the premises adopted by the government, which are the same as those IBRAM has defended since we last spoke with Global Business Reports in 2013, deserve a closer look. Amongst them, of particular importance, is the need to increase the geological knowledge of the country, and to de-bureaucratize and accelerate environmental licensing.

It is important to highlight that Brazil has big mineral potential; however, it is little known. Today, less than 30% of the national territory has been geologically surveyed on a scale appropriate for the activity.

Furthermore, the mining industry understands that the current environmental licensing model must be revised so as to incorporate aspects of sustainability, innovation and competitiveness. A new model could therefore consider environmental licensing as a territorial management model, integrated with planning and sustainable development policies, thus generating gains for the whole society.

What are the immediate prospects for Brazil's mining industry?

Although the expectations for mineral activities have fallen due to the international crisis, growth is driven by the urbanization process in large emerging countries with high demographic density and a high GDP, such as the BRICs (Brazil, Russia, India and China).

As investment forecasts are made on a five-year horizon, this allows us and even obliges us to make periodic reviews. Our most recent review showed that total investments fell from \$63.7 billion to \$53.6 billion. Following the Federal Government's announcement of the new mining code in 2013, which is yet to be defined, investors are reluctant to act due to the current uncertainty. Some projects have therefore been delayed. Having said this, the current mining crisis has a bigger impact on prices than

on demand. Given ore is a raw material, the production of countries in crisis may fall, but it does not stop.

For those who intend to invest in Brazil, the most attractive sectors are fertilizers (the country has a shortage of these) and minerals associated with technology, such as graphite, lithium, and thorium, amongst others.

Will the new mining code help?

Little progress has been made regarding the new code over the last few years, so we must keep waiting to really assess the impacts.

What are Brazil's main markets for the mining and metals industry?

In addition to China, we should further explore new markets such as India and South-east Asian countries. China continues to be the largest buyer of Brazilian iron ore (as well as minerals in general). This is primarily due to the rise of the middle classes and the urbanization process, which requires an increasing amount of ores. Although the country's growth has dropped, it is important to note that, at 6.8%, it still doubles the world average.

With regards to Brazil's internal market, we have a very particular situation: although we have pretty much all mineral goods, per capita consumption is lower than the world average. By virtue of the full supply of the national market and the sale of the surplus overseas, the mineral sector promotes local, regional and national development.

How have environmental standards evolved?

IBRAM has contributed strongly to the sector's adoption of a low-greenhouse gas (GHG) model, through the dissemination of knowledge, and through policies related to climate change, as well as via guidance on new technological standards to reduce emissions. Options like biofuels, the association between fossil fuels and renewables, are interesting alternatives. —



Hector Gomez

Country Manager
**INTERNATIONAL FINANCE
CORP. (IFC)**

“

We have a great deal of faith in investing and supporting mining companies in Brazil, whether it is in supporting logistics, city services such as waste management, and the integration of mining with steel and other sectors.

”

What is your vision for the IFC in Brazil?

I have been country manager for the IFC in Brazil for two years. The vision for the IFC remains the same, but we have adjusted over the past months in light of current dynamics, and will need to continue to adjust and adapt to the new environment. Brazil is one of the IFC's largest operations in the world, where we invest roughly \$2 billion annually. We need to identify the segments where we can provide commercial support and where we can have a real impact.

There are three reasons that make Brazil very attractive for investors: first, there is a massive domestic market with roughly 200 million consumers and a huge territory, which allows for economies of scale. Second, Brazil is blessed with natural resources, both for extractive industries and agribusiness, where there can be many crop cycles per year. Finally, the infrastructure gap is quite massive with considerable pent-up demand for it, which provides a huge upside. There is a fast ramp-up curve for infrastructure projects and potential for returns. Infrastructure is a massive sector with many different subsectors.

Of the roughly \$2 billion invested annually in Brazil, how much of this investment directly or indirectly touches the mining industry?

Indirectly we have some exposure through some of our clients. For example, we are shareholders in VIX Logistica, which is a big logistics supplier to Vale and Petrobras, among others. We also support financial institutions that finance mining clients. Because of the commodity cycle, however, we have entered into more conversations with Brazilian or international mining companies about potentially supporting them. One area we are also actively pursuing is how to support Brazilian multinationals in foreign countries.

Can you highlight some infrastructure investments that you are excited about and that might be important for the mining industry?

Of all infrastructure subsectors, we are most actively targeting logistics and transportation, which includes ports, logistics

services, airlines, transit lines, etc.; water and sanitation, particularly in mid-sized cities; and power, both in renewables and distribution. We had a project with MRS Logistica which involved moving iron ore to the port, but this is no longer active. We have actively been looking at projects that might connect mines to ports. We have also been looking at fertilizers, which are linked to our agribusiness strategy. Brazil has such rich soil and sun, which means that fertilizers are underutilized. Mining is crucial to supplying the plants that make fertilizers.

What is the largest challenge to developing a more sustainable and profitable mining industry in Brazil?

At the IFC, we have the advantage of looking at the long-term of 10 to 12 years or more, which is similar to a mining company. We view the current macro political and economic situation as a temporary crisis that will last two to three years. For us, the sustainable management approach is probably the main obstacle. Brazil and Brazilian companies are responding to the crisis in an appropriate way. After two to three years, a new, more sophisticated environment can emerge in which high standards of sustainability and governance will be necessary to be a successful company.

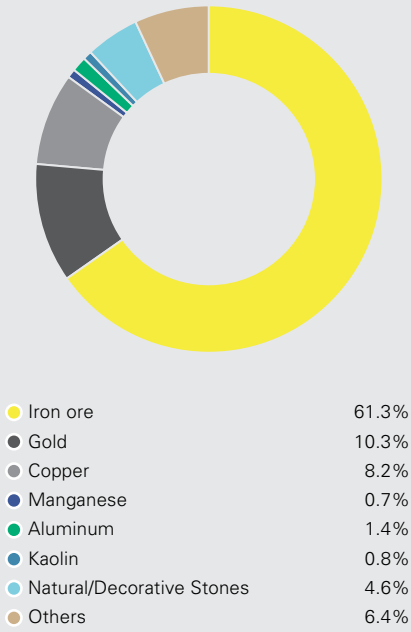
Overall, what is the support that the IFC can provide?

We may not have a large, direct experience in mining, but can probably add more value to our clients. It is an attractive area for us to add more value in sustainability. Mining is also attractive from a commercial aspect for the IFC. We will continue to play this dual role going forward.

We have a great deal of faith in investing and supporting mining companies in Brazil, whether it is in supporting logistics, city services such as waste management, and the integration of mining with steel and other sectors. These efforts are a bit clouded now by the macro conditions but we continue to invest in the country. Brazil may have a negative outlook in the short and medium term, but it is unbeatable in the long-term because of the competitive cost of both extractive and agricultural commodities. —

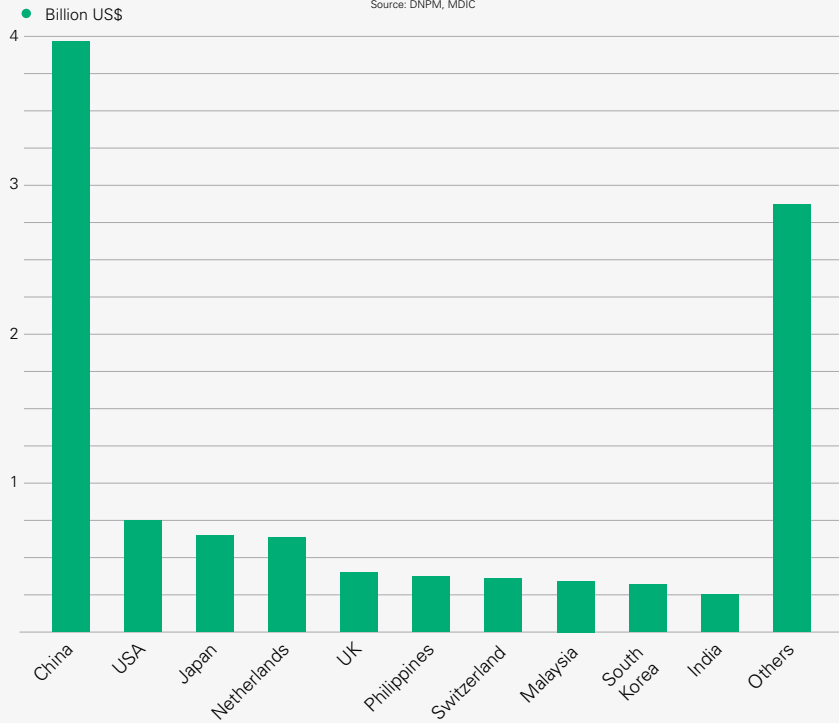
BRAZIL'S MAIN MINERAL EXPORTS (H2 2015)

Source: DNPM, MDIC



MAIN EXPORT DESTINATIONS (H2 2015)

Source: DNPM, MDIC



VALUE OF BRAZIL'S MINING PRODUCTION

Source: IBRAM

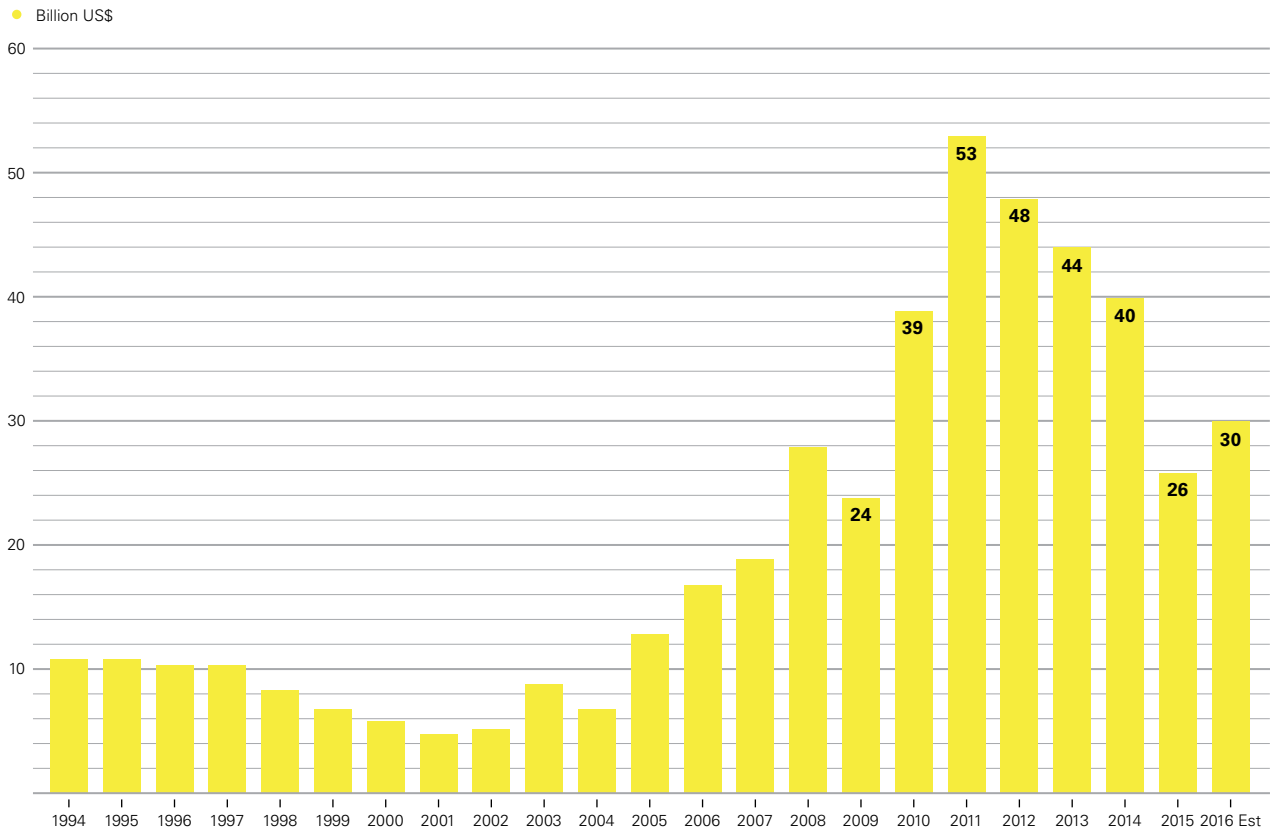




Image: S11D project - processing plant module being transported.
Courtesy of Emy Miranda / Vale





MINING PRODUCTION AND **PROJECT DEVELOPMENT**



“After the commodities super-cycle, I think companies have to focus on cost reduction, high productivity and iron ore quality in order to overcome the many challenges that our sector faces every day.”

- Sebastião Costa Filho,
CEO Mining Brazil,
ArcelorMittal

Iron Ore

*Sailing steady through the storm –
What companies are doing to survive*

The historically low prices of iron ore have had serious adverse effects on the revenues of companies operating in this sector and, as such, there has been a considerable slowdown in new project development and exploration, an important driver for Brazil's mining industry.

Vale, the Brazilian mining behemoth and largest producer of iron ore globally, accounts for around 90% of all iron ore mined in the country. In 2014, it was the company with the largest planned investments into new projects, but with a number of these projects being brought into operation and the drop in iron prices, the prospects of further investment from Vale have diminished somewhat. Even some of its existing operations face potential closure. The Brazilian iron ore producer's future now depends on the success of S11D, the largest iron ore project ever undertaken, that should begin operating in the second half of 2016 and reach a production of 90 million mt/y by 2018. This project, set to be the first 'truckless' mining operation in the world, comes at a time when demand is behind supply. Some have raised concerns that this flood of new ore may have seriously detrimental effects on the already low competitiveness of the iron ore sector in Brazil.

Size has not protected Anglo American either. Another major miner of iron ore in Brazil, Anglo American has already put its \$1 billion niobium and phosphate business up for sale and may even

“

Iron ore has never been produced the way it will be mined in the S11D project, which is currently the world's largest mining project. This new mining model represents a challenge as well as a big step forward in the mining industry.

**- Luiz Mello,
Executive Manager
Innovation and Technology,
Vale**

”

Crusader is confident for the future and hopes that the revenues generated from its iron ore mine will contribute to the development of the company's gold projects in the north of Brazil. —

be planning an entire withdrawal of all operations in Brazil. This speculation comes after reports that the London-based giant may sell its expensive Minas Rio iron ore project, which only began operating last year - that is four years late, and at twice the original budget.

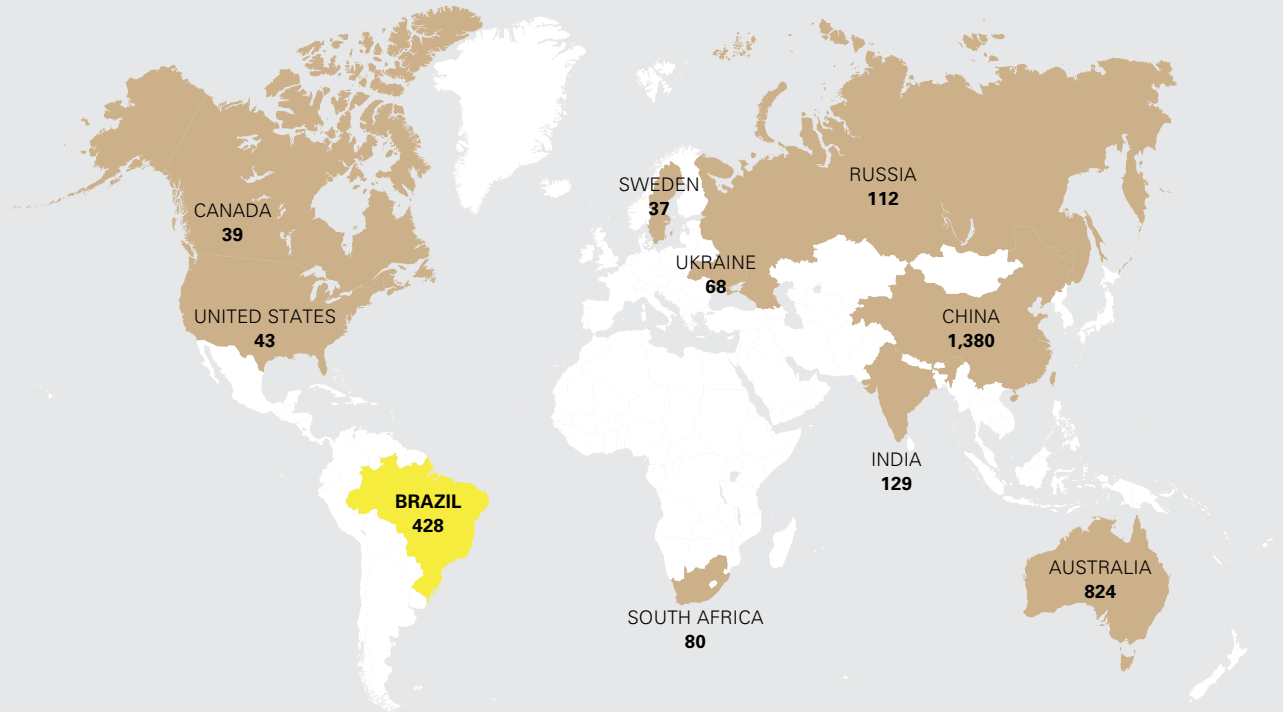
Iron ore is important for the Brazilian economy and remains by far the most important mineral in Brazil's mining industry. In 2014 it accounted for 73% of export income. Besides the very large mining operators, this segment also presents some opportunity for explorers and small junior companies, but the country has other challenges for them usually in the form of licensing procedures.

Crusader Resources is an Australian junior that recently started producing iron ore from its Posse mine located not far from Minas Gerais' capital Belo Horizonte. "When the market picks up again, the weak real will make Brazil an attractive destination for investment, but difficult-to-navigate licensing procedures may stem the investment inflow," said Robert Smakman, managing director, Crusader Resources.

