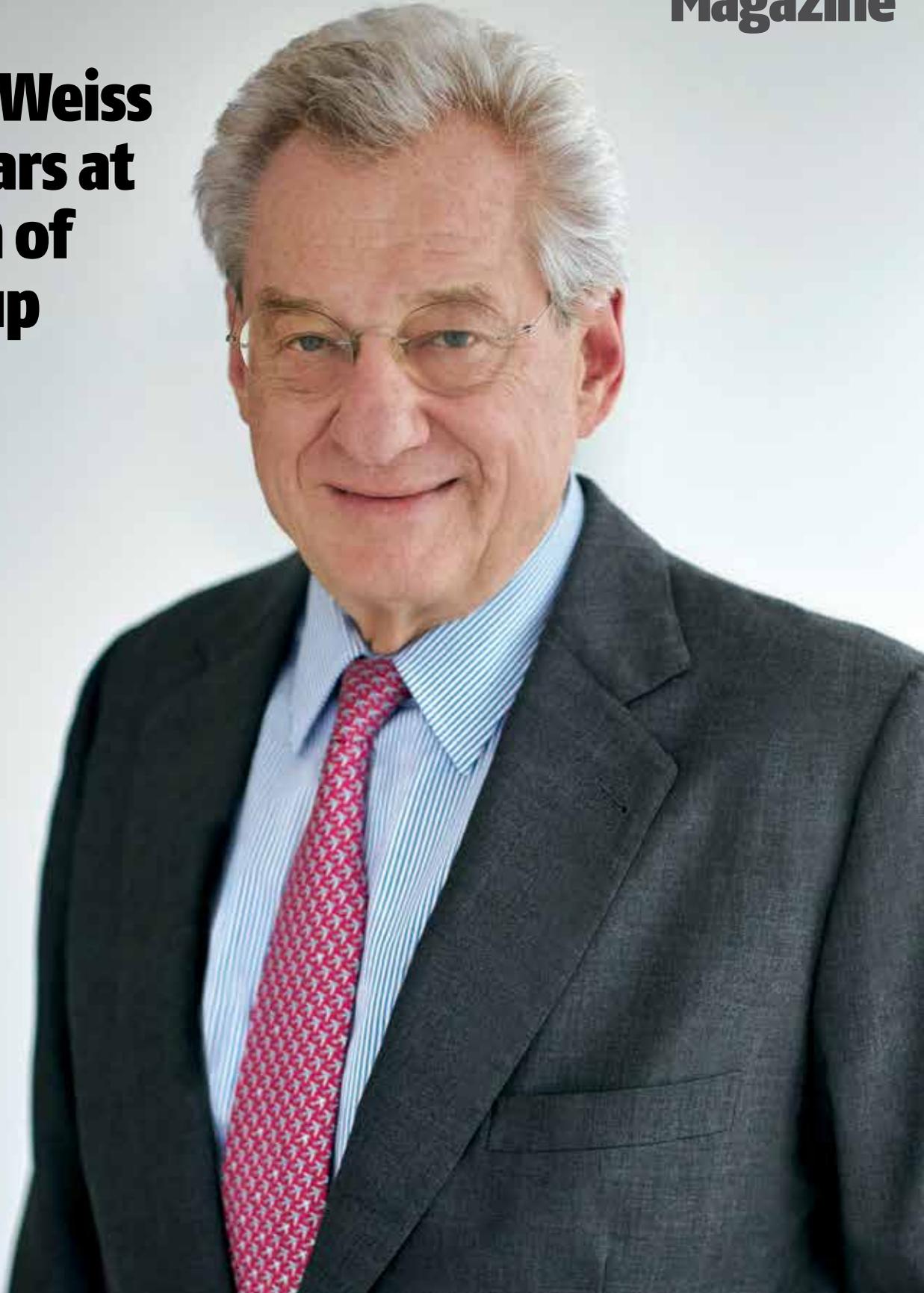


July–August 2016 | Leading for over 100 years

Metal Bulletin

Magazine

**Heinrich Weiss
on 45 years at
the helm of
SMS group**



**Non-ferrous
technology**

**Software
strategies**

**India's
progress**

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 **Overall:** seven major measures to ensure improvement in overall quality of the environment during the 13th 5-year Planning period that bring new chance & opportunity

 **Manufacturer:** technology & equipment demand increasing by requirements of energy saving and consumption reducing

 **Processor & Trader:** international cooperation demand increasing by requirements of Chinese company transformation and upgrading regarding to Chinese recycling system gradually perfection, discarding period is approaching, and new urbanization construction objective in 13th 5-year Planning

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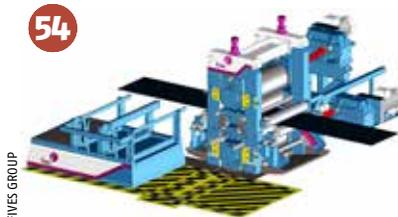
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Digital revolution

Buzz phrases tend to generate a degree of scepticism – especially when they describe a broad subject which means different things to different people. Nevertheless, there is a real sense in which the interrelated topics of Big Data, ‘Industrie 4.0’ – or the Fourth Industrial Revolution – and the Internet of Things are combining to deliver tangible advances with advantages in terms of productivity, efficiency and production costs. Some experts regard this as nothing less than a new digital revolution.

Some of the concepts involved have actually been around for decades, but only now is the combination of modern telecommunications, computer processing power, sensor technology and data storage at a level where those long-held ideas can be put into practice.

For example, as our cover profile interviewee, SMS group’s Heinrich Weiss, mentioned during his insightful discussion with *MB Magazine*, the idea of an IT company remotely monitoring equipment it supplies to a client in order to predict and/or detect a problem within it was around in the 1980s. Remote condition monitoring via an array of sensors and the Internet is now an increasingly widespread reality.

As the software feature section in this issue of the magazine elaborates, a strategy to extract value from the vast and rapidly growing volume of data generated by these and other automation and controls systems is something that metallurgical plantmakers like SMS group and Danieli are actively pursuing. The ideas of controlling a whole production process through a series of machines from factory entrance to exit – rather than independent islands of activity – as well as smart plants that will ‘learn’ for themselves are also a focus.

The ability to marry up ‘shop-floor’ data with commercial and business data, and decision-making, is another very active area of interest. It is also attracting the attention of large international providers of ERP systems. Software for commodity trading, trade finance and risk management is similarly taking great strides forward. Meanwhile, additive technology (3D printing) – the topic of another of our features – is also rapidly starting to come of age.

Two other feature sections in our combined July-August issue illustrate geographical trends. One looks at India’s steel and aluminium sectors, which have great potential and ambition, but still face some challenges in realising them. The other provides our latest list of new plant orders and upgrades: a snapshot of where investment is being made. Wherever progress is made, it is sure to be touched by the digital revolution.

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‘The ability to marry up ‘shop-floor’ data with commercial and business data, and decision-making, is a very active area of interest’

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News review: non-ferrous

Mitsubishi Materials to set up e-scrap recycling in Moerdijk

Mitsubishi Materials will spend ¥4 billion (\$40 million) to set up facilities in the Netherlands to receive, inspect and sample electronic scrap from the European market. The new facility in Moerdijk is a joint venture with partner Hanwa Co, which will hold a 10% stake, with Mitsubishi controlling the remaining 90%. The Moerdijk plant – which will be run by a new joint venture company named MM Metal Recycling – will be operational in the spring of 2017 and will be used to streamline the sourcing and sorting of e-scrap from the European market. Following an expansion at its Naoshima smelting and refining complex in Japan in April, Mitsubishi is capable of processing 140,000 tpy of e-scrap in Japan, an increase of 30,000 tpy.

Metraco finalises acquisition of Sims FE Mottram

Belgium-based ferro-alloys and metals trader Metraco has acquired the business and assets of the UK-based ferro-titanium producer Sims FE Mottram, in Sheffield. The business will continue under the name of FE Mottram Ltd. Metraco will be running the financial and commercial elements of the operation, as well as the FE Mottram laboratory. Metraco's partner, Tivac Alloys, based in Rotherham, will be in charge of the operational aspects, including scrap preparation and the foundry side of the business.