Crusader's focus is entirely on the domestic pig iron market. Though the company has experienced its fair share of hardship,

TOP IRON ORE PRODUCING COUNTRIES, 2015 (Million mt)

Source: USGS



IRON ORE PRICE CHART

Source: InfoMine



Sebastião Costa Filho

CEO Mining Brazil
ARCELORMITTAL



What have been the main developments at Serra Azul over the last years?

The Serra Azul mine is located 65 km from Belo Horizonte. ArcelorMittal acquired it in November 2008. At that time, the mine was only producing lump ore. Since 2009, when the sinter feed plant installation started, the mine produces both lump ore and sinter feed. At the beginning, we used old stockpiles of fines to produce at the full capacity of the plant, which is 3.6 million mt/y. Later we started using our resource of friable itabirite. The Serra Azul mine is close to two railroad terminals that make it possible for our iron ore to reach the nearest port in a competitive way. Due to low international prices, ArcelorMittal has been selling sinter feed only to the internal market since 2015. Regarding lump ore sales, we supply to ArcelorMittal steel plants in Brazil and other third parties.

How has production at Serra Azul compared to what you expected when you acquired the mine in 2008?

When ArcelorMittal bought Serra Azul in 2008, the expectation was to produce at full capacity, i.e., 3.6 million mt/y. Unfortunately, the market started changing just after that. Iron ore prices began to go down. This scenario did not make it possible for the company to invest and improve the crushing plant production capacity, which is smaller than the concentrator capacity. Since then, we have been operating

on average 2.4 million mt/y, using friable itabirite. For the next years, we need to re-evaluate our strategy. We have a large resource of hard compact itabirite that needs a completely new design to be developed. That also includes new plants and, for that, a substantial investment will be required.

Where is investment currently being focused in the Serra Azul mine?

We are currently investing to continue to operate and to maintain the mine. Investments for the next years must consider the world's demand for iron ore as well as our strategy to mine the hard compact itabirite resource.

What advanced technology have you implemented at the mine to protect human exposure?

Safety is a top priority for ArcelorMittal. For our company, it is important to always be at the forefront of new technologies, particularly in this area. In the Serra Azul mine, we have never faced a fatality since the mine opened in 1975. The Andrade mine has been operating for 68 years now without any fatality, and no LTIs for the last 23 years and 7 months, which makes it a reference around the world.

Both mines have modern equipment with new installations designed to simplify and automate many of the processes (installed in 2013 in Andrade and in 2010 in Serra Azul). At both plants we have operators, of

course, but systems are automatically controlled. This gives us good control over the plant functions and provides an overview of the equipment and production.

Did the incident at Samarco prompt you to explore new waste management methods at the Azul mine?

We do not use tailings dams at the Serra Azul mine or the Andrade mine. The Serra Azul mine tailings dam closed in 2013 and, since that time, has been monitored following all procedures according to Brazilian law. Since 2013, we have developed a new disposal method for the Serra Azul mine - the dry stack system. We use the caves inside the mine to dispose tailings. After decanting, we remove the tailings from the cave and stack it in piles mixing it with other waste materials from the mine. This is a quite innovative type of technology in the mining segment.

Do you have a final message for companies operating in the iron ore industry?

After this commodities super-cycle, I think companies have to focus on cost reduction, high productivity and iron ore quality in order to overcome the many challenges that our sector faces everyday. At ArcelorMittal we will continue to follow both economic and political events in order to make the best decisions for our business. —

Pedro Borrego

Interim CEO Iron Ore*

ANGLO AMERICAN BRAZIL



**Since June 2016, the new CEO of Anglo American Brazil is Ruben Fernandes.*

Minas-Rio is one of the largest iron ore projects in the world, but has experienced delays and cost overruns in the past and there are rumors that it could be sold. Could you update us about the project and how you anticipate production unfolding in 2016?

Minas-Rio is no longer a project, but an operation and a true business with all the required elements now truly complete and in place. We have built the mine, the wet and dry processing plant, and a 529-kilometer pipeline that links our integrated system to our self-constructed and dedicated iron ore port terminal. Looking forward, this is obviously a challenging time in the iron ore market and we have had to look at our cost base as we have transitioned from being project-based to an operational business. It has been tough to shave off costs, renegotiate supplier contracts and downsize the organization to ensure we are a sustainable business for the future in the interests of all stakeholders.

How important is Minas-Rio in Anglo-American's overall strategy?

We made significant changes in Anglo American. There were important announcements back in February 2016 and the company identified three areas as our core assets going forward. The first is diamonds, which is a strategic and historic pillar for our business through De Beers. The second is our very strong and leading

position in the platinum business in South Africa within the well know Bushveld Igneous Complex. Our third pillar is copper, which we have been expanding in Chile for decades, but where we also have great future projects both in Peru and in Finland. We are divesting the coal, niobium, phosphates and nickel businesses. So, in terms of iron ore, Minas-Rio is now classified as a non-core asset, but we have invested over \$15 billion in the project and it is now self-sustaining. It is important to note that despite being non-core, Minas-Rio is not for sale. For 2016 and 2017, we have an aggressive production profile given the market and licensing challenges and we are stabilizing the operation to bank all efficiency gains. We have dropped production targets for 2016 from 26,5 million metric tons (mt) to a range between 15 and 18 million mt.

What is the major challenge that you face operating in Brazil?

Licensing is one of the biggest challenges that we face in Brazil, but also infrastructure, which is insufficient for moving bulk products such as iron ore and coal. We invested in the pipeline to transport from our mine to the dedicated port where we ship our products to our clients. Brazilian licensing is one of the most sophisticated licensing environments in the world. The authorities are concerned about the right things. The Minas Gerais state has a high-

ly sophisticated licensing department, but does not have enough people to deal with the bottleneck of investment submissions. It is not the rigor and sophistication of the licensing department that is the challenge, but how agile companies must be to get things done and approved.

The Samarco disaster has rocked the mining industry. How does Anglo American see this event affecting licensing and environmental processes?

I struggle to talk about this because it is so close to us all in the industry and in Minas Gerais. The human and environmental tragedy has caused heartache not only for us here in Brazil and for Samarco in particular, a company that we respect greatly, but also for people around the world. It goes without saying that we must always learn from incidents and strive to be a leader in providing the best techniques in the safety and sustainability area. We have been doing a lot of work to revise all of our processes around our own tailings dam, which uses a different and more robust construction method, and hopefully everyone with a tailings dam is also revising their processes as well. —



20

VALE'S MINING OPERATIONS IN BRAZIL

- IRON ORE
- POTASH
- PHOSPHATE
- MANGANESE

VALE

BRAZIL'S GIANT MINING COMPANY

VALE STOCK PRICE (NYSE)

Source: Bloomberg

5 years up to August 24th, 2016



154,000

employees and contractors
in Brazil

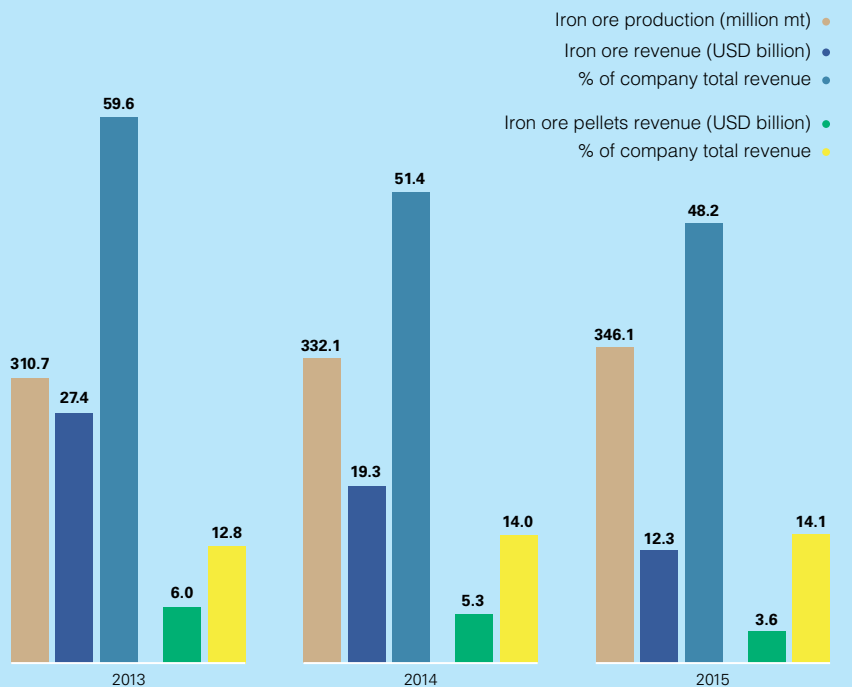
10,000km

of railways in Brazil

VALE'S MINING OPERATIONS
AROUND THE WORLD

Peru	Phosphate
Canada	Nickel, Copper, Cobalt, PGMs, Gold, Silver
Mozambique	Coal
Zambia	Copper
Australia	Coal
China	Coal
Indonesia	Nickel
New Caledonia	Nickel, Cobalt

THE EFFECT OF LOWER IRON ORE PRICES ON VALE



U & M

40 years



WORLDWIDE REFERENCE IN MINING WORKS

CUSTOMER BENEFITS



**PREDICTABILITY OF MINE
OPERATION COST**



**GREATER FOCUS ON THE
CORE BUSINESS**



**VERSATILE EQUIPMENT
FLEET**



**AGILITY IN RESPONSE TO
CUSTOMER DEMANDS**



**INVESTMENT REDUCTION
IN IT'S ASSET BASE**



**FLEXIBILITY TO ADAPT
THE OPERATION TO
SEASONALITIES**



DILUTION OF RISKS



**INTERNAL BENCHMARKING
IN SHARED OPERATIONS**



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Aloysio Antonio Peixoto de Carvalho

Executive Director
GERDAU MINING AMERICAS

Could you give us an overview of Gerdau's mining operations in Minas Gerais?

We acquired mining rights in 2004. There is a large iron ore concentration in this part of Brazil. We have around 6 billion metric tons (mt) of resource, but obviously not all of it has been measured. We have 11.5 million mt/y of capacity to process iron ore, and are now producing and delivering about 8 million mt/y. We supply our own mills with roughly 6 million mt/y and the other 2 million mt/y are either exported or sold domestically. We do not have a company port, but we rent one. We also have a share in MRS, which is the railway company that we use to reach the ports, so our product can reach our main export market: Asia.

How is the business doing in 2016?

Right now, we are focusing on cost-effectiveness and are having a lot of success, even though there are a lot of small miners who are going out of business. Gerdau has one of the last high-quality resources in this part of Brazil. This keeps us in the iron ore business, even though we are not a large mining company. We can also convey our competitiveness to our steel business, because we deliver quality and have logistics advantages. Our mine is 9 km away from our major mill, which lowers costs considerably.

What dynamics do you see shaping the steel market in the near term?

The steel market is keeping us in the mining business. There are long cycles of investments. In the short term, we are watching a considerable distance between demand and capacity. Nowadays, the world capacity is around 2 billion mt/y and demand is 1.4 billion mt/y, so the steel industry has a lot of capacity that is not being used. It would be great to see this gap getting smaller as the industry reaches a better equilibrium. While we have low steel prices, we will face low iron ore prices.

In this environment, are you seeing more interaction between producers in order to cut costs and achieve synergies?

We are experiencing a good environment to carry out partnerships. Service compa-

nies are offering a lot of new approaches to improve productivity in different areas. They are adapting themselves as they offer cost-cutting services. Also, the mining industry faces many environmental requirements, which increases costs for mining operations, and this does not necessarily guarantee sustainability. It has to do with Brazilian laws, which comprise a whole system that brings a high load of costs and taxes, but misses its main purpose of ensuring sustainability.

Could you please expand on the mission and values of Gerdau?

Production and profits aside, the environment is a priority for us. For example, I was talking to Itabirito's mayor today, and he was giving me enough feedback to realize that we are doing our job well. He has identified us as a benchmark company who takes care of small rivers in the area. Last year, we invested roughly \$10 million to improve our processes regarding environmental issues and impacts.

We have many projects going on that reduce environmental impacts and strengthen the relationship with the surrounding communities. We send volunteers to help solve social problems and work on education projects. For example, one of these projects works on the recycling of waste products from the dam to make bricks. The bricks will then be used to build schools and pave the ground to reduce dust as trucks pass by.

Where do you see the challenges in working in Brazil's mining industry?

The biggest challenge is the environmental and sustainability issues. The Samarco incident made things even worse. Licensing is another hindrance for business to flourish. Recently, uncertainty about our political situation has increased as well. This creates difficulties to secure new investments and acquire operating licenses. We have room to work together as an industry in Brazil. There is room to educate people and change their mindset so they can understand and recognize the real value of mining. —

Gold

Better prices should result in increased levels of activity

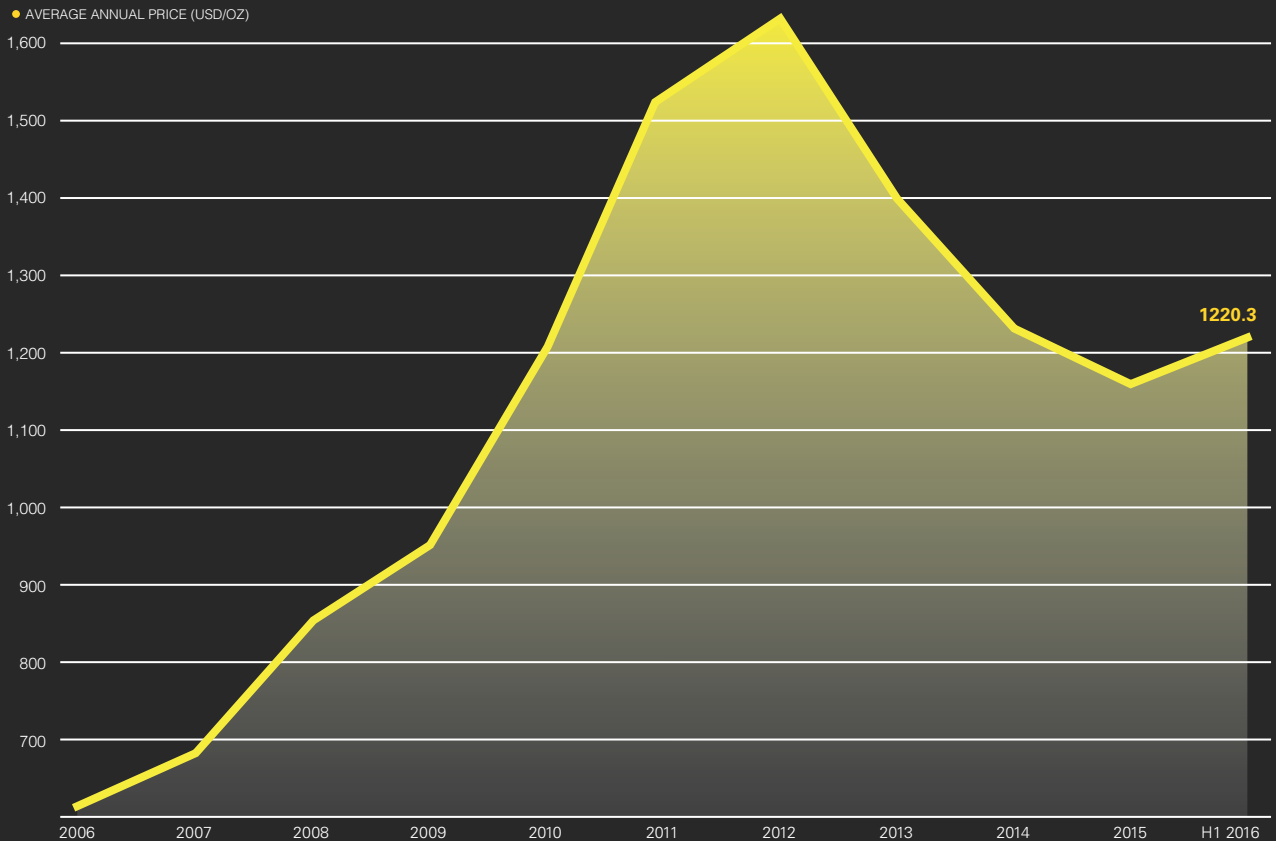
Gold is Brazil's second most important mineral and is the focus of the majority of exploration work being carried out in the country. Though large players, such as AngloGold Ashanti, Kinross and Yamana Gold already operate in Brazil, this mineral segment seems to be more dynamic than that of iron ore and, as such, offers more opportunity to smaller players. Serabi Gold, a London based junior, began producing gold from its Palito mine in 2014 and expects to start production from its Sao Chico mine later this year. For Serabi to conduct further exploration it is important to increase productivity in both these operations. "Serabi wants to continue to invest in increasing productivity on our operational projects so as to reduce our costs to the range of \$800/oz to \$850/oz," said Ulisses Melo, general manager for Serabi Gold in Brazil. "In terms of exploration, we hope to use some of the cash flow

generated through the operations to target two to three areas in the 12,000 hectares that we have."

Yet some seem to think that numerous small projects will not actually do much to stimulate the growth of this sector. "In terms of increased gold production, I do not think Brazil has a bright perspective at the moment," said Victor Belo, who was involved with Carpathian Gold before it divested its Riacho dos Machados mine to Yamana. "We have lots of small projects but nothing major in the pipeline," he said. Yet a fresh wave of investment in exploration as a result of increasing gold prices may see a changing trend in the gold segment. After all, the starting point to develop large new mines is a good discovery and, with other gold districts worldwide reaching maturity, Brazil's fairly untapped geological potential may provide for good news in the coming years.

GOLD PRICE CHART

Sources: KITCO / GBR





Ulisses Melo

General Manager
SERABI GOLD

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Serabi wants to increase productivity and reduce costs to \$800-\$850/oz. In exploration, we hope to use some of the cash flow to target two to three areas in the 12,000 hectares that we have. We are also open to potential mergers in the Tapajos area.