LBMA votes to incorporate PGMs

Members of the London Bullion Market Association (LBMA) have voted to incorporate the platinum and palladium (PGMs) markets, as well as to enhance governance of its board. The changes to the LBMA's Memorandum & Articles of Association were approved by an



MMG's Dugald River zinc, lead and silver mine is expected to start in H1 2018

overwhelming majority during a general meeting held on 29 June, and are designed to support the LBMA's strategic development and expanding remit. The inclusion of the PGM markets reflects the LBMA's ownership of the intellectual property rights for the platinum and palladium price benchmarks, and allows it to formally support its members' activities in the PGMs markets.

Dugald River project on track for 2018 start

MMG has entered into an amended facility agreement of up to \$550 million for financing the development and construction of the Dugald River zinc, lead and silver mine in northwest Queensland, Australia. The agreement is with China Development Bank Corporation and Bank of China Limited, Sydney Branch. The company continues to expect first concentrate production in the first half of 2018.

The optimised mine plan will support a 1.7 million tpy nameplate plant with annual production of around 170,000 tonnes of zinc in concentrate, plus by-products. The mine will operate over an estimated 25 years while the orebody remains open at depth.

Newmont to sell Batu Hijau mine stake for \$1.3 billion

Newmont Mining Corporation has agreed the sale of its stake in PT Newmont Nusa Tenggara, which operates Indonesia's Batu Hijau copper and gold mine, to PT Amman Mineral Internasional (PT AMI). Newmont will sell its 48.5% stake for \$1.3 billion, including cash proceeds of \$920 million paid at the close of the deal, and payments of \$403 million, contingent on metal prices and the development of Elang – Newmont's copper project on Sumbawa Island.

"Selling our stake in PT Newmont for fair value is aligned with our strategic priorities to lower debt, fund our highest margin projects and create value for shareholders," Gary Goldberg, Newmont Mining's president and CEO, said in a statement.

Arconic will retain up to a 19.9% stake in Alcoa

Arconic, the downstream company that will be formed following the split of Alcoa later this year, will retain up to a 19.9% stake in the upstream company Alcoa Corporation. This provides

Arconic with a liquid security that can be monetised to strengthen its balance sheet, reduce reliance on Alcoa Corp to raise debt, and enables Alcoa Corp to be separated with lower leverage, Alcoa said in its Form 10 filing to the US Securities and Exchange Commission.

KGHM renews major copper supply deal with Minmetals

Copper producer KGHM has signed a new five-year supply agreement with China Minmetals, worth an estimated \$1.18-2.83 billion. The deal is the fourth long-term copper cathode supply agreement signed by the two companies since 2002, and is the largest in the history of their partnership, KGHM said. The overall value of the deal will depend on the quantities taken up by Minmetals between 2017 and 2021, when the agreement is set to expire.

Pacorini Metals becomes Access World

Pacorini Metals changed its name to Access World on 1 July. The warehousing and logistics company, which was purchased by Glencore in 2010 and operates the Vlissingen warehouses where

almost 1 million tonnes of aluminium are held, has recently increased its activity in non-metal commodity markets, such as lumber, paper and soft commodities. It has changed its name to better reflect this diversity.

EGA will build 12 million tpy bauxite mine in Guinea

Emirates Global Aluminium (EGA) is to begin construction of a 12 million tpy bauxite mine in Guinea, securing its feed of the aluminium ore to its facilities in the UAE. The project will help to integrate the producer's smelting operations with its upstream assets; reduce its dependence on third-party suppliers; and boost revenue through exports to Asia, the company said. Development at the mine site in Guinea's Boké region will begin under the management of local subsidiary Guinea Alumina Corp, with bauxite production expected to begin in 2018.

EGA is in the process of building its first alumina refinery alongside the existing Al Taweelah Operations' aluminium smelter in Abu Dhabi. The refinery is expected to have an annual capacity of 2 million tpy.

HKEX will launch mainland spot commodities platform in 2017

Hong Kong Exchanges and Clearing (HKEX) plans to launch its mainland spot commodities trading platform by the second quarter of 2017 in Qianhai, Shenzhen, China, ceo Charles Li said in an interview with *Metal Bulletin*. The bourse is focusing on launching physically-delivered base metals through the spot trading platform and will quickly extend into ferrous, energy, rubber and other commodities, he said. Various types of tradeable warehouse receipts will be available on this mainland



Emirates Global Aluminium is investing in bauxite mines and a refinery to increase its feed self-sufficiency

commodities platform. The bourse is also in talks with multiple existing warehousing networks in China.