”

Could we have a brief introduction to Serabi Gold and the company's operations at Palito?

Serabi started in 1999. The company stopped operations in 2008 as the financial crisis hit and focused on exploration in the Tapajos area until 2012. In 2012, Serabi was fortunate to consolidate with Chilean investors who believed in the potential of the Palito mine project and invested \$25 million. With the Chilean investment, the Palito mine and the plant were reconstructed and operations started in 2014.

Serabi also acquired the Sao Chico project, which is approximately 23 km from our Palito mine. This is a small narrow-vein mine. This project has been under development in 2015 and, in 2016, the Sao Chico mine is becoming fully operational. As any other junior in the market, we are aware of the constraints created by gold price fluctuations, thus Serabi has invested heavily in the operation so as to increase productivity. With these investments, Serabi managed to keep its costs below \$900/oz.

What are Serabi's expectations for the Sao Chico mine over the course of 2016?

The prospect is to consolidate both the Palito project and the Sao Chico project into one operation. Serabi's production rate increased from 18,000 oz in 2014 to 33,000 oz in 2015 and the aim is to produce 40,000 oz in 2016. Serabi has a license for over 12,000 hectares, but the strategy is to keep expanding and we are looking at other prospects and assets in the area.

What strategic partnerships does Serabi have in place to strengthen your existing infrastructure?

There has been a great improvement in the area in terms of roads and logistics since our first phase of operation. The concentrate that we produce is trucked from Palito to Itaituba, which is 300 km from the site. This trip used to take about 12 hours in 2008, but currently that time has been reduced to six hours.

In 2011, the region was described as a graveyard for explorers. What were

some of the challenges which have now changed?

Serabi's strategy was always to look for small high-grade deposits. Small deposits have small cutbacks, which reduces risks significantly. We also managed to keep all our licenses in place while we waited for the market to recover and, when it did, we were only one year away from production, which was an advantage for potential investors. One of the biggest challenges in Brazil's mining industry is finding skilled labor. Tapajos is very remote and isolated and thus it is not the region of choice for many workers. It is also difficult to find adequate suppliers in the region, which means we need to manage our own logistics.

How big of a concern is the environment to the operations of Serabi?

Palito is an underground mine that has a limited impact on the environment. Operating in the Amazon Forest, Serabi is always under the watch of environmental authorities of the State of Pará. We get visits from the authorities two to three times a year and as we would like to extend the validation of our operational licenses, the visits might increase.

What are Serabi's expectations for the future, both in terms of the operations and your exploratory projects?

Serabi wants to continue to invest in increasing productivity to reduce our costs to the range of \$800 to \$850/oz. In terms of exploration, we hope to use some of the cash flow generated through the operations to target two to three areas in the 12,000 hectares that we have. We are also open to potential mergers with some projects in the Tapajos area.

Tapajos has ample opportunities for investors, but you need to have the right skills and knowledge of the area. You have to be involved in every aspect of the business and, over the years, Serabi has attained the skills and knowledge of operating in this industry. The company is currently in a very good position and we would like to consider some M&A opportunities in the near future. —



Rob Smakman

Managing Director
CRUSADER RESOURCES

“

Brazil is a major mining country and is part of the international commodities cycle. Unfortunately for Brazil, the current political instability and uncertainty about the new mining code is adding to the crisis. This is impeding further foreign investment.

”

What is Crusader's involvement in the Brazilian market?

Crusader is an Australian junior explorer and miner that listed in 2004 and has been operational in Brazil since 2005. Having looked at opportunities in Australia, Asia, Turkey and Africa, Crusader decided that Brazil offered the most opportunities. The prospectivity of the country and the availability of projects and long history of mining combined to make the country the most attractive of the jurisdictions we considered. There were also relatively few other junior companies operating in Brazil, meaning that it did not present as much competition to us as some of the more developed mining countries. Today Crusader is focusing on four principal projects exclusively in Brazil.

Can you please go into details about those projects?

The first project Crusader began developing was an iron ore mine named Posse which is located 30 km outside of Belo Horizonte. We were able to acquire this project in 2007, before the real boom in iron ore, for around \$A3.4 million. An open pit mine, Posse began operating in April 2013 and has since generated revenues well over \$A30 million. This is a relatively small operation supplying the domestic market, predominantly the local pig iron industry.

Our second project is called Borborema and is located in the northeast of the country. This is a gold project we purchased in 2010, previously mined in the 1980s by Xapetuba, one of Eike Batista's former companies. The mine was purchased for around \$A2.4 million and, to date, we have conducted over 85,000 meters of drilling, spending well over \$A20 million. After slowing down over recent years (coinciding with the weaker gold price), work on this project has recently picked up again due to the weaker Brazilian Real (meaning the BRL gold price is currently trading at near all-time highs). Our recent feasibility studies show that the site has 2.43 million oz in resources, including 1.6 million oz in reserves. It will be a fairly simple open pit operation but, before Crusader can start operating here, we must first complete an updated feasibility study, obtain the licenses and raise the capital required to build the project.

The third major project Crusader is working on is Juruena, which was bought in late 2014. Juruena is also a gold project, however it has much higher grades than Borborema. The previous owner had conducted a lot of sophisticated studies, which gave us a head start on exploration. So far, we have conducted 10,000 meters of our own drilling.

Our latest project is Manga in Goias state. This is a project that we had previously explored for tin and indium. However, with the recent strength in the lithium markets, we are currently evaluating Manga for its lithium potential.

What are the main factors contributing to the current crisis facing Brazil's mining industry?

Brazil is a major mining country and is part of the international commodities cycle. Unfortunately for Brazil, the current political instability and uncertainty about the new mining code is adding to the crisis. This is impeding further foreign investment. In addition to all this, the Samarco disaster has made the licensing process, which has always been tough, even more difficult.

Many people have cited that licensing is one of the main challenges in Brazil. What is your experience with this process?

In Brazil there are two categories of mining licenses: those handled by the federal government (via the state agencies), and environmental licenses which are dealt with by the State or, in some cases, the municipal governments. The latter presents more challenges and I believe the system needs to be standardized across the country. When the market picks up again, the weak real will make Brazil an attractive destination for investment, but difficult-to-navigate licensing procedures may stem the investment inflow.

How dynamic is the mining industry in Brazil currently with regards to mergers and acquisitions?

Until now, there has been relatively little M&A activity, which surprises me. Normally when an industry is at its low ebb the market becomes very dynamic in this regard. However, we are seeing that activity is picking up now. —

Brazil's Other Minerals

Alumina and bauxite production remain relatively stable with half the bauxite production in Brazil coming from Rio do Norte (MRN). The major contributors to the remaining half are Hydro Brasil, Alcoa and Votorantim Metais. The latter company is the main contributor to potential increased production of aluminum with new projects set to come on stream in Pará.


Other minerals in Brazil are copper, which is now Brazil's third most important mineral, nickel, niobium and zinc. However, Brazil is yet to become a leader in these segments. Mineral fertilizers are of interest for some. Despite Brazil's vast deposits of potassium and phosphate, the country has imported the majority of mineral fertilizers in order to support its vast agriculture sector. The reason being that this method was cheaper, but today this is

no longer the case. To reduce dependence on increasingly costly imports, made so by the weak real, Brazilian producers have investment plans for mineral fertilizers that add up to around \$3 billion.

Contrary to the general trend to export the majority of the minerals produced in the country, Brazil has an important local market that needs to be catered to. Ferbasa, for instance, is focusing on the production of ferroalloys and is the largest integrated producer of ferrochrome in the Americas. Its mining operations are focused on the extraction of chromite. "The open pit mine located in Campo Formoso has been operating since 1978, and today we are developing economic viability studies to examine the possibility to transform it into an underground mine," said Wanderley Lins, Ferbasa's mining director.

Meanwhile, Mineração Taboca, owned by Peruvian company Minsur, operates the Pitinga tin mine, which is the largest tin deposit worldwide with 420,000 mt of tin contained, although it does not offer the same high grade as the company's rich San Rafael mine in Peru. After some technological developments, the company has been able to separate the tin to produce other elements such as ferro-niobium and ferro-tantalum, obtaining better access to the final clients. In parallel to this, tin production at Pitinga has doubled over the last four years and it should reach 6,000 mt in 2016. —

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BUILDING A COPPER COMPANY IN BRAZIL
 Avanco Resources is developing two projects in a staged approach while also evaluating other opportunities:
 Stage 1 – Antas North
 Stage 2 – Pedra Branca

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“

The Pitinga mine is the world's largest deposit of tin and tantalum, while it also has niobium and rare earths. We have been able to separate the tin and to produce ferro-niobium and ferro-tantalum. This year we expect to produce 6,000 mt of fine tin in Brazil. We are also investing to expand our flotation capacity for niobium and tantalum this year.



- Juan Luis Kruger,
 CEO,
 Minsur

”

Anthony Polglase

Managing Director

AVANCO RESOURCES



Could you introduce us to Avanco Resources?

Avanco is an emerging mid-tier copper company situated in the mining-friendly Carajás mineral province of Brazil. The company is listed on the ASX and is already producing copper from the high-grade Antas Copper Mine (Stage 1), while it is currently developing the Pedra Branca (Stage 2) copper project, and is exploring for additional copper projects.

The Carajás region is regarded as one of the most prospective mineral provinces in the world for the discovery of copper-gold and iron ore resources. It hosts numerous IOCG (Iron Oxide Copper Gold) deposits, including Sossego, Igarapé-Bahia, and the world-class Salobo deposit.

Can you walk us through the Antas and Pedra Branca projects?

We are ramping up production at Antas, which is expected to produce roughly 12,000 metric tons per year (mt/y) of copper metal in concentrate, with around 7,000 oz in contained gold credits annually. Antas will produce a desirable, clean copper concentrate, for which the company has executed a three-year offtake contract for more than 40% of the total production.

The Pedra Branca project is located 50 km from Antas. The land package is mostly contiguous farmland with good access and no environmental limitations. The area benefits from excellent infrastructure within a district experiencing substantial investment from Vale's development of "Serra Sul", soon to become one of the world's largest iron ore mines.

What are the greatest challenges to operating in Brazil?

Avanco is firmly focused on the north of Brazil and believes that the Carajás region

is as good a mining district as any other globally. Taxation and labour laws are a complicated subject in Brazil and require considerable effort to comply with. However, a corporate tax rate of roughly 16% is available in the north of Brazil, and this goes a long way in compensating. Maintaining good working relationships with local government and unions is also an important part of operating in the region.

Have communities raised concerns about tailings post-Samarco?

The Antas tailings dam is a fundamentally different type of design. Being new, it incorporates the latest in real-time monitoring equipment built into the dam wall. In comparison, the dam is also smaller and is located in an area where there are no inhabitants downstream. Following the incident, Avanco immediately recognised the seriousness of the issue for the mining industry in Brazil and took pre-emptive steps to further improve safety procedures and knowledge, while also getting in front of any pending legislation changes. This also included commissioning a full, independent review by a leading industry consultancy. Unlike many companies before us, Avanco sourced its environmental technical staff locally, and used local companies in Pará State for its environmental studies and licensing. This has further enhanced community and local government confidence in the Antas mine.

What new technologies is Avanco Resources employing in Brazil?

We have made extensive use of drone filming technology. More recently, we have purchased ground electromagnetic exploration equipment, so we have access to a leading-edge geophysical tool that has already proven to be efficient in known IOCG deposits in the Carajás province. This new exploration

equipment is expected to become one of the company's key frontline tools in exploration, both in near mine exploration and in regional exploration surveys, with the ability to define more prospective drill targets, and more quickly.

During the construction of the ball mill, state-of-the-art bolt tightening technology was used by Metso to facilitate installation. New ultra-sonic technology was employed to measure and apply the correct tension to critical foundation and machinery bolts. Finally, there is fibre optic infrastructure just 10km from Antas. We plan to connect to the fibre optic to greatly increase internet communications, reliability and speed. This will facilitate the installation in the mine site of a computer-based business management system, connected in real-time to our Rio and Perth offices.

What is your outlook for the global copper market in the near-to-medium term?

The company is focused on high-grade copper-gold deposits. This means that there is a high concentration of metal per ton of ore extracted and treated. As a consequence, our operating costs are expected to fall within the industry's first quartile. This is particularly pertinent since there appears to be considerable uncertainty about the copper price.

Will you look to acquire new assets in Brazil and, if so, in what minerals?

Avanco is a copper-gold company. These two metals remain our focus since they complement each other from an economic perspective, because when the copper market softens, gold tends to be strong, and vice versa. Our preference is to look for advanced projects, acquisitions or partnerships in the north of Brazil, focused on those minerals. —

Marcos André G.V. Gonçalves

President
CODELCO DO BRASIL



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As Chile's major mining company and the largest producer of copper in the world, what were the initial opportunities Codelco identified in Brazil?

At the beginning of Codelco's operations in Brazil, our company initiated joint venture agreements with local explorers (Santa Elina) and copper producers (Carajá Metais). This was considered the fastest way to appropriate the learning curve on Brazil's geology at that time.

What are Codelco's current projects in Brazil and how are the company's exploration efforts being directed?

Our company explores exclusively for copper in Brazil and elsewhere. Codelco do Brasil has been evaluating various prospects country-wide. Our main focus has been the Carajás Province, which is the largest mineral province of the world. Having said that, we also evaluate properties in other Brazilian states.

Brazil's licensing procedure is notoriously difficult and hard to navigate. With the new mining code still in discussion, what is your view on this bill and how will it affect Codelco should it be passed?

I do not think it is appropriate to evaluate the new mining bill given that it is not clear at the moment that political conditions are set to have it moving on to Congress. Brazil's current mining code dates back to 1967 and, on a broader perspective, has all the necessary provisions in terms of mineral exploration and mining. Obviously, there are other ways to have the current code updated, not necessarily creating a new code. As to Codelco's operations, right now exclusively dedicated to mineral exploration in Brazil, I would say that the most worrying issue would be the public auctions provision on the new mining bill. It is also important to note that all discussions regarding the new mining bill have been appropriately discussed by the main

mining entities in Brazil: IBRAM and, on the mineral exploration side, ABPM.

Looking ahead, where would you like to see Codelco in Brazil in five years time?

As a world leader in the copper market, our company is fully determined to have an operating mine in Brazil and contribute to the country's development in a socially and environmentally responsible way.

Technology is becoming more important in all facets of the mining industry to both reduce costs and to increase safety. Are you able to provide examples of new technologies that Codelco has implemented in its exploration work in Brazil?

Codelco keeps an eye on the mineral exploration sector and is always evaluating new developments in software, hardware, mineral exploration techniques and, by doing that, has incorporated new tools and concepts to its business. One example is the use of new consoles and portable equipment on its exploration work. We also use techniques such as SOM (Self Organizing Maps), Vectoring and Specialized Systems (knowledge-based and data-based).

Do you have a final message for our readers?

As miners, we must not focus on the short term. I am pretty sure that the current commodity downturn is not the first and will not be the last one that we see. I am confident that our industry will move on with confidence and will take all necessary measures in order to move forward. We have a highly skilled workforce, although sometimes it might not look that way, and we have the knowledge and the tools necessary for change, but will is needed. Brazil is friendly on foreign investment and there are opportunities for all interested parties in our country. —

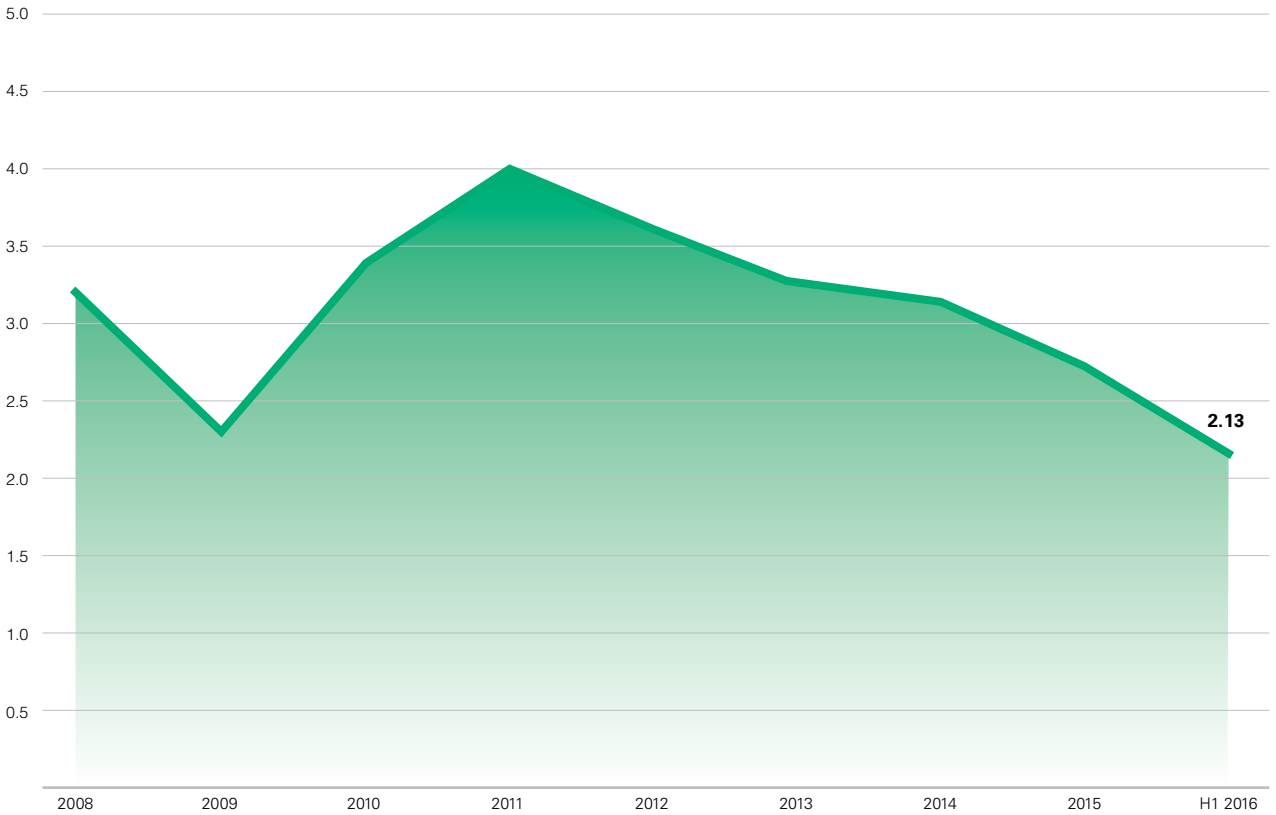


Image: Komatsu

COPPER PRICE CHART

Source: LME

● AVERAGE ANNUAL PRICE (USD/lb)



Mark A. Smith

President and CEO

LARGO RESOURCES



Could you give us an introduction about Largo Resources' assets and team in Brazil?

The Maracás Menchen mine is the highest known ore-grade vanadium project in the world and has demonstrated its ability to metallurgically extract vanadium out of the ore and sell it as V2O5 flakes. In addition to being a world-class asset, Largo has a fantastic group of people who are committed to success. I am personally thrilled to be working in Brazil. I have been involved in Brazil since before 2000, when I was part of a company called CBMM, which is the largest niobium-producing company in the world.

How is the Maracás Menchen mine developing?

The mine is very close to operating at nameplate capacity and has actually exceeded this capacity on several occasions. We have gone through two rounds of refinancing in the last 12 months due to start-up/ramp-up costs, but also due to the price of vanadium. Vanadium had been at roughly \$6 to \$7 per pound (lb) but fell to \$4/lb in April 2015 and to a low of \$2.25/lb in December 2015. 100% of the debt is financed by Brazilian banks, which believe in Largo and refinanced us based on their trust in our abilities and the market opportunities for vanadium. These refinancings bought us time so that the price of vanadium can return to a level at which we can produce economically. Glencore is our major international

partner, and has an agreement to buy all of our production for the next four years.

We are strategically focused on getting the Maracás Menchen mine operating to its full potential and taking advantage of the world-class nature of the asset. Our unit costs are roughly \$3.50/lb, which is nearly the cheapest in the world. The ore body is so large that it will be able to support additional supply as the market demands it.

How do you see the market fundamentals of vanadium developing in the near term?

We expect prices for vanadium to rebound impressively during 2016. This is due to steady global demand, which appears to be growing at about 2% to 3%, but largely due to a drastic decrease in forecasted supply. The recent decline in prices caused severe pain for vanadium producers around the world. Two major suppliers in South Africa, which in combination represent 12% to 14% of global vanadium supplies, are in bankruptcy and winding down their business.

China's vanadium production is also set to decline markedly due to several factors. First, there are eight companies in China producing roughly 53% of the world supply, less than 10% of which is exported. These companies harvest vanadium from slag from Chinese domestic iron ore used in the production of steel. The content of vanadium in the slag is high, roughly 4% to 10%, but these eight companies are associated with many of the older steel companies. As China rationalizes its steel industry, it will close down older steel mills that are cost-inefficient and polluting.

With these closures, we estimate production will decrease at one of these producers from about 30,000 metric tons (mt) to about 22,500 mt or lower. If another 7,500 mt of vanadium comes off the market from China, there will be a total reduction in supply of roughly 20,000 mt worldwide. As a final point, China is importing more iron ore from Brazil and Australia than ever before because it is higher quality, but it has no vanadium. Thus, as a result of importing more iron ore, China's ability to produce vanadium is decreasing. China might actually turn into a net importer of vanadium. The last time this happened in 2004, the price of vanadium rose to \$25/lb. —





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Luiz Terra

General Manager

**EMBU S.A ENGENHARIA
E COMERCIO**



What is Embu's positioning in the market?

Embu has been operating in Brazil since 1963 and we produce the highest quality of aggregates for the construction industry. Our first mining project was in Embu das Artes, Sao Paulo. In 1970, we established another plant in Mogi das Cruzes in the East of Sao Paulo; in 1986 a plant was opened in the Northern district of Sao Paulo, Perus; in 1988 we established a plant in Vitoria, Espirito Santo.

From 2007 until 2013, the construction industry was thriving, and Embu made some investments to improve our operations. We established two new plants in Itapeti and Viracopos, which began operations in 2014. Currently we have a total of six operational plants as we recently established a plant in Paraibuna.

What are some of the main products that Embu offers?

About ten years ago, we began to group the categories together, as from crushed stone production we are manufacturing sand. Our

aggregate product line currently includes stones of various sizes; graded gravel (*brita graduada*) that can be machined, crushed or treated with cement; roller compacted concrete; pedrisco, grit, gravel and various forms of sand. Embu is vertically integrated and we sell our products directly to contractors and concrete plants.

What is Embu's current level of production in terms of tonnage?

Currently we are producing between 320,000 and 350,000 metric tons per month. Not only has our production level decreased (Embu's average production levels in 2013 were 550,000 metric tons of aggregate per month), but also production costs are increasing, while the price of products in the markets is declining. This means that Embu's profit has significantly decreased over the last three years.

How does Embu remain competitive in the market?

Embu has been making necessary internal adjustments since 2014. We have reduced the size of the company and have been focusing on cutting costs. We have been trying to enter different markets and we are making a huge effort to keep offering competitive prices. The locations of our plants are strategically placed in Sao Paulo, a state that offers plenty of opportunity; we currently do not have plans to expand our operations to farther regions in Brazil such as Rio de Janeiro.

The product that Embu offers to the market can almost be seen as a commodity. We can add value to the market through the services and the quality of the products that we provide. Aggregates are not a simple product as there are many difficulties in the production process. By adding innovative technologies and services, we can remain competitive.

What are some of the technological advancements that you have incorporated in the production units?

Embu uses equipment such as excavators, 40-ton off-road trucks, crushers and screening equipment. The main brands that we use are Caterpillar and Liebherr as they provide very good after-sales services, and our crushers are mainly Metso equipment. In terms of technologies, we utilize automated equipment within our plants. The technologies used to manufacture sand are also very advanced.

Embu has a strong commitment to sustainability. Could you expand upon this?

It is necessary to commit to sustainability and we are aware of our social responsibility. Embu's good mining practices translate into care for the environment and the population of the surrounding communities. We also have an Institute of Sustainability that develops and promotes sustainable projects.

What is your opinion on the future evolution of mining aggregates in Brazil?

We expect that the future of aggregates in Brazil, and of Embu as a company, will be very positive. Construction projects will never stop and thus there will always be a demand for aggregates. We believe in the future of Embu and the industry we operate in. —

EMBU SA

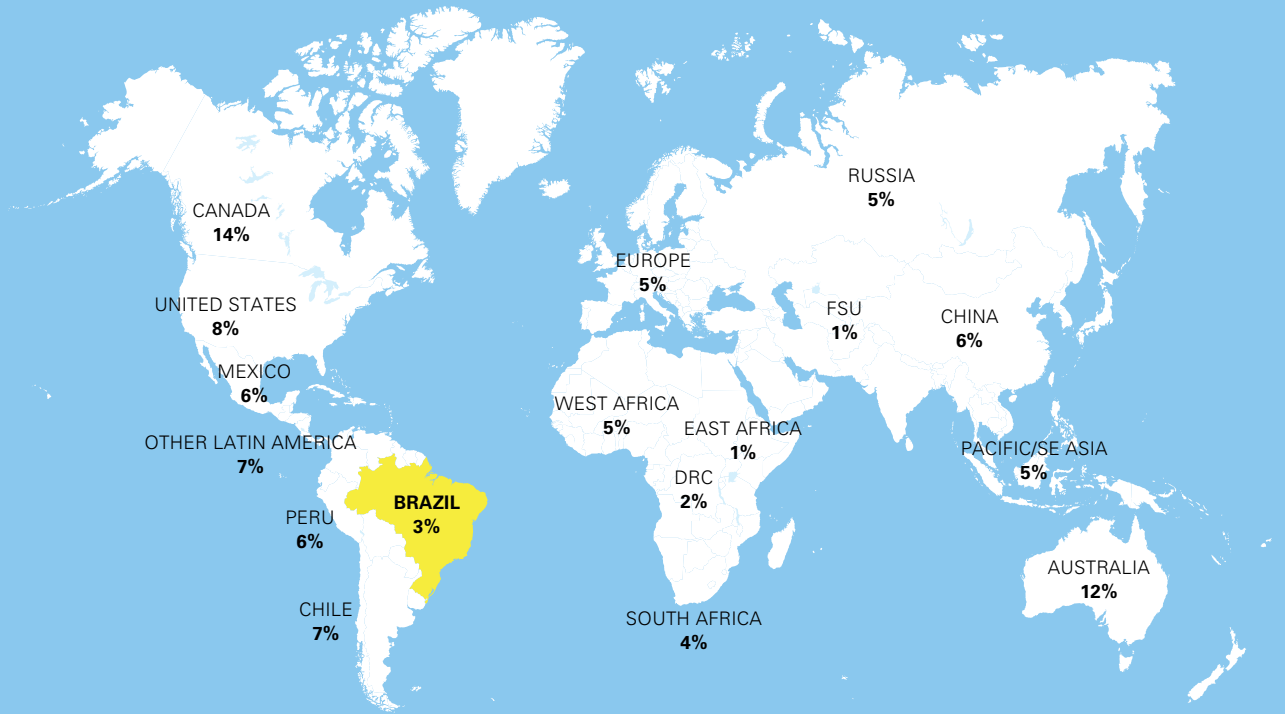
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TOP DESTINATIONS FOR NONFERROUS EXPLORATION 2015

Source: SNL Metals & Mining



Other locations account for 3%



Image: Embu





REGULATORY FRAMEWORK



“The rules today are the same for all sizes of mines; how can the same principles be adequate for S11D and for a small gold mine such as Andorinhas? Moreover, we may be one of the few countries in which underground mine shifts are limited to six hours per day. Obtaining a mining permit in Australia takes normally one to two years, in Brazil it normally takes from three to five years.”

- Luis Maurício Azevedo,
Director,
FFA Legal

Brazil's New Mining Code Is Old News

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First announced as one of Dilma Rouseff's flagship policies a few years ago and formally discussed in Congress since 2013, the 'new' mining code has become old news and the subject of frustration for many miners in Brazil. While a number of attempts have been made to speed the passage of this bill, the country's political disturbance has prevented this. A special committee in Congress is currently discussing the code. It is certainly in the government's interest to have this bill passed, as the new regulations will see increases in the royalties paid by miners. Indeed, the minister of mines and energy, Fernando Coelho, stated earlier this year that the government wants to expedite the passage of this project.

Besides royalties, another key aspect of the new code is to introduce a bidding process for licenses on undeveloped mineral deposits. This will replace the current 'first come, first served' model. This system was designed to prevent companies from sitting on deposits and instead give the rights to develop the lands to those with the abilities to do so. However, many have raised concerns that this will push out the smaller players that would be unable to compete against majors in such a process. This may prove a threat to exploration in Brazil, which is primarily driven by small juniors. The bill would also see the creation of a new agency called the National Mining Agency (ANM) and the dissolution of the current National Department of Mining Production (DNPM). The establishment of an independent agency is favored by most as it may go some way to easing the highly complicated licensing procedures.

Whether companies support the new bill or oppose it, the uncertainty over its future is a cause for concern and is making potential foreign investors more reluctant to put their money in Brazil. In 2014, IBRAM estimated that Brazil had missed out on R\$20 billion of investment due to the uncertainty surrounding the new mining code. This shows that, without regulatory stability, Brazil will lose out on even more investment. —



Luis Maurício Azevedo

Director
FFA LEGAL



Could you give us an overview of FFA Legal and the services it offers to its clients?

FFA is a legal firm dedicated to the mining sector in Brazil, providing legal support, accounting, consulting, auditing and financial advisory and risk management to its clients. FFA intends to be a “one-stop firm” that delivers specific solutions to individual challenges and helps clients get the results they need. When it comes to junior companies, we can provide them all their back office, which allows them to focus on their main business, exploring and mining in a more competitive way. Due to our local expertise, we have in many cases helped our clients find competitive opportunities for acquisitions, joint ventures and farm-ins, optimizing their investments and developing a strategy of being cash-sustainable.

Changes were proposed to mining legislation, but these proposals seem under threat due to the current political environment. Are these changes good for the industry?

No, definitely those changes were not good and I am glad that the government seems to have backed off. In our sector, changes need to be carefully considered. We need to understand that we are solely dependent on risky investments, and any changes, unless they are clearly beneficial, would frighten

investors. In this particular case, the government was bringing changes that were inconsistent when compared to the rest of the world. Combined with the crash of commodity prices and the current political environment, they have definitely frightened regular investors.

Why do you think Brazil has yet to fulfill its potential in mining?

I am sure that Brazil could bring lots of mines into production in the next years. Maybe not world-class mines, as S11D Paracatu, but small to medium size mines. We have a great potential, but this will only be realized if we change the environmental and labor legislations. The rules today are the same for all sizes of mines; how can the same principles be adequate for S11D and for a small gold mine such as Andorinhas? Moreover, we may be one of the few countries in which underground mine shifts are limited to six hours per day and 36 hours per week, while in most countries it is eight hours per day. Obtaining a mining permit in Australia takes normally one to two years, in Brazil it normally takes from three to five years.

Besides your activities in FFA, you have also been active directing junior miners, launching IPOs and facilitating mergers

and acquisitions. Could you tell us more about this line of work?

My first opportunity to put a project together and find investors to launch an IPO was in 2005. Since then, this has been a very active part of my career. I presume that, being a lawyer and a geologist, and after working for 20 years with mining and smelting companies, I am able to identify good opportunities and help develop them. From 10 initiatives we have worked with, two became real mines: Rio Verde and Avanco, and it looks like we have a third one in the pipeline. By including me in the management team, investors are adding local and reliable expertise, and this goes beyond the regular client-attorney relationship. It gives investors security that I am fully watching their interests.

Do you have a final message for our international readership?

Investing in Brazil can be very beneficial as the country has a friendly environment. Banks and service companies have people that really understand the dynamics and needs of the mining sector. It is important for investors to get the right advice as to how to better operate in Brazil. If you can make people understand your vision and mission, you will get the support that you seek. —

Carlos Vilhena

Partner

PINHEIRO NETO ADVOGADOS



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“

I would recommend my clients to stay away from 50/50 joint ventures like Samarco. In a case where both parties have equal shares, it is difficult to determine the company that is responsible for operations.

”

Please tell us about the significance of the mining practice within Pinheiro Neto Advogados.

Pinheiro Neto Advogados is Brazil's leading law firm with a legal practice in the mining industry. We serve all the legal needs of the mining industry, including mining policy review, consultation on environmental policy, tax law, mergers and acquisitions (M&A), mining litigation, project financing and regulatory matters.

How has the demand for your services changed over the past two years?

The volume of the work that we do has not changed, but we have seen a change in the type of services we provide. There is a lot more bankruptcy-related and debt-renegotiation work. We have seen a sharp decline in demand for services around debt financing and M&A, while there are still some requests around royalty and stream financing.

Our client composition has also changed. A few years ago most of our clients were exploration companies, specifically Australian and Canadian juniors. Today, this kind of work has almost disappeared, and we mainly work with producing companies and banks.

What changes need to occur in order for companies to begin to invest in exploration in Brazil again?

Brazil is a very rich country in terms of geology, but this alone cannot attract exploration dollars. Today, investors are looking for mature projects with low risks, rather than greenfield projects.

Brazil is currently facing a difficult political situation, and it remains unclear how it will develop further. Yet the unstable political situation is not the main factor keeping exploration companies from working in Brazil. A more pressing issue is the lack of financing resources available on the market. Hopefully, rising commodity prices will bring improvements to the financing side. The Brazilian government will need to do its homework and finalize the changes in the mining legislation to attract mining companies.

How has the recent disaster at Samarco affected the discussion about the regulatory framework?

Right after the accident, there was a reaction on behalf of the Lower House to

amend the current mining legislation. There was a proposal to create a provision in the mining code stipulating that mining companies need to put money aside for mine closure and for dealing with environmental issues. The regulation for tailings dams was also proposed to be amended. Currently, the industry decides what to do with tailings, and the government is not involved. If this responsibility is transferred to the government, however, it will create a lot of administrative changes. At the moment, the mining department does not have the human and financial resources to review all the dams.

What has the industry learned from Samarco?

Before the disaster, Samarco was perceived as a model of safety and a benchmark for other mining companies for tailing dams. From the legal and business perspectives, there are several conclusions that we can draw. First, I would recommend my clients to stay away from 50/50 joint ventures like Samarco. In a case where both parties have equal shares, it is difficult to determine the company that is responsible for operations. Second, I would recommend my clients to avoid being involved in operations that are managed by independent entities; like the case of Samarco.

The system that is in place to review tailings dams clearly is not working properly and needs to be improved. Whether through transfer of this responsibility to the government or to an independent person, as in the case of other mining jurisdictions, the system needs to be updated.

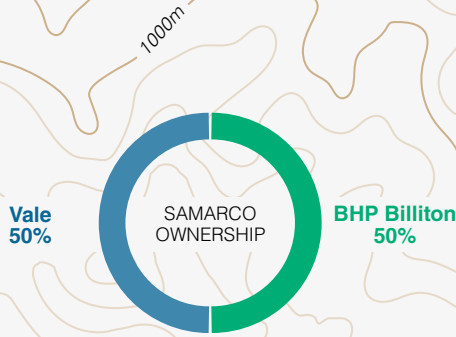
When will the mining legislation be finalized?