Umicore to sell zinc chemicals unit

Umicore has reached an agreement to sell its zinc chemicals business to OpenGate Capital for €142.2 million (\$158.6 million). The transaction is expected to close in the second half of this year. Umicore Zinc Chemicals has industrial operations in Belgium, the Netherlands, Norway, China and Malaysia, comprising six legal entities across three product lines: fine zinc powders, zinc oxide and zinc for batteries. OpenGate is a USA-based private equity firm that has interests in the Americas and Europe, including downstream aluminium producer Constellium.

Hydro upgrades recycling at Clervaux

Norsk Hydro has unveiled a €15 million (\$16.7 million) aluminium recycling upgrade at its Clervaux remelting plant in Luxembourg. The upgrade allows Hydro to take in more post-consumer scrap at the plant, as well as increase its output of extrusion ingot. Two melting furnaces have been replaced with one of the same design as those at the company's facilities in Deeside, Wales, and Azuqueca in Spain. A casting furnace has been converted into a second melting furnace, while the remaining casting furnace has been given a larger capacity.

Magna will build new UK aluminium diecaster

Canadian automotive supplier Magna International will build a 225,000 sq ft (20,900 sq metre) aluminium diecasting facility in Telford, UK, to provide cast automotive products, mainly for Jaguar Land Rover. "[The facility] will use Magna's innovative high-pressure vacuum die casting process to produce a number of advanced lightweight aluminium castings – a key building block in the next generation all-aluminium and multi-material vehicle architectures," the company said. Construction will start later this year and the plant is expected to be in production by 2018.

Aqua Metals forms strategic alliance with Interstate Batteries

Lead recycler Aqua Metals has formed a strategic partnership with Interstate Batteries, USA,

which includes the supply of over one million automotive and other lead-acid batteries plus a \$10 million investment in California, USA-based Aqua Metals. The batteries will initially be recycled at Aqua Metals' AquaRefinery, claimed to be the first ever non-polluting lead recycling facility, which was set to open in July.

The new recycling technology is said to be lower-cost and more efficient than conventional smelter-based recycling of lead-acid batteries. AquaRefinery will be located in Nevada's Tahoe-Reno Industrial Complex and will have an initial production of 80 tpd of mixed primary and secondary lead.

LME profits rise 160% in 2015

The London Metal Exchange recorded net profits of \$108.57 million in 2015, up 160% on the previous year, as an increase in trading fees, stronger market data sales and the disposal of a stake in LCH.Clearnet more than offset the commercial impact of a 4.5% drop in trading volumes. The LME raised trading fees by an average of 60% at the start of 2015, as part of a drive to commercialise the business following its acquisition by HKEX in 2012. The exchange has attributed the 4.5% drop in overall volumes seen during the year to a decline in underlying business conditions in the metals markets, not to higher fees.



Higher fees have helped to raise the LME's profits

News review: steel

Tata Steel invests \$222M in Dutch plant

Tata Steel is to invest €200 million (\$222 million) in a new continuous slab caster at its 7.50 million tpy IJmuiden plant in the Netherlands. Construction of the new slab caster began in July 2016, with the project expected to take three years to complete. “Our long-term investment strategy includes building a new slab caster at IJmuiden, plans for which were drawn up several years ago,” a Tata Steel spokesman told *Steel First* on 30 June. “The new caster will enable us to make more of the higher-strength steels and steels with improved surface quality, which will help [car makers] reduce vehicle weights and emissions,” he added.

Vale sells VLOCs to China

Vale has concluded the sale of three 400,000 dwt very large ore carriers (VLOCs) to ICBC International for around \$269 million. ICBC is a wholly owned subsidiary of the Industrial & Commercial Bank of China. Vale is also negotiating the sale of other vessels, which is consistent with its strategy of strengthening the balance sheet and focusing on core assets, the company added.

Gunung starts up meltshop

Indonesia’s Gunung Steel Group commissioned a new EAF and slab caster at its Bekasi works in West Java in June. The new meltshop can produce 1.2 million tpy of steel, using scrap, hot briquetted iron and pig iron as raw materials. The 1.2 million tpy caster produces slabs 220-250 mm thick and 800-2,100 mm wide. Output will be for both structural steel grades and for pipe and heavy plate. The plant was supplied by the SMS group.

China plans 45 million tpy cut in steel capacity

China is looking to eliminate up to 45 million tpy of crude steel capacity this year as part of its efforts to address overcapacity, a senior government official has said. The cut means around 180,000 workers would lose their jobs and need to be relocated, Xu Shaoshi, the chairman of China’s National Development & Reform Commission (NDRC), said on June 26. There are also plans to eliminate up to 280 million tpy of capacity in the coal industry in 2016, which would result in an estimated 700,000 workers being laid-off, Xu said.

PT Indoferro raises NPI capacity by 100,000 tpy

PT Indoferro, the nickel pig iron (NPI) arm of Indonesia’s steel major Growth Steel Group, will raise its production capacity to 350,000 tpy by the end of 2016, an increase of 100,000 tpy; commercial production should start by the second quarter of 2017.

The expansion will see PT Indoferro install an electric

furnace that will consume some 1 million wet metric tonnes of laterite per year, plus a sintering line and dust control facilities. It will produce NPI with a nickel content as high as 12%, which will take PT Indoferro’s installed capacity to an equivalent of 20,000 tpy of nickel.

NSSMC to build US wire rod plant

Japanese steelmaker Nippon Steel & Sumitomo Metal Corp (NSSMC) broke ground in June on a \$50 million cold-heading steel wire plant in Shelbyville, Indiana, USA. The 150,000 sq ft facility will be able to produce 39,000 tpy of steel wire. The operation will target fastener applications in the automotive parts industry and is expected to be fully operational by spring 2018, targeting manufacturers in Indiana, Ohio and Kentucky. The plant is likely to source wire rod mainly from NSSMC steel mills in Japan, the company said. The Indiana operation will include one pickling and coating line, four wire drawing machines and two

heat-treating furnaces. NSSMC has a 42% stake, while there are seven other Japanese investors.

EU steel packaging recycling hits record

The rate of recycling of steel packaging in the EU reached a new record level of 76% in 2014, the Association of European Producers of Steel for Packaging (APEAL) reported. This confirmed that steel has been Europe’s most recycled packaging material for ten consecutive years. EU targets for the recycling and reuse of packaging waste have been increased to 80%, to be achieved by 2030. The steel packaging industry, meanwhile, has set its own objectives of 80% steel recycling by 2020 and a reduction to zero in the amount of steel packaging sent to landfill.

Rio shelves Simandou project

Rio Tinto has shelved its \$20 billion Simandou project to develop one of the world’s largest untapped high-grade



Gunung’s new meltshop produces slab for structural steel, pipe and heavy plate



Steel has been the EU's most recycled packaging material for 10 years

iron ore resources due to ore market overcapacity and slumping prices. Simandou would have a mine life estimated at more than 40 years at capacity of 100 million tpy. Rio ceo Jean-Sebastien Jacques said in an interview with *The Times* that the company could not see a way forward with Simandou in the current market situation. However, the Guinean government said on 4 July that it would go ahead with the project, and believes that a financing solution will be found.

SDI acquires Vulcan Threaded Products

Steel Dynamics (SDI) in the USA will acquire threaded rod producer and special bar quality (SBQ) finisher Vulcan Threaded Products for \$126 million, and expects to close the deal in August. Vulcan is the largest US manufacturer of threaded rod products. The company also produces cold drawn and heat-treated bar, which typically uses SBQ hot rolled bar as input material. The acquisition will allow SDI to offer threaded rod and cold drawn bar, which it currently does not sell, and to expand its presence in heat-treated bar.

Global DRI production down 2.6%

Global output of direct reduced iron (DRI) was 72.57

million tonnes in 2015, a drop of 2.59% compared with 2014, according to Midrex Technologies data, audited by World Steel Dynamics. Falling steel prices, along with a decrease in steel production caused by a slowdown in Chinese demand and 'extreme overcapacity' in the country, were the primary reasons for the downtrend, Midrex said on 30 June.

India maintained its position as the world's largest producer of DRI, with output there rising by 2.14% year-on-year to 17.68 million tonnes in 2015. Twelve Midrex plants are currently under construction, the company said. Eight are being built in Iran, two in Algeria and one each in Russia and the USA.