There is a long way to go to pass new mining legislation. It still needs to be voted by the Lower House and reviewed by the Senate. If the Senate decides to introduce any changes, it will have to go back to the Lower House and the process will be repeated. If there is a real interest and commitment on behalf of stakeholders involved to approve this legislation, it may take as little as six months. Yet we do not see this kind of interest and willingness at the moment. The government is not interested in creating an independent mining agency because it will raise costs. —

SAMARCO'S BENTO RODRIGUES DAM DISASTER

Date: November 5th, 2015

Location: Mariana, Minas Gerais, Brazil



60 million cubic meters

of tailings flowed into the Doce River



DAM

800m

1000m

1000m

800m

800m

1000m

Bento Rodrigues



casualties

17 deaths
16 injured

200 homes destroyed

Mud reached the Atlantic Ocean

20 billion real (\$6.1 billion)

Value of compensation package as per Brazil's Superior Court decision, June 30th 2016

800m

José Ribeiro do Prado Jr. & Pedro Henrique Jardim

JRP: Partner

PHJ: Senior Associate

MACHADO MEYER



JRP



PHJ

How does Machado Meyer assist its clients?

JRP: Founded in 1972, we are a full-service firm that is focused on clients who want to do business in Brazil. These clients are leading players and come from Brazil as well as abroad. We are focused on areas such as business, environmental issues, mining and infrastructure. As of now, we have 55 partners with 350 lawyers in various cities around the country, including a small office in New York.

What are the firm's mining-specific services?

JRP: We are working with sponsors developing projects and banks financing projects. We help guide newcomers to the market if they want to do mergers and acquisitions, as well as structuring existing businesses.

PHJ: We have also been working intensively in related areas, such as ports and railways. We have done some work together with BNDES, which is Brazil's development bank, and other governmental entities in regards to investments in those areas, as well as advising on new legislation. They work with consultants like Machado Mayer to develop or understand how to improve the market.

What is the importance of the mining industry for your firm today, and do you see any projected growth in the future?

PHJ: When it comes to future growth, now it is probably the time to consolidate rather than develop new projects, which means that we will continue to see a lot of activity in this sector. The nature of the work will be different, though.

Besides mergers and acquisitions, are there any other active trends?

JRP: Refinance is a very active area. Due to the fluctuation of international prices, some projects may or may not be feasible anymore and companies may not be able to meet their obligations under the current financial conditions. As a result, the banks have been allowing changes or refinancing deals, so that companies can repay their debts in full.

How much does the mining industry rely on international markets for financing?

JRP: International banks are very active in big projects with big companies behind

them. We also have some smaller companies and projects financed by international banks. The Canadian stock exchange is often used to fund junior projects.

PHJ: There is a difference between smaller mining companies and big players in terms of how they finance their projects. Big companies have access to international money, and there are other projects in Brazil that have issued bonds and incentivized notes, which is a new type of financing for mining projects.

Your firm helped Samarco arrange a settlement with the Brazilian government for the dam catastrophe in November 2015. Beyond that settlement, is the mining industry taking enough measures to prevent disasters?

JRP: This is a good question because there is a lot of public pressure right now. Politicians and authorities in general are reassessing current legislation and its consequences. We may see changes in environmental law and mining legislation as a result. There are a lot of consultants providing advice on how to improve this system.

Some international investors are concerned about the political situation in Brazil. Are these concerns justified?

PHJ: What is going on is a unique event, but of course we have concerned clients. On the other hand, there are others who believe that, if they have long-term strategies, now is a good time to invest. The currency has devaluated by about 30% to 40%, and those who need fast cash to get out of debt can benefit from selling assets. Yes, there is political instability right now, but we continue to have strong political institutions and legal and judiciary systems.

Could you give us a final message for our readers?

JRP: Brazil is a place that welcomes foreign investors and foreigners in general. We need international money and we need foreigners here to help our economy and society grow in different ways. We have few restrictions in the well-developed industry of mining. I continue to believe that foreign investors, with the right advice and the right partners, can be very successful here. —

Fábio Figueiredo

Partner

FIGUEIREDO, WERKEMA & COIMBRA



What are the main lines of work for Figueiredo, Werkema e Coimbra?

Figueiredo, Werkema e Coimbra Advogados Associados is law firm that is based in Minas Gerais. Due to our location in the mining capital of Brazil we work predominantly in the mining industry. Our clients include companies from all types of the mining value chain including explorers, engineering companies and equipment manufacturers. We help our clients deal with both mining and environmental matters, and we operate as any regular law firm would in this regard, involving ourselves with litigation, consulting and civil law.

The new mining code has been discussed by Congress for several years and there is a lot of uncertainty regarding Brazil's regulatory framework. What is your opinion about this?

My personal opinion is that the current mining regulatory framework is a safe and secure environment. It is a code that was introduced in 1967, has governed this industry for many decades and has survived through a number of constitutions. Moreover, the current code is very similar to the previous one, which had been in place since the early thirties. It is not an undemocratic code and it controls the industry in the same way as the regulatory framework in other major mining countries. Brazil's oil and gas regulation was changed a few years back and this prompted the govern-

ment to think that the same was needed for the mining industry. However, I believe that a full change is unnecessary and instead a few aspects of our current code should be reassessed.

The new mining code would see the abolishment of the DNPM and the creation of a new agency. Is this a good change?

Should the proposed new agency work in the same way as an agency does in the U.S., i.e. with money and independence, then this would be a hugely successful model. However, if I look at existing agencies in Brazil, such as the ones for energy and transportation, they really are not as independent as they should be. A mining agency for Brazil would need money to be able to carry out its own audits and deal with all the needs of this sector.

What changes to the current mining code would you introduce?

The main aspect that needs to be addressed in the current mining regulatory framework is environmental law. The system needs to be changed to expedite processes and also to reduce uncertainty. In Australia, for example, one can submit studies to apply for an environmental license and that company will know that exactly in six months they will receive their license. In Brazil, one will never know how long the process will take and the process can often take up to several years. This uncertainty has deterred

a large amount of investment into Brazil's mining industry.

Are you able to provide details on the difficulties of the current process for obtaining mining licenses?

Currently, obtaining a mining license is a three-step procedure. First, you must obtain a previous license, then a license to install your operation. Finally you must obtain an operational license to begin producing from your project. This makes for a very bureaucratic and timely process. Again, it also creates uncertainty and risk, as after installing your operation and investing in the country you will still not be entirely sure that you will obtain your license to actually begin producing, however I have never seen this happen.

Is there any time when a company is able to begin operations without having obtained the final operating license?

There are two cases whereby a company can begin operations. The first is to apply and obtain a provisional license, though this is an uncommon occurrence. The second case is that a company will simply begin operating once it has installed without an operational license. The company will then approach the government, invite to inspect the operation and then begin the process of applying while continuing to produce under an agreement. This, however, results in a penalty for the company. —





SERVICE PROVIDERS



“In this economic climate, there are no new investments in greenfield projects and many companies are focused on reducing their sustaining capital expenditure. This can be reduced by optimizing solutions and improving production capacity through minor investments.”

- Alvaro Bragança,
Business Director,
Promon Engenharia

Exploring New Opportunities

The strategies of the suppliers

What are the suppliers doing to survive? With no more mega-projects and juniors mothballing or cancelling greenfield and expansion ventures, suppliers face a radically altered playing field. Many engineering services and equipment providers that were able to ride the boom of the country's mining industry now have to seek either new industry segments or international markets in which to apply their expertise.

In this context, a strategy of diversification has become the most common course of action. "Steinert's approach to the Brazilian market has changed completely and we are currently focusing our attention on recycling," said Paulo da Pieve, managing director of Steinert Latinoamericana, a German-headquartered provider of separation equipment for materials handling. "We are still capable to assist the mining market in Brazil, but to survive we had to diversify our markets."

Trado, which manufactures lightweight drills for exploration work, has not been able to diversify into other industries due to the niche nature of the company's product. They are instead looking to break into other geographical markets. "Trado has been exploring foreign markets for some time now," said Alexandre Neto, Trado's general manager. "Today, however, there is a serious imperative for us to do so as the internal market has become so small."

Another strategy some manufacturers are taking is to focus on the aftermarket services. The decreasing number of new projects and a general reluctance from the industry to invest in new equipment means that miners are now looking to maintain and optimize existing fleets rather than replace them. In this sense, the suppliers are pushing for long-term contracts with their customers to provide on-site maintenance. However, unlike other Latin American mining countries, post-sale contracts are not common in the Brazilian market, with companies preferring to simply buy a piece of equipment and operate and maintain it themselves. "Unfortunately, Brazil is not very fond of maintenance contracts compared to places like Chile. When the mining industry started in Chile, mining companies did not have enough skilled employees to maintain their equipment and they relied on the manufacturing company for maintenance services," explained Francisco Macedo, vice president of mining at Komatsu in Brazil. "[This] is not the case in Brazil where there is availability of skilled labor and the companies have their own maintenance crews."

Normet, which is an international company that provides solutions for underground mining operations, still continues to expand the fleet it has in Brazil, but also sees a rental service as offering

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- ❖ Underground drilling;

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- ❖ Hydrogeological boreholes;
- ❖ Over core drilling for stress measurement;
- ❖ RC drilling;
- ❖ Air core and screw core (hollow auger) drilling;
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João Luiz Carvalho

CEO
GEOSOL

What has been GEOSOL's history and evolution?

GEOSOL was founded in 1953 under the denomination of Geologia e Sondagens Ltda., by Victor Dequech, a mining and civil engineer, with headquarters in Criciúma, Santa Catarina. The company developed its first drilling works in the coal mines of southern Brazil. During the 1960s, GEOSOL expanded its operations to other states: Pernambuco, Minas Gerais, Goiás, Paraná and Rio Grande do Sul. The cycle of large structural transformations in the company started between 1967 and 1978, when it created a chemical and geochemical analysis laboratory directed to clients from the mineral sector, which became the largest analysis laboratory in Brazil. Subsequently, the fleet of equipment was expanded. The geology activities were assisted by almost twenty geologists dedicated to several geological mapping works and the assessment of mineral deposits.

From 1970 onwards, operations concentrated on the drilling services, with acquisitions of a number of drill rigs overseas. In 1971, the headquarters were transferred to Belo Horizonte. The expansion of the drilling activities continued over the following two decades, by means of modernization and mechanical standardization of equipment, resulting in significant productivity gains. During the late 1980s and early 1990s, the major Brazilian mining companies began to subcontract their drilling services.

How important was it to professionalize the company?

In 1970, GEOSOL stopped being a family business and started being controlled exclusively by Brazilian partner-employees – a policy introduced by its founder, Victor Dequech. By allowing their employees to take part in the control of the company, GEOSOL ensures not only its survival, but also renews its human potential by means of the incorporation of new professionals to its technical and managerial structure. Currently, the partner-employees hold 100% of the company's capital.

Today, GEOSOL has an integrated management system looking after the entire drilling process. The company has a range of modern hydraulic drill rigs prepared to perform tasks in different ground conditions, remote areas and in-depth holes, with excellent core recovery and core presentation quality. Its exclusive management software provides the drilling reports data, production rate, bit

consumption, maintenance schedule plans, and logistics services to support the different conditions.

Could you please describe the company's vision for the future?

GEOSOL has an investment plan, revised annually, mainly focusing on the technical and behavioral training of our staff, improving drilling techniques and renovating the drill rig fleet, vehicles, down-hole equipment, and hole survey tools. We seek the best products in the world market, participating in trade shows and industry conferences, maintaining our teams trained in the industries' best practices.

Recently, GEOSOL invested in drilling know-how for gas exploration. For that, we developed an entire range of technology using drill rigs designed for the mining industry to drill deep on shore gas wells, with enormous cost reduction, never seen before in the gas exploration industry.

How has the environmental disaster at Samarco changed the Brazilian mining industry?

In my entire 25-year career, I have always seen Samarco as an example of respect to the environment, as well as to its employees, to the community and to the contractors, determined to promote the sustainability of the mining industry. This is a company that has a remarkable role with the social development of the region of Mariana. Those affected will not miss the social responsibility which is part of Samarco's DNA. I am sure that the causes of this accident will be identified and the learning will serve to prevent future occurrences around the world.

Do you have a final message about GEOSOL?

Previously, the focus was to structure and consolidate the GEOSOL Group. Now, the biggest challenge is to keep the company on the direction that promotes growth with innovation, market diversification and perpetuation of the group, even in periods of low commodity prices.

We are always looking for high level of corporate governance, ethics, respect to the communities and the markets where we operate. The growth of an organization should not compromise the quality of life of current and future generations, but create sustainable solutions to promote the growth of all stakeholders. —

José Mendo Mizaél de Souza

President

J. MENDO CONSULTORIA EMPRESARIAL



Could you give us an introduction to J. Mendo Consultoria Empresarial?

I founded J. Mendo Consultoria ten years ago, but I brought my 55 years of experience in this industry to the company. I founded IBRAM and directed the institute for almost 30 years. To sum up, J. Mendo combines the best national and international experts. We carry out projects of various types, such as technical studies, strategic support and innovative solutions to improve safety results and productivity and to reduce costs. As an example, J.Mendo has developed, with some technology partners, methods to filter the waste before the stacking stage, in order to avoid or reduce close to zero the need for dams.

What opportunities or advantages do you see for new investors in Brazil's mining industry?

The investor who is analyzing Brazil finds a territory of continental dimensions that presents the world's best geological potential. Further-

more, Brazil is seeking investment in infrastructure in the mining sector, since it needs to develop steel and cement production, improve ports, roads, and railways, and overcome other logistical challenges. Mining is holistic.

Could you give more details on your filtration system for tailings?

Water is one of the most important mineral commodities for humanity and must be preserved. Even if the filtering technology is already well known, its importance has been widely recognized, especially after the latest tailings dam incidents. The application consists of the development of a high-pressure filter that is capable of delivering water more effectively through the drainage of the waste. This is a great technology because it offers minimum risk. How this separation occurs depends on the characteristics of the material produced and the peculiarities of each mining activity. For instance, VOGBR, a J.Mendo partner, developed a system for ArcelorMittal, consisting of a draining stacking system where the material drainage is simultaneous to the stacking process, decreasing expenditures even further.

How do you see Brazil's mining industry evolving?

Demand and supply are critical for the iron ore industry. However, since Brazil has the world's highest-quality iron ore and dominates the necessary infrastructure for its exploration and supply, it is competitive under all circumstances. The demand for iron ore and steel will increase again, either with China acting as a major player or with the participation of new competitors such as India. —

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Alvaro Bragança

Business Director

PROMON ENGENHARIA

Could you describe your main offerings in mining?

Our service offering includes prefeasibility studies, as well as engineering and integrated solutions such as EPCM and EPC. In mining, we work with clients in gold, aluminum, iron ore and fertilizers. A project has a certain life cycle and typically there are different phases. Promon believes that if it can offer its expertise during the studies, tradeoffs and conceptual phases of a project, we can add significant value to the entire operating chain. We can then leverage our position and be involved in other project phases.

Promon was engaged by Largo Resources to engineer and build its Maracas Menchen vanadium project. We developed the basic and conceptual engineering designs and assisted the client in the environmental licensing process. After finishing the basic engineering design, we presented our implementation strategy to the bank and obtained the necessary financing. After that, we implemented the

project on time and on budget. Currently, we are also assisting Largo during the operations.

Mining companies are trying to cut costs. Where can Promon add the most value for customers?

In this economic climate, there are no new investments in greenfield projects and many companies are focused on reducing their sustaining capital expenditure (capex). This can be reduced by optimizing solutions and improving production capacity through minor investments. Promon's strategy is to help existing players in the market be more efficient and unlock value in their existing operations.

Promon has recently opened an office in Peru. What is the company's strategy for establishing an international presence?

Promon has been working on its internationalization strategy for many years. From our Brazil offices, we have been assisting our clients on exporting operations to different parts of the world such as Australia, Saudi Arabia, Africa, Argentina, and Chile. After evaluating our strategy, we identified that it will be more beneficial to have operations outside of Brazil as to position ourselves in different global markets and to balance our risks.

What is Promon's vision for the next three years?

We are positioning ourselves to be a relevant player in the mining industry of Brazil. We want to collaboratively work with our customers from ground zero to the final solution of the process. What differentiates Promon from other competitors is that it is not only a service provider, but also a partner to our clients. —

Marcelo Xavier

Director, Mining & Metals
PÖYRY



What is Pöyry's expertise internationally and in Brazil?

Pöyry is a Finnish company that has more than 55 years of experience in the market and has been in Brazil for more than 40 years. It always had its base in pulp and paper, but has diversified by getting involved in mining and metals, energy, infrastructure, chemicals, and bio-refining. Currently it has 500 to 600 employees in Brazil.

What sets Pöyry apart from other firms?

In 2014, we were able to anticipate the market approach that companies would need in 2015. We integrated specific business units with other services to make a package that we can offer to our customers in mining and metals. We told the market that we would serve them all the way from planning mine projects to operating logistics at the ports.

Is there a specific project that you are proud of?

We have one that was difficult to manage at the beginning because it was a customer with nine different sides to their company, and we had to unify those sides under one leadership and operation. We have seen many improvements in their operations and we have been given the privilege to suggest new projects and improvements. Having this kind of exposure within the company is a new way of working alongside the customer.

How would you compare Brazil's unique challenges and opportunities for ECPM players?

EPCM has standardized working processes with pulp and paper. In mining, however, it is more difficult to implement a big EPCM because companies are conservative and they need strong technical teams to help with implementation. Some tend to divide their projects into pieces, so it is common to see five or six different engineering companies working on the same segment. It is hard to change their mindset.

In Chile, they are more open to innovation in mining. Engineering companies that work in Chile have a long-term partnership with

their customers, so customers are more willing to experiment and innovate with them. We have seen something similar in the pulp and paper industry. They feel comfortable with all of the new ideas we bring, but when it comes to mining and metals, clients tend to be more reserved. We have to test out our ideas before we pitch them.

What practices has Pöyry developed that have proven useful in other locations?

Peru, for example, is strong in energy. The technological developments that we have applied in dams and hydroelectric energy are often brought to Brazil. We often combine services and innovation so different regions can benefit from them. Other fields, like bio-solutions, have positive developments in Brazil, so when we have the first project we will introduce it to Chilean and Peruvian markets.

Please give us an example of a partnership that you have engaged in which resulted in mutual benefit?

Mining contractors that take care of assembly and construction need firms that provide robust engineering with clear instructions and drawings, and give support during their work. We have received many references to contact other companies and, as a result, we exchange a lot of business development information and we get new projects. One characteristic that attracts companies to us is our large network of specialists and business units that become available to them.

How would you describe the state of the environment and the interaction it has with the mining industry?

Environmental and landscape preservation is evolving in a natural way, especially in new mine locations. As a result of the Samarco incident, projects will most likely be more expensive because of bureaucracy, and mining companies will be in the government's spotlight. What is important, despite all of the risks and changes, is to keep innovating.

If we look ahead, what is Pöyry envisioning for the next three years?

We imagine that the market will recover and will rise again. As we focus on companies developing innovation to their processes and to reduce costs, we hope they can be more sustainable so that when the market is back, they will be in a much better position.

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Image: Weir Minerals

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potential. “Normet is also focusing on replacing the older machines in the fleet with newer models and improving our technical support services throughout full time on-site contracts,” said Odilon Mendes, managing director of Normet Brasil. “Nowadays, with smaller projects being developed, customers are looking to rent rather than buy equipment, therefore we are developing our rental business.” A company of interest is U&M, a contract miner. U&M specializes in earth movement so that its customers can focus on their core competencies and avoid purchasing and operating their own equipment. “U&M’s current major clients include Alcoa, Vale and Yamana Gold. We have just started a new project with Vale and we are excited to showcase our abilities on this project,” said Sérgio Machado,

the company’s CEO. “We aim to prove to our clients that using U&M can be less expensive than investing in equipment and the goal is also to be competitive to the client’s own standards and set a benchmark for production.” One potential opportunity is that the weak real means that it could be the right time for international equipment suppliers to localize aspects of their supply chain. Brazil has a rich history in metal mechanics nurtured by the automotive industry. Most of the equipment manufacturers selling to the mining sector in Brazil still import the vast part of their machinery. Neuman & Esser, a German headquartered company that manufactures mills for non-metallic minerals, is one company that has capitalized on this opportunity. “Last September, due to the low value of the Brazilian Real,

Neuman & Esser decided to produce a whole mill entirely in Brazil,” said Marcelo Veneroso, president of Neuman & Esser Sistemas. “With this decision we will reach almost 100% of the milling system produced locally, giving our products a high commercial competitiveness.” Brazil’s tendency towards protectionism leads one to believe that there would be more in the way of promoting local manufacturing capabilities and incentivising a decrease in imports. The current environment does not favor high hopes for a great deal of investment in local manufacturing in the short term, but with a lower value of the Brazilian currency and of costs more generally, suppliers might yet see healthy prospects for setting up shop in Brazil. —

Sérgio Machado

CEO
U&M



How has U&M evolved in Brazil's mining market over the last years?

Since U&M started our mining business, we have been growing significantly fast. As a company grows, it starts to become more bureaucratic and complex. In 2012, we realized that we had to try and reach the same simplicity that we had 10 years ago as to not lose focus on our core business. As a result, U&M has made a 360-degree change over the last few years. We decreased the amount of employees in our head office from 120 to 20 employees, who can still offer the same structural support to our operations. We also reviewed our contracts and started to cut costs where possible. New and innovative technologies were implemented so as to make our business less bureaucratic.

The crisis was a huge motivation for the company to re-focus our business and we were ready for the situation. The scope of our capabilities has not changed and, as a service provider, U&M is able to offer contract *opex* services to companies and add value to their business when they are not able to invest in new equipment. U&M has a very large mining fleet, including 500-ton excavators and 300-ton trucks, therefore we can help our clients to complete operations significantly fast.

Who are U&M's major clients within the mining industry?

U&M's current major clients include Alcoa, Vale and Yamana Gold. We have just started a new project with Vale and we are

excited to showcase our abilities on this project. We aim to prove to our clients that using U&M can be less expensive than investing in equipment. The goal is also to be competitive to the client's own standards and set a benchmark for production. U&M specializes in earth-moving so that our clients can focus on their core competencies. U&M is currently in the process of finalizing the Vale S11D project where we had three contracts. The open pit contract was worth \$7 million.

Please highlight some technological advances that U&M has been incorporating in the company's operations?

U&M is implementing as many new technologies as possible to improve our equipment and services. We have technologies on our equipment that can show us if there are any technical issues so we can adhere to the problems before the equipment fails. We strongly believe in the skills and knowledge of our operators, but we try to avoid any failures with innovative technologies. We have recently invested in a system that monitors the operator's eyes and can tell you when the operator is getting tired.

In Brazil, equipment that is wider than five meters needs a police escort, which comes with significant challenges. Together with a team of engineers, U&M had a project whereby we reduced all of our flatbeds to 5 meters. We also aim to standardize all of our equipment so as to simplify operations and maintenance.

Can you elaborate on how U&M has refined the company's equipment fleet?

The aim is to refine our fleet to 100-ton Caterpillar trucks and 240-ton Komatsu equipment, and only use these two sizes in the future. With these two sizes we can fulfill all the needs of many different mines. In terms of excavators, we have decided to only have 250-ton and 500-ton Hitachi equipment. Our current fleet also includes Atlas Copco drills.

What is U&M's commitment to the local communities in the areas in which the company operates?

U&M is committed to community development and in many areas we were involved in infrastructure development of towns. We also support educational projects and we have been involved in a computer learning project for children. Creating jobs and training people can also be a benefit of our operations in mining areas.

What strategic goals does U&M hope to achieve over the next five years?

Our dream is to be the world's best company in our industry. U&M strives to develop people and we want to act on opportunities for improvement. We believe that there is always a way to improve operations and we strive to learn from other players operating in the industry. —

Percy Alberto Hilário

General Manager
OSSA BRAZIL



OSSA is a company with more than 60 years of history. Could you summarize its main milestones?

OSSA was founded in Spain in 1952 as a family business in the mining area. In the 1980s, the company underwent a diversification, expanding to other sectors such as infrastructure construction, including roads and railway tunnels. Later, in the 1990s, the company began to develop projects in high-speed transportation. In the early 2000s, OSSA restructured when the founding family sold most of its stake and thus ceased to participate in its management. A new organizational structure was implemented with the entry of the current president, Carlos Puente. Alongside these changes, OSSA began to increase its global market share, developing projects in Greece, Taiwan, China, Honduras, Costa Rica and Nicaragua. Today, we are working in countries such as Norway, Mexico, and Latin American countries such as Peru and Chile. In 2011, I moved to Brazil and set up the OSSA Brazil Underground company.

What are the main opportunities that the company saw in the Brazilian market?

Brazil has many investments in the energy and transport areas, mainly from development programs launched by the government. During this period, the mining industry was doing very well, as iron ore was being exported on a large scale and with high commodity prices. OSSA

made market research and found that, in addition to the prosperous local economy, the country was also investing in the installation of subway lines, which is one of the company's specialties. It was then that the administration decided to come. Today, the company is in Brazil as OSSA Brazil SA, which in turn enables their participation in international public tenders, increasing the possibilities for new contracts, especially in large government projects which are more competitive and more restrictive for their concession. To date, the company has worked in the private sector and in subcontracting arrangements with government agencies. The company had to import a complete fleet of equipment.

What were the challenges you faced?

Although mining is one of the main markets in the history of OSSA, to date we have not deployed any job in this sector in Brazil. On the other hand, since the company's founding in 2011, I had focused on the small hydropower sector, which was very hot at that time. However, I still have the objective to carry out activities in the mining area. In this sense, the greatest challenge to enter this market is the fact that there are already well-established companies performing similar activities to OSSA Brazil and usually performing long-term contracts. In addition to these factors, today, the current downturn in new investment hinders our entrance into this sector. Despite the current weakness of the Brazilian mining sector, if we compare the current Brazilian production with the whole of Europe or even the rest of South America, Brazil still constitutes a production much more expansive and diverse, from potassium to gold mining. This is exactly why this industry is a very interesting target for OSSA in Brazil.

As a final message, why should a mining company hire the services of OSSA Brazil?

I would like to say that OSSA Brazil is not simply a company for underground works, but a high-tech player in this segment. The high level of productivity that the company has is derived from a very qualified international workforce, coupled with permanent investments in machinery and expenditures in research and technological development. The company has, without doubt, a great advantage in this market with huge potential to contribute to the Brazilian mining industry. —



Paulo Medeiros

General Manager
MASTER DRILLING



What has been Master Drilling's evolution in Brazil?

Master Drilling was established in 1986 and the company started operations in Brazil in 2000. The incentive to open a facility in Brazil was the fact that AngloGold Ashanti invited Master Drilling to be part of their projects. We have a long-term contract with AngloGold Ashanti and have already been working on their projects for 15 years. Two years after starting operations in Brazil, Master Drilling also attained Yamana Gold as a client and we are still working with them.

We are currently the contractor of choice for any raise boring projects at all the mines in Brazil. The only commodity that we are not working with is coal, as these mines do not normally use raise boring as a technology. At the end of 2015, Master Drilling started to communicate with the coal mines to discuss some possible opportunities for the future. We are also in discussions with EPCM projects to start working in hydropower projects.

What was the impact of the crisis over your business?

Until 2014, Master Drilling did not feel the impact of the crisis very strongly. In 2015, gold prices decreased significantly, which had a strong impact on the company, as 70% of our revenue comes from the gold mines. When the crisis was strongly felt in 2015, Master Drilling still retained our clients as there is no way for mines to go underground without ventilation. Big projects for things such as shafts were stopped,

but ventilation operations had to continue. Currently, most of our projects in Brazil are for ventilation and, although Master Drilling experienced a decrease in revenue in 2015, we were still profitable as we had seven operating ventilation machines. Currently, gold price is recovering and we expect the situation to keep improving.

With regards to new drilling technologies, to what extent are they being implemented in the mining industry of Brazil?

One of the principle problems in the mining business is accidents, and we are working hard to mitigate these. Master Drilling has been developing automation technologies so operators do not have to touch the machines at all. With automation, there is less room for human error and accidents. Master Drilling's target for 2016 is to control the machines from the surface through internet cables. This technology will significantly reduce risks and costs for mining houses as much less operators are needed on site.

Do you have a final message to our international readership about Master Drilling's role in the mining industry of Brazil?

I believe that Brazil will continue to be the "El Dorado" of the mining business. Our mines are not very old and the capacity and possibilities of the mines are excellent. The government of Brazil is, however, a challenge for the mining industry and change needs to take place. —





EQUIPMENT & TECHNOLOGY



“Localizing our supply chain in Brazil has been a challenge in the past because of the fluctuating exchange rate. The quality in Brazil is of good standard, but there is work to be done to improve the logistics and planning challenges in the country. We have tried to bring about change, but the government is yet to adhere to requests from the industry players.”

- Sergio Zamorano,
General Manager,
Tenova TAKRAF

The Way Forward

The importance of technology and innovation

“

Due to the market retraction, the S11D project will start to operate at less than 30% of its total capacity. The industry is surviving with a huge gap between its capacity and its actual productivity. The machinery industry is no different, and activity has contracted by about 40%. The only effective strategy to restore Brazil’s economy is to promote exports.



- Carlos Pastoriza,
President,
ABIMAQ

”

Ultimately, to tackle the current challenges, the opportunity lies in technology. Miners are turning to technology-driven and innovative companies to develop solutions that optimize existing operations while boosting a project’s environmental and safety controls.

Some companies are already employing electromagnetic (EM) exploration geo-

physical equipment to locate iron, copper, and gold ore deposits. The managing director of Avanco Resources, Anthony Polglase, described how his company is benefitting from EM. “EM exploration geophysical equipment will not only allow the company to undertake its own EM surveying in the field without time constraints on equipment and at a far more competi-

tive cost, but also give it access to a leading-edge geophysical tool that is hard to source locally.”

Polglase, who has considerable expertise in developing and operating gold, copper, lead, zinc and tin assets, went on: “Previous EM work and baseline studies show definitively that all known IOCG deposits in the Carajás, including Antas and Pedra Branca East/West, produce strong EM conductors. Thus it is expected that ground EM will be a far more efficient and direct, drill-targeting, geophysical tool, in comparison to older conventional techniques such as induced polarization.”

The Samarco incident in November 2015 brought worldwide scrutiny to business’ adherence to environmental regulations. The collapse of the tailings dam belonging to the company owned in equal part by Vale and BHP Billiton, resulted in the death of 17 people and immeasurable devastation to local communities and the environment. This generated a surge in the number of companies seeking to optimize their waste management systems. For Outotec, an international technology and service provider, this presented an opportunity to aid the mining sector in its progression towards sustainability. “After the incident at Samarco, it will be significantly more difficult to get approval and licenses for new tailings dams and thus miners are starting to look at more sustainable solutions,” said Lars Duemmel, executive director. “Outotec is currently in the final stage of delivering a filtration plant for Alunorte, which is the largest alumina refinery in the world, so as to avoid the storing of wet tailings.”

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Francisco Macedo

Vice President Mining
KOMATSU

What has been Komatsu's evolution within the mining industry in Brazil?

Komatsu Brazil was established in 1975 in Suzano, Sao Paulo state, and was focused on manufacturing construction equipment. Our first facility still exists today and it is a well-equipped factory for small and mid-sized construction equipment. In addition to the construction market, Komatsu also developed a presence in the forestry and mining industries.

In the late 1990s, the company acquired different mining product lines, which promoted our complete package for mining solutions including trucks, dozers and hydraulic excavators. In 2013, Komatsu decided to acquire the local distributor. Currently, we only manufacture construction-sized equipment in Brazil and our mining equipment is manufactured in Japan, Germany and the US. The mining industry is Komatsu's main source of business and contributes more than 50% to our total sales in Brazil.

How have you adapted to the downturn in the mining business?

Komatsu had a great year in 2013, as the mining market was still in good condition. In 2015 our sales decreased significantly and this trend should continue in 2016. Sales volumes are important for survival, but most important to Komatsu is that our customer recognition is still increasing in these difficult market conditions, thanks to our efforts towards improving our service and after-market quality.

What is the size of Komatsu's fleet operating in the Brazilian mining industry?

Komatsu has about 400 pieces of mining equipment, 80% of which is in operation. Our equipment is mostly concentrated on Vale's mining projects, which contribute about 80% of our mining business. The remainder of our equipment is with Anglo American, CSN and MRN. In terms of market share, our hydraulic excavators are currently our strongest product.

What are some key competitive advantages of Komatsu's products?

Our SLQDC approach, which is: Safety, Law, Quality, Delivery and Cost. Safety is one of the most important aspects in all of our equipment. Komatsu aims to abide by all laws and regulations and to have compliance on all fronts. Quality is one of the

most recognized aspects of Komatsu equipment. Also, through the direct distribution of mining products to end users, Komatsu leverages its competitive advantage, while better understanding customer needs. Komatsu strives to be the most competitive supplier in terms of cost per ton and the goal is to prove this to our customers every day.

What is the scope of after-market services Komatsu offers to the Brazil mining industry?

The focus on the after-market is the result of companies going into survival mode and of the decline of greenfield projects. We are trying to amplify our market coverage with service teams on site. We have also dramatically increased our inventory levels and improved logistics efficiency to assure very fast response times and customer satisfaction. Komatsu also has innovative technological tools to monitor machine conditions online so as to enable predictability of parts, service and maintenance requirements.

The high availability and low cost of labor has resulted in Brazil being slow to implement new technologies. How are you pushing for new technology developments?

Delayed implementation of innovative technology is definitely the case in Brazil. Komatsu has a comprehensive fleet of autonomous trucks that are operating in Australia and Chile and which have not been welcomed into the Brazilian market. A joint initiative is a basic requirement for the development of such projects and that is how we are marketing and selling this product. Autonomous equipment is interacting with manual equipment and safety might be a great issue. A great majority of mine employees are truck operators and thus autonomous trucks may also cause community and union issues.

Cost per ton or efficiency is our main driver in the mining industry in general. To ensure that efficiency is continually growing, Komatsu is heavily investing in new innovative technologies. Going forward, we aim to invest in equipment overhauling capabilities and we are also thinking of local manufacturing in the future. Although importation tax is very high, at this stage it is still less expensive to import goods as compared to making an investment in a local plant. —

Davi Freire

General Manager

MODULAR MINING SYSTEMS



How do you see the current downturn in mining?

The global mining community has come up against a serious international crisis. Companies are facing considerable difficulties due to the substantial decrease in commodity prices. However, despite this crisis, companies in Brazil continue to operate and large firms such as Vale and Anglo American are searching for business efficiency improvement solutions, which presents a great opportunity for Modular Mining Systems. Our company has a rich history in producing tools to improve mining operations.

How has the business evolved since 2013?

Modular has always adopted an aggressive growth strategy. By adjusting our offerings

to fit the current environment, we have managed to increase our market share over the past three years as more companies turn to Modular as the preferred solution provider. This is an impressive accomplishment when you consider that the Brazil mining market is not expanding at all.

What are some of Modular's service offerings that you are most excited about?

Our software, MineCare, was first implemented in Brazil in 2008 for Vale's Itabira, Mariana and Brucutu mines. Since then we have also sold this software to Carajás, the largest iron ore mine in the world, which contributed to cost reduction. Based on this success, Modular Mining Systems recently launched MineCare 3, which is a cloud-

based product that allows us to sell what we call 'software as a service' (SAAS). The system will be running on a cloud-based data center and Modular can provide the mine sites with the fleet monitoring services. This makes the solution much more affordable for smaller mining companies and contractors.