DRI production was hit by the steel slowdown in 2015

Tsingshan Group starts up Indonesian stainless plant

China's Tsingshan Group has started up its stainless steel plant in Indonesia, which is likely to result in reduced shipments of nickel pig iron (NPI) to China. The current capacity of the Morowali plant on the island of Sulawesi, which started up on 17 June, is 1 million tpy of 300-series stainless steel billet, and the target capacity is 3 million tpy. Output will mainly go to the Southeast Asian market. The group's NPI smelter at Morowali – which has previously exported all its output to China – produces just the right quantity to feed the 1 million tpy stainless mill, one analyst noted.

Greybull finalises purchase of UK long products assets

UK turnaround investment firm Greybull Capital has finalised the purchase of the Long Products Europe (LPE) business from Indian steelmaker Tata Steel. The LPE business began trading under the name British Steel on 1 June. The deal covers Tata Steel UK's Scunthorpe steelworks, two mills on Teesside, an engineering workshop in Workington and a design consultancy in York – all in northern England – plus a mill in

Hayange in northern France, as well as associated sale and distribution facilities. Greybull has arranged a £400 million (\$584.32 million) investment and financing package to support a turnaround plan.

World EAF production falls by over 5%

Global electric arc furnace (EAF) production dropped by 5.40% in 2015 on falling iron ore prices, Rolf Willeke of the Bureau of International Recycling (BIR) told delegates at the BIR World Recycling Convention. EAF production of crude steel fell to 402.7 million tonnes in 2015, compared with 426 million tonnes in 2014, and now makes up 24.85% of total crude steel output. This slump in production mirrored a 5.13% year-on-year decrease in global steel scrap use in 2015, which fell to around 555 million tonnes.

Global external steel scrap trade declined by 13.10% last year to 86.60 million tonnes. The EU-28 region, which is the world's largest scrap steel exporter, saw its external trade for 2015 drop by 18.90% to 13.74 million tonnes.

CSP produces first slab in Brazil

Brazilian joint venture steelmaker Companhia Siderúrgica do Pecém (CSP) produced the first slab material at its works in the country's north-eastern Ceará state, on 20 June. It expects the facility to be fully operational by the second half of the year.

Correction

The 2015 output figure for Erdemir, Turkey, published in the 'Top steelmakers in 2015' table in the printed edition of the June 2016 issue of *MB Magazine* (page 26) was incorrect. The correct figure is 8,930 thousand tonnes, placing Erdemir at position 46 in the ranking table (one position higher than in 2014).

MBR analysis

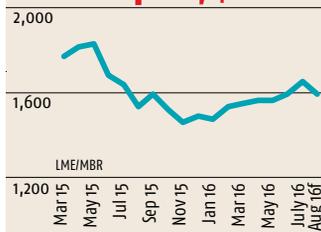
Aluminium

Stronger, but not for much longer

Aluminium prices have been surprisingly robust at the start of the second half of the year, especially in China where the SHFE contract reached a 13-month high. Exchange stocks continue to fall which, on the surface at least, suggests a tightening market and is supportive to the price rally. But we believe that off-market stocks of ingot continue to rise, as do Chinese inventories of semi-fabricated products. With higher prices improving smelter margins and triggering more capacity reactivations in China as well, it is hard to root the apparent bullishness of late in the fundamentals.

Tellingly, physical premiums, already at depressed levels, are deteriorating further, which

LME cash price, \$/t



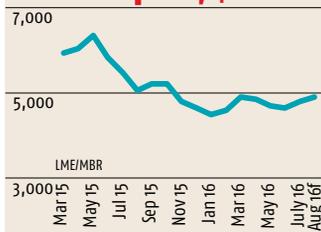
shows that there is no actual tightness in the physical market. We have raised our price forecast recently to accommodate the latest upswing, but that forecast allows for a significant pull-back in the coming months once upward momentum wanes and the fundamentals reassert themselves. We forecast a Q3 average of \$1,595/tonne.