How can you overcome the current reluctance to invest in new technologies?

As companies in Brazil struggle with the crisis, they are studying the success of global giants such as Rio Tinto and BHP Billiton. This leads them to an increased understanding of the importance of partnering with global solution providers like Modular. However, there is still hesitancy in the Brazilian market to invest in new technologies. Modular works with potential new clients to understand their operational needs and to showcase the success of our software when used by existing customers.

What are some of the challenges that you expect to tackle in the near future?

The next two years will present Modular with both challenges and opportunities. The difficulties will be the current unfavorable exchange rate, which means imported goods are more expensive. To overcome this, Modular has developed MasterLink Enterprise, a Cisco-based wireless network for mines where 80% of the devices are sourced locally. Another challenge is the local inflation rate. This causes problems on local service contracts.

Could you highlight the main opportunities for Modular and for the mining technology market in Brazil?

A major opportunity for Modular will be in underground mines. Currently the underground mining market is very small in Brazil, but it is predicted to grow as many open pit operations have the potential to develop underground processes. Modular recently released its DISPATCH Underground fleet management system for which we recently won an award. Safety at the mine sites is another area where the mining companies are willing to invest. To meet that demand, our brand new Collision Avoidance System is already running in Brazil. It runs based on intelligent path prediction algorithms and addresses more than 100 collision scenarios. This and other opportunities make for an optimistic outlook for both Modular and Brazil's mining industry. —

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Leonardo Parreiras

Director
INMECO



How has the market changed since minerals prices started to fall?

The market has changed significantly over the last three years and this has had a great impact on Inmecco. In 2015, we experienced a 60% decline in our sales revenue and 2016 will also be a very challenging year as there is a lack of investment in the mining sector. Inmecco is still keeping our focus on supplying better products to the industry, and we believe that there is still room for innovation.

At the end of 2015, Inmecco supplied innovative equipment to CBMM. The focus was to produce the equipment with 100% special steels and we were able to reduce the total weight by about 20%. This innovation is expensive but it can be beneficial, as it can bring about significant long-term savings for our customers. The challenge is that in this current economic crisis, not all customers are able to pay for more expensive products.

What particular impacts is the crisis having on the heavy vehicles segment?

Inmecco's main customers are the mining companies or the subcontractors for the mining companies. In 2011, the government reduced the interest rates and gave subsidies to companies to buy new trucks. Customers bought trucks at an interest rate of 2.5 % per year, which is very low by Brazilian standards. The crisis brought interest rates increases, and currently customers are paying 1.5% per month. As it

is very expensive to buy new trucks, companies are trying to operate with what they currently have.

Companies started to consolidate investments and shut down mines, which reduced the demand for equipment. The dump truck market came down from about 20,000 units per year to about 5,000 units in 2015. The reduction in the need for equipment, together with the surplus of equipment acquired in 2011, impacted the heavy vehicle segment significantly. There is currently a surplus of equipment in the market and it will take a while for demand to catch up.

Has adopting a strategy of diversification helped support Inmecco during this crisis?

The crisis has not only affected the mining industry, but many markets that Inmecco operates in. We still have a diversification strategy in place and we are trying to expand our operations into the agricultural market, where there still are significant opportunities. The agricultural market does, however, require lighter and less expensive equipment compared to the mining industry, but it offers a means of survival within this difficult period.

How did you adjust the manufacturing operations to cope with the current economical downturn?

Inmecco has adapted to the situation by reducing the amount of employees from about 200 to less than 40. As we are cur-

rently running in slow motion, we have time to rethink and study every task of the manufacturing process in order to improve our operations and become more efficient. We are improving our ERP as to double our production without increasing the amount of employees.

With regards to entering new areas of business, what differentiates Inmecco from competitors?

A competitive advantage is that Inmecco is starting to supply to niche markets such as small coffee producers. Inmecco puts significant efforts into the design of our products. We aim to supply the industry with innovative products that are better than what is available on the market. In 2015, we presented an innovation on the design of the tilting bucket. The aim was to reinforce some areas of the equipment, especially the rear flap of the bucket.

What goals would Inmecco hope to achieve within the coming five years?

The main focus is to optimize our manufacturing process so as to reduce production times for our products. Optimization will enable Inmecco to reduce the prices of our equipment for our customers. Inmecco does not want to be a commodity producer and we aim to offer tailored and value-adding solutions to the industry. We are also planning to expand our product line in the future so as to meet the equipment demands of our customers. —

Odilon Mendes



Managing Director

NORMET DO BRASIL

What have been Normet's main milestones over the last years in Brazil?

Normet is an international company focused on providing advanced solutions for the underground mining and tunneling markets. Normet supports nearly all underground mining operations in Brazil. Our main focus over the past three years has been to increase the size of our fleet and to develop our after-market services. Our key areas of improvement have been developing the customers' knowledge of our products and services, and improving our logistics.

You recently moved to a new facility. How important was this for your operations?

Normet do Brasil moved from a 250 square meter facility to our current one, which has 700 square meters. We can now bring equipment to undertake full overhauls and develop and promote our chemicals business as well.

What efforts have you made to diversify your business?

Today, Normet has a fleet of around 80 machines in Brazil, operating in selected processes for underground operations. These machines are mainly concrete sprayers, concrete transporters, lifting equipment and scalers. Currently, around 80% of our business is related to the mining industry. We have been working to expand our operations in tunneling but the current market conditions in Brazil have delayed many projects. We deal with nearly all mining companies that have underground operations in the country and our main customers are AngloGold Ashanti, Votorantim, Caraiba and Ferbasa.

With fewer greenfield projects, what areas of business have you been focusing on?

Certainly, there has been a decrease in the amount of greenfield projects, but Normet has worked on several pre-feasibility studies that are considering our equipment as a reference. Those projects should be fully developed by the end of the year or early 2017.

Normet is also focusing on replacing the older machines in the fleet with newer models, and improving our technical support services throughout full time on-site contracts. Nowadays, with smaller projects being developed, customers are looking to rent, rather than buy equipment, therefore we are developing our rental business.

What are some of the new technologies Normet is developing for the underground mining market?

Normet is currently developing new equipment that uses the NorSmart system, which enables intelligent control, controller adjustments, diagnostics and data collection. The purpose of the system is to ensure a cost-effective operation by creating a versatile and effective interface between the machine user and the machine process. We are also incorporating a new generation of engines that provide a clean and efficient operation, reducing emissions, which is important in an underground environment. Some of these technologies are already being used abroad but are not yet fully implemented in Brazil.

Is Brazil slower on the uptake of new technologies than other mining countries?

In Brazil, companies are open to adopt new technologies but no one wants to be the first one to do so. Businesses here like to see a product working before they invest. To overcome this, Normet is trying to develop technologies in partnership with its clients rather than simply introduce something entirely new. By tailoring a solution to a client's need, we can eliminate some of the risk.

What are the prospects for your business?

Our key focus is to optimize our processes, expand our fleet, develop our rental and chemical businesses and perform full, in-house overhauls for our customers. —

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Image: Vale

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As well as improving waste management systems, Outotec is currently more focused on small brownfield projects, as is Modular Mining Systems, a U.S. software company owned by Komatsu that provides fleet optimization technology. Davi Freire, general manager of the company's Brazil office, said: "Like any company, Vale's main focus is cost reduction [...] and Modular was aggressive in offering our solution for predictive maintenance; the MineCare Solution. In using our solution, along with some other tools, Vale Carajás publicly presented that they reduced significantly the annual cost of corrective maintenance since they started to use it in 2010."

Brazil's mining industry has been criticized in the past for being reluctant to implement new technologies. The country has historically lived by the old saying "if it ain't broke, don't fix it." But, as global competitiveness has drastically increased with the low price of commodities, companies in Brazil are beginning to realize the importance of being as technologically up-to-date as other major mining countries. This thinking is permeating through even to miners that are not directly affected by international commodities prices. Embu S.A Engenharia e Comercio is a Brazilian company that produces aggregates for the domestic construction market. "Technology is very important in all of our processes in the plants as well as in making contact with our clients," said Luiz Terra, Embu's general manager. "Due to innovative technologies, the quality of our productions is similar to the quality in the US and Europe."

Cristovam Paes, the executive president of Fundação Gorceix, cited 'internationalization' as highly important for the progres-

sion of the mining industry in Brazil. The Fundação Gorceix is a non-profit organization that supports scientific projects that are developed by teachers and students of the Escola de Minas (school of mines) in Ouro Preto. "[The foundation's] primary mission is to contribute to the professional qualification, scientific, and technological development of the mining sector, always taking social and environmental responsibility as the starting point," said Paes.

Technology has always been crucial for the development and maturation of an industry. Companies must not lose sight

of the fact that, despite the current situation, investing in new technologies is essential. "It is how we deal with the crisis that will discern whether a company survives or not," said Marco Aurelio Soares Martins, director of operations at CEMI, a local software and solutions provider. "I think what is crucial for every member of the industry to understand today is the fundamental importance of technology. One must overcome hesitancy and invest in new technology which will not only ultimately save expenditure, but also prevent accidents." —

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Marcelo Motti

Vice President
METSO BRAZIL

What have been the main milestones for Metso in Brazil?

With a history of over 100 years, the company and its predecessors have served the South American pulp and paper, mining, construction and power industries for more than a century. Metso was created through the merger of Valmet and Rauma in 1999, and shortly after it acquired Svedala Industri AB. This way it soon became one of the world's leading suppliers in the process industry. Metso currently focuses on intelligent solutions and services for the mining, construction and oil and gas industries.

Metso has several service centers spread throughout Brazil and employs about 1,300 people. We have two manufacturing plants in Sorocaba. One is dedicated to screening equipment, crushers, valves and pumps. The other is a steel foundry that is exclusively dedicated to manufacturing and supplying products for Metso.

Metso has both a mining division and a construction division. What is the relative importance of these?

The mining industry represents about 50% of our business, with construction only contributing about 38%. Metso has two more business divisions. We are also in the process of developing a metal recycling division.

What is the full array of products and services that Metso provides to the Brazilian mining industry?

Metso has a wide range of products for the mining industry. Our products are equipped with the latest technologies and include screens, crushers, grinding mills, various types of feeders, and conveyors. We do not only supply equipment to the industry, but we also provide high-quality solutions and services to our customers.

In the segment of process optimization, Metso brings solutions for the control, monitoring and consulting of processes and mining assets using innovative tools that are able to collect data, conduct dynamic tests of performance and control different stages of the process automatically.

How has Metso's services division changed over the last years?

Over the last 15 years, Metso has decided to push our strategy of developing our service offerings. Of the 1,300 employees that we have in Brazil, about 800 work on services. Currently, services contribute about 50% to our business, as we have experienced a reduction of capital equipment sales. With commodity prices being very low, Metso aims to reduce operational costs for its customers and increase their efficiency. We have several contracts where we are focused on operational performance.

What is Metso's strategy in terms of R&D?

Metso has a very strong research and development department, in which we invest significantly, and we have a team dedicated to technology and innovation. In the current market situation, innovative technologies to improve operations are critical. Technologies have become less expensive and more accessible and can certainly add value to our customers' operations. Metso has also acquired an American company, Expert Tooling, which is dedicated to improve operation efficiency.

How has Metso's exposure to the mining industry been affected by the current economic climate?

Operating in Brazil is currently a huge challenge as the country is experiencing a political and economic crisis. These two crises heavily affect investment into Brazil, and Metso has also felt the impact. The exchange rate has, however, created exporting opportunities for Metso. —



Marcelo Sigalla

Business Director
WEIR MINERALS

What has been Weir Minerals' evolution within the Brazil mining industry?

Weir Minerals has been operating in Brazil for over 30 years, and we specialize in developing equipment solutions for the mining, oil and gas and power industries. Our main focus area in Brazil is the mining industry as it represents 95% of our business. We provide equipment required for the entire mining process; our diversified product portfolio includes pumps, crushers, screening equipment, wear liners, mill liners, hydrocyclones, valves, hoses and spools, feeders, washers and conveyors. Weir supplies equipment to the majority of mining companies in Brazil. Our strongest segments are slurry pumps, mill liners, and cyclones, and we have a 90% market share in the slurry-pump segment. In 2015, Weir acquired an American company, Trio, which enabled us to provide a more complete comminution product and service offering.

What services and products are currently in the greatest demand in the mining industry?

The greatest demand is currently for engineering solutions. Our customers also

demand after-sales services and we will provide them with services such as installations and maintenance. As a result of the economic environment, Weir has remained flat in its revenue in the last few years and we had to reduce our headcount.

What is your customers' perception about Weir's global support from its international branches?

Most of our customers are international companies and have experience with Weir around the world. Our customers know that we have very good expertise in our business and collaborating with our branches in other countries makes us stronger. Our engineering team is focused to attend customer needs; their R&D insights are spread to specific centers around the world.

Recently, the Minas-Rio pipeline in Brazil was an international case from which our other branches could learn. We have also developed a mill-liner technology locally that we have shared with other branches. As a company, we have a very strong internal network and we share knowledge of all our projects. After this project the Brazilian team was recognized with excellent feedback.

What are the main challenges of operating in Brazil?

Brazil is experiencing a mining crisis as well as a political crisis, which results in a very challenging operating environment. To survive, Weir is currently looking for opportunities in brownfield operations and focusing on its after-sales services. We are working closely with our customers and offering them equipment that will improve efficiency. We aim to find solutions that will add value to our customers' operations and optimize their processes.

What goals does Weir hope to achieve within the next three years?

The key for success for any mining company in Brazil is to utilize innovative technologies in the market so as to optimize their operations. Over the next three years, our core business will still be the pump segment. With the acquisition of Trio, there is a significant amount of opportunity to grow in the sand and aggregates market, in terms of comminution equipment. —



Sergio Zamorano

General Manager
TENOVA TAKRAF

What is Tenova's involvement in Brazil?

The Techint Group was founded in 1945 and mainly operated within the steel industry. Techint Technologies was established in 1980, and, over the years, acquired various companies to expand the company's service offerings. In 2007, Techint Technologies became Tenova, and in 2008, Tenova acquired TAKRAF, which is a 290-year old German company with a vast history of steel fabrication. TAKRAF's experience in open pit mining equipment and mining systems complemented and strengthened Tenova's bulk materials handling business in Brazil.

We have been operating in Brazil for 40 years and we offer equipment for the global mining, bulk materials handling and mineral industries. Our operations are mostly in the iron ore segment and, from 2007 to 2012, Vale was our main client in the mining market. Currently we are still doing work for Vale, but we have now diversified our services offerings and the markets that we operate in.

Tenova undertook a port project with the government in 2014. Could you elaborate on this?

Tenova participated in an international bid for a project at the port of Pecem. We fulfilled the requirements and were awarded the contract for a continuous ship unloader to handle iron ore at the port. The project utilizes very unique technologies that only Tenova is able to provide. The design and management of the project has been done by our Italian office and the assembly has been done in China.

What efforts has the company made to localize its supply chain?

Localizing our supply chain in Brazil has been a challenge in the past because of the fluctuating exchange rate. Tenova's strategy is to look for the best solutions for a project, whether the solution is in Brazil or in another country. Planning and logistics in Brazil is also a huge challenge and it is easier and less expensive for Tenova to import parts from China than to transport them within Brazil to remote mine sites.

The quality of work in Brazil is of good standard, but there is a significant amount of work to be done as to improve the logistics and planning challenges in the country. We have tried to bring about change, but the government is yet to adhere to requests from the industry players.

What will be the key drivers for growth in the future?

Brazil exports about 900 million tons of bulk material every year and thus the development of ports will remain the main growth driver for the next few years. Brazil also has a significant amount of commodities which can be a driver for economic growth.

Do you have a final message for the attendees of the World Mining Congress about Brazil's mining industry?

Brazil can be a complex and challenging country to operate in, but if you are not in Brazil you are missing out. With regards to the mining industry, Brazil is one of the key markets in the world and there are still significant opportunities. Foreign companies operating in Brazil need to "tropicalize" and learn to understand the social codes of the country to be successful. —

Marco Aurelio Soares Martins

Director of Operations
CEMI



Could you provide an overview of CEMI's evolution over the past three years?

CEMI Process Technology and Engineering is a company that has now been in the market for 27 years. Over this period, our goal has not changed much, however the company you see today is a more mature, consolidated and well-known one. We have expanded our business to serve not only the mining industry, but also the sugar, food and beer industries, as well as oil and gas, paper and cellulose. The next step CEMI will soon embark upon is international expansion.

The current crisis facing the mining industry in Brazil has had a knock on effect on all suppliers. What is the company's strategy to navigate the crisis?

Brazil is heavily reliant on the export of commodities and as such the country has certainly felt the recent crisis harder than other mining countries. However, this climate has presented great opportunities for CEMI as mining companies look for new solutions to reduce costs and optimize existing projects. That is why today CEMI is focusing more on working with brownfield projects. Our optimization technologies are the cost reduction solutions that companies in the market need today. Despite this, mining only represents 50% of our revenue as opposed to 80-90% before. This is due to a strategy of diversification into other markets, however mining still is our core competency.

As a local company, what are the advantages CEMI holds over multinational players present in the market?

Our main competitors in the market are big multinational companies like ABB, Schneider Electric, Metso and Honeywell. What sets CEMI apart from these corporations is our ability to provide local, on the ground expertise to support all of our product offerings. We also run a highly efficient R&D department to support all of our operations.

You said in 2012 that Brazil was becoming less dependent on overseas R&D; in light of the recent crisis, do you still believe this is the case?

Unfortunately my opinion in this respect has changed. During the boom there was a great acceptance of local innovation and

technology. Now that we are experiencing a crisis, companies are turning to the multinationals that, in their eyes, offer a more reliable product. This has made competition very tough for CEMI and this is why we have decided to expand overseas. We want to be seen as a multinational company and be able to take our products to the world.

How are you implementing this internationalization strategy?

CEMI has embarked on many missions overseas with associations such as IBRAM and also government bodies. This was done in order to promote the CEMI brand, but also to better understand the needs of the markets we hope to operate in. It is important for us to maintain strong relationships with the companies we work with here in Brazil so that we may also do business with them in the other countries where they have operations.

Later this year we hope to have established our first permanent overseas office in Houston, Texas. We will hire local talent, as this is crucial to the CEMI business model, and will initially send over our engineers to cover their training. I am certain that CEMI will be well received in the U.S. market.

What final message would you like to send to the mining community?

It would be wrong to say that Brazil, and indeed the global mining community, are not facing a crisis. It is how we deal with this crisis that will discern whether a company survives or not. So far, at CEMI we have seen this as an opportunity to mature and expand. I think what is crucial for every member of the industry to understand today is the fundamental importance of technology. One must overcome hesitancy and invest in new technology that will not only ultimately save expenditure, but also prevent accidents. I strongly believe that companies should invest more in newer technologies with regards to waste management and filtration to avoid damaging the environment. Not just in waste management but also in all aspects of the mining world, using technology and automation will reduce the human exposure to difficult and dangerous conditions. —

Marcelo Veneroso

Managing Director

NEUMAN & ESSER AMÉRICA DO SUL



What is the history of Neuman & Esser in Brazil?

Neuman & Esser began in Brazil in 1997. Our company is split into three different businesses: the first sells compressors to the industry, the second supplies mills to the mining sector and the third segment is dedicated to providing after-market services.

What are the specific products you are supplying to the mining industry in Brazil?

The mills we supply are used in the processing of non-metallic rocks such as calcium carbonate and different types of fertilizers. The core machines are manufactured in Germany, but the assembly and packaging is carried out here. We also have local suppliers for spare parts. Last September, due to the low value of the Brazilian real, Neuman and Esser decided to produce a whole mill entirely in Brazil. With 100% of the machine produced in Brazil we will qualify for the FINAME program, a scheme by which our customers can receive subsidized interest rates from the National Bank of Social Development (BNDES)

What are the steps Neuman & Esser takes to guarantee the quality of its products in Brazil?

Neuman & Esser has a strict quality control program. It is to this standard that we select our suppliers. Many of our parts are large and complex and we have an internal program called the 'supplier evaluation commission' to select only the highest quality suppliers. We also carry out regular inspections and will often do the final inspection of a product. When a supplier is unable to meet our standards we conduct a development program for that company. Now that we are planning to produce the entire mill in Brazil we will have a master technician team visit us from Germany to oversee the development of our suppliers and the production of the first machine.

Currently around 10-15% of our business comes from the mining industry. We hope the localization of manufacturing capabilities will help increase our market share. With the decrease in sales in the oil and gas sector and an increased market share in the mining industry we expect mining to account for 50% of our business in the future.

The mining industry worldwide is not doing well. How has this affected your operation?

The crisis has certainly caused a decrease in the number of new investments made by the mining industry. Interestingly enough,

in our area of focus, non-metallic rocks, investments are being made and this is the opportunity that Neuman & Esser has identified. In the past it was cheaper for companies to import fertilizers. This is no longer the case and we are seeing growth in the local fertilizer market. We were not left entirely unscathed by the crisis, though, and we had to focus on our after-market services to cover some of the loss of investment attributed to the current situation.

Innovation is the theme of the World Mining Congress this year. Can you explain the role R&D plays for Neuman & Esser?

Neuman & Esser has a dedicated R&D department called the CT that is focused on developing new technologies. Today, Neuman & Esser offers two different types of mills: a pendulum mill and an impact mill. The CT recently discovered that the impact mills can replace pendulum mills in smaller projects, providing a cheaper solution with the same quality. Neuman & Esser constantly strives to develop new solutions that increase performance and lower energy consumption.

What is your outlook for the future of the industry and the future of Neuman & Esser in Brazil?

The crisis has prompted us to be very conservative with our numbers. Looking ahead, however, we have potential to grow. We expect the mills business to contribute 50% of our total turnover. We are optimistic about our future. —



Paulo Da Pieve

Managing Director
STEINERT
LATINOAMERICANA



Currently our most promising mining projects are in Peru. These projects are operated from our facility here in Brazil, which supports the entire South America and Central America. Our main markets are currently the mining sectors in Peru and Chile and the recycling industry in Brazil.

To what extent has the crisis affected Steinert and other industrial players?

Steinert's approach to the Brazilian market has changed completely and we are also focusing our attention on recycling. We are still capable to assist the mining market in Brazil but, to survive, we had to diversify our efforts. The company made a strategic decision to change our setup and we reduced our headcount and made our engineering operations more flexible, while still keeping a strong focus on sales. We have the advantage of having a manufacturing facility in Brazil, as manufacturing costs in the country are more competitive than in other locations. In 2015, the equipment manufacturing sector in Brazil was directly employing 400,000 people. This figure has significantly dropped to less than 300,000 in December 2015 and I believe that we have not reached the bottom yet. There are currently no big projects in Brazil and the equipment industry depends on new investments. The greatest challenges are the lack of confidence of the investors, high interest rates, high inflation and a lack of equipment demand. The advantage is that the exchange rate can help manufacturing companies in terms of exportation. Steinert currently has a huge focus on exporting our products to South America.

Could you provide more details on your manufacturing capabilities?

Steinert has two product lines, which is magnetic separation and sensor sorting. In sensor sorting, the parts are imported from Germany and supported by the after-sales from Brazil. The entire magnetic separation line is manufactured in our Brazil facility and the major components are imported from Germany.

Is Brazil dependent on R&D activities from abroad or is there sufficient Brazilian innovation?

Brazil is more conservative in terms of innovation and the designing engineers are not always open to use new technologies. The mining companies are looking for new and innovative technologies and if it cannot be found in Brazil, they will look abroad. Steinert is currently working with the biggest mining company in Brazil to take on five tasks and optimize operations with our sensor sorting technologies.

What is Steinert's strategy for the coming years?

Steinert has very promising projects in the pipeline and our strategy is to focus on sensor sorting. To maintain our turnover, we will apply the same technologies that we apply to the mining sector to other markets in Brazil such as the recycling industry. We have been receiving enquiries from Argentina and this market also presents huge opportunity for the future. —

What is Steinert's positioning in the Brazilian market?

Following the growth of the Brazilian mining industry in 2011 and 2012, Steinert had a target to double the company's turnover. The company established a facility in the country and manufacturing operations started in November 2011. The company moved very fast to reach our target and, in 2013, we doubled our revenue.

By the second quarter of 2013, the mining industry started to slow down, which was problematic for Steinert as 90% of our revenue came from the mining sector. The company decided to diversify our sales efforts to other local and national markets. Our diversification strategy enabled us to maintain the same turnover over the last two years.



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INNOVATION

*Food for thought from
industry leaders*

“In Chile, they are more open to innovation in mining. Engineering companies that work in Chile have a long-term partnership with their customers, so customers are more willing to experiment and innovate with them. We have seen something similar in the pulp and paper industry. They feel comfortable with all of the new ideas we bring, but when it comes to mining and metals, clients tend to be more reserved. We have to test out our ideas before we pitch them.”

Marcelo Xavier,
Director Mining & Metals,
Pöyry



“I strongly believe that companies should invest more in newer technologies with regards to waste management and filtration to avoid damaging the environment. Not just in waste management but also in all aspects of the mining world, using technology and automation will reduce the human exposure to difficult and dangerous conditions.”

Marco Aurelio Soares Martins,
Director of Operations,
CEMI



“Delayed implementation of innovative technology is definitely the case in Brazil. Komatsu has a comprehensive fleet of autonomous trucks that are operating in Australia and Chile and which have not been welcomed into the Brazilian market. A joint initiative is a basic requirement for the development of such projects. A great majority of mine employees are truck operators and thus autonomous trucks may cause community and union issues.”

Francisco Macedo,
Vice-president Mining,
Komatsu



“In 2013, Outotec won a turnkey contract for the delivery of a red mud filtration plant for Alunorte. The plant is the biggest of its kind worldwide and has eight press filters, which can process about 600 metric tons of red mud per hour. Filtration will be one of the solutions for the future in the mining industry. After Samarco, it will be more difficult to get new tailings dams approved.”

- Lars Duemmel,
Executive Director,
Outotec



Luiz Mello

Executive Manager Innovation
and Technology
VALE



Could you give a brief overview of your personal background and your responsibilities as executive manager in charge of innovation and technology?

It is not common that physicians operate in different professions, but I did not want to practice as a physician, but rather as a scientist. My background includes a career as a researcher (I am a member of the Brazilian Academy of Sciences) as well as administrative roles in funding agencies, at federal and state levels in Brazil. I also served as dean of academic affairs at the Federal University of Sao Paulo, which was strongly dedicated to the health sciences. During my time as dean, we created four new campi, of which one was to be exclusively dedicated to engineering. At the time I approached Vale in search of support for our engineering program and campus. In a meeting with the CEO of Vale, I ended up being offered a position in the company.

For the past seven years I have been working for Vale as head of research and development (R&D). My main goal was to create a new R&D group and thus we established the Vale Institute of Technology (ITV in Portuguese). ITV has been a very successful initiative that has persevered through changes in the company as well as through the downturn in the mining industry since 2011.

How does Vale's innovation help to increase the value and productivity of the S11D project?

There are a number of research teams that have been engaged in the S11D project. Vale has mapped out all the activities required to develop the project and it is currently the world's largest mining project. The S11D mine is located in the Amazon rainforest and there is a significant amount of features of the project that pertain to the ecosystem. ITV is doing DNA coding and mapping animal (mostly invertebrates) and plant species, so as to provide basic knowledge that is required to operate in these environments, which are key to environmental permitting. We are providing different software tools for mining plans and coming up with strategies on how to progress with mining activities in the most environmentally-friendly way.

Iron ore has never been mined in the way that it will be mined in the S11D project. This new way of mining represents a challenge as well as a big step forward in the mining industry. ITV tries to anticipate problems in this new model and we aim to provide solutions for these difficulties.

Could you elaborate on the most important partnerships forged by the Institute in terms of fostering innovation and the use of new technology?

In 2006/2007 Vale acquired Inco, which had a long tradition of interacting with different academic institutions and organizations. Over the years, we have strengthened our partnerships that existed with different universities and we have also further strengthened our relationships with governmental agencies in Brazil.

Since the ITV was created, we have received over 80 million reais from the government as funds for research and development activities. These funds also fostered greater interaction with academic institutions and, since 2009, we have granted over 2,000 scholarships in engineering fields. The ITV has also developed masters programs in Brazil and Mozambique and we have strengthened our relationship with academic organizations, governmental bodies, vendors and potential partners.

Our membership of AMIRA (Australian Minerals Industry Research Association) allows us to engage with many global partners. We also interact with universities from abroad such as with the MIT, Kyoto University, and the Weizmann Institute in Israel.

How can technology help reduce the likelihood of a future environmental disaster, and what steps are already being taken to apply innovation to redress environmental concerns?

The recent Samarco disaster had a great impact on the global mining industry. Vale has a number of R&D initiatives dedicated to tailings disposal, which we have been working on since 2006. We have ongoing projects, which, if successful, might represent potential industrial uses for tailings. —

Cristovam Paes

Executive President
FUNDAÇÃO GORCEIX



What is the Gorceix Foundation's involvement in the mining sector?

Fundação Gorceix (FG) was founded in 1960 and supports scientific projects that are developed by the School of Mines (Escola de Minas, EM). Its primary mission is to contribute to the professional qualification, scientific and technological development of the mining sector, always taking social and environmental responsibility as the starting point. Some of our actions consist of offering better infrastructure for the university: we have our own infrastructure, equipment and laboratories that can be used for the development of projects. In addition, we assist with scholarships for needy students and those who stand out as the best in their respective courses.

What partnerships do you have with mining companies?

FG has two main partners, the EM and UFOP for statutory reasons, but also works together with several private sector companies, mainly Vale, Petrobras, Samarco, ArcelorMittal, Usiminas, Gerdau, CSN, Votorantim and Namisa. FG also has partnerships with international companies, such as AngloGold, Anglo American, ArcelorMittal, Novelis, and some companies located in Venezuela, Argentina, Portugal and Mozambique. As an example, we worked with the National Petroleum Institute of Mozambique. At the governmental level, we support the prosecutor's office and work with several town halls of the country, usually in the environmental field, or giving support in the deployment of strategic development plans.

From a technical perspective, what sort of projects have you developed with the private sector?

The main studies developed at FG in the mining sector consist of concentration of zinc sulfide and oxidized minerals, lead concentration and carbonate minerals, graphite concentration, removal of impurities of magnesite, concentration of phosphate rocks and studies of concentration of iron on mines in Brazil. In fact, almost all of Brazil's iron mines have worked with FG or with the EM through the foundation. Another important project was carried out with iron ore from Ukraine brought by ArcelorMittal. In this study, they brought a total of 500 metric tons and an entire logistical planning was implemented so we could work with such a large amount of iron ore. In addition, we conducted other foreign projects and have received and studied ore from Kazakhstan and Liberia.

We also conduct corporate courses: a great example was the mining and metallurgical systems courses in which we trained over 2,400 engineers.

Could you highlight the importance of the Triple Helix?

Since the UFOP is a public university, this institution is bureaucratic and, as a result, the relationship between private companies and public universities is difficult to establish. Fortunately, here in Ouro Preto, we managed to overcome this obstacle within FG. In this context, we act as a bridge between these two parties. Every time we sell a project for the private sector, we can effectively use the intelligence at the university to achieve and conclude the study. All knowledge and learning from these projects can be applied to the courses, improving the quality of education. On the other hand, the companies receive a fast and positive result because FG can always mobilize young people and the best technicians and teachers for these projects, and thus companies achieve higher profits from such studies. I can say we are the only place in Brazil where we see this harmony between those three components: university, government and the private sector. —

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It is in the Cultural Heritage of Humanity that Brazil's mineral heritage is developed.

The School of Mines (Escola de Minas) of the Federal University of Ouro Preto (Universidade Federal de Ouro Preto - UFOP) and Gorceix Foundation (Fundação Gorceix), united by the scientific and technological development of the mineral-metallurgical sector, in a socially and environmentally responsible manner.



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Issamu Endo

President
EM (SCHOOL OF MINES)



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How has the Ouro Preto School of Mines' organizational structure evolved?

Ouro Preto School of Mines, founded in 1876, is one of the academic units of the Federal University of Ouro Preto. We have the Mining Engineering and Metallurgical Engineering courses, and also courses such as Civil and Geological Engineering, inserted in the school curriculum 50 years ago. Subsequently, the following engineering courses were added: Production, Environmental, Mechanical and Control and Automation. The course of Architecture and Urbanism was the latest one to join the School of Mines. In addition to these nine undergraduate courses, we have four graduate programs which include masters and doctorate degrees and we have just approved another professional master degree in Instrumentation, Control and Automation in Mining Processes. Currently, we are seeking to diversify our areas of education. We have submitted a proposal for Applied Geophysics and Chemical Engineering undergraduate courses still to be approved by the MEC (Ministry of Education and Culture). We intend to insert an undergraduate course related to the energy sector in our curriculum in the near future.

Please elaborate on the importance of the role of academy in the Triple Helix systems of innovation that consist of government, industry and education relationships.

This model is not fully implemented in Brazil. Currently, the relationship between academy and government happens primarily through research funding agencies. The Ouro Preto School of Mines has been nurturing a strong relationship with the industry. In this context, we saw the establishment of supporting foundations, such as the Gorceix Foundation, which plays a major role. However, in difficult times like the one we are going through in 2016, this bond is likely to weaken and some benefits are suspended, such as the law known as Lei do Bem, created in 2005, that consists of the concession of some fiscal advantages for investment in technological innovation. Despite all these struggles, we succeeded to forge a very important part-

nership with Vale in 2013, to develop the Vale Technological Institute (ITV) at the university campus. This project comprises the building of a 1,200 square meter laboratory. It has just received the approval for its first professional masters program.

How important are internationalization and global collaboration?

Internationalization is an extremely important process; it is a way to be in contact with innovation, new knowledge and new ways of thinking. However, I believe that Brazil is still facing obstacles to fully benefit from this process, one of them being the language barrier. Internationalization is not limited to sending students abroad, but also and perhaps, most importantly, the opposite way: to receive students and researchers. Today, the amount of foreign students that come to our university is too small in comparison to the number of students sent abroad. We have some double degree agreements with universities in Italy and some graduate students from France, South Africa and Italy, but we are still struggling to find effective ways to make internationalization more effective.

Looking ahead, what are your thoughts on the future evolution of the mining industry in Brazil and what role do you want the Ouro Preto School of Mines to play in this regard?

The unfortunate accident of the Fundão tailings dam at Bento Rodrigues made the whole community think more accurately about the future of the mining industry and the academic involvement. It is important to state that within the academic environment, there is a strong and continuous self-perception and self-questioning on how we are teaching engineering and how we will lead this task. The Brazilian educational system and its structure still have a long way to meet international excellence levels and need continuous updating. Nowadays, in the Ouro Preto School of Mines, the greatest challenge is to figure out how we will manage to improve this structure to better integrate the knowledge among the different fields within engineering, and how to create new opportunities in education and research. —

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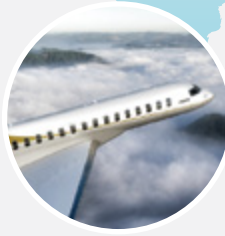
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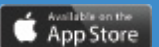


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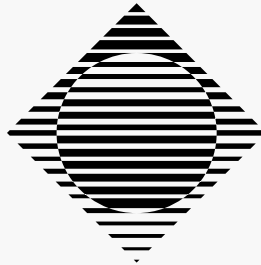


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