Copper

Poor fundamentals

Copper prices continue to struggle, at least relative to some other base metals that have pushed on the new multi-month highs in the first half of July. Fund buying is the driving force behind this upswing and, in general, funds are not particularly bullish on copper and see more compelling stories in some other markets, such as zinc and even nickel. Copper concentrate supply is rising and so too are TC/RCs, with spot terms now well above annual contract terms. Chinese refined production is set to expand further on the back of this, with smelters' collective pledge earlier in the year to cut up to 350,000 tonnes of production, now seemingly

LME cash price, \$/t



long forgotten. Better Chinese demand sentiment or unexpectedly weak Q2 production reports might help to restore the perception of balance to this market. But our technical analysis suggests that only a sustained break above \$5,160/tonne will end what is now an eight-month-long phase of base building. Our Q3 cash price forecast is \$4,930/tonne.

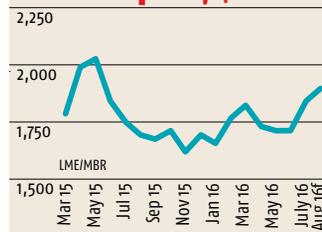
Lead

Quietly bullish

Lead has been an underperformer this year, overshadowed by funds' interest in sister metal zinc. Admittedly, lead probably remains the weaker sibling because over 50% of annual lead supply comes from scrap, so it is less affected by zinc-lead mine closures and cutbacks that are the foundation of zinc's bull story. However, we believe the reality for lead is that demand is stronger than official data suggest, given robust markets for automotive and storage batteries, especially in China.

Exchange inventories are also very low and this market has a tendency for fast price moves once it gets directional. So we expect dips to be well

LME cash price, \$/t



supported and we are prepared for prices to surprise on the upside when funds finally take note of this market's underlying fundamentals and the catch-up potential for prices. Overall, we think lead supply and demand will end up essentially balanced at worst this year, and we have a Q3 price forecast of \$1,930/tonne.

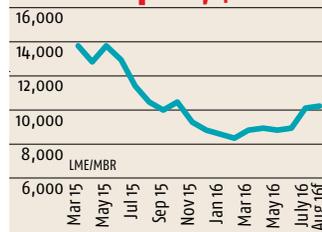
Nickel

All eyes on the Philippines

Sentiment towards nickel improved in July. Although metal is still accumulating in SHFE warehouses and unreported stockpiles remain huge, LME inventories are heading lower, cancellations are holding around 30% and premiums are firmer. Moreover, prices of nickel, NPI and stainless steel are strengthening on a combination of speculative, strategic and physical demand.

But the big story in nickel is the environmental clampdown on the Philippine mining industry launched by the country's new president. This resourceful industry, however, has adapted to many challenges, so we would not be too hasty to reduce China's NPI production

LME cash price, \$/t



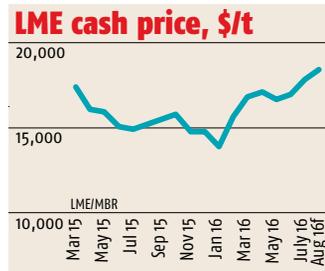
forecasts. In fact, we recently raised our forecasts on the back of NPI producers' rapid response to higher prices and success in ramping-up new plants in Indonesia. And the short-term response to the Philippine crackdown may even be more ore supply, not less, as miners rush to ship material before inspectors arrive. Our Q3 nickel price forecast has been raised to \$9,880/tonne.

Tin

\$20,000/tonne on the horizon

Tin continues to go from strength to strength, recovering from its mid-May pull-back into the \$15,000s to re-establish itself in the mid-\$17,000s in June and then break out beyond \$18,000/tonne in July for the first time in 16 months. Prices are likely to continue eroding resistance levels, which, according to our technical analysis, could bring \$20,000/tonne into play sooner rather than later, but not without some sharp corrective pull-backs along the way.

Although demand still seems weak and exchange stocks are creeping higher, the ongoing tightening of legislation in Indonesia is unlikely to allow for any unexpected increase in

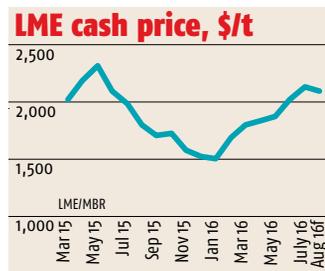


exports from the country, or from many other countries where supply is structurally constrained. This should help keep markets tight and the forward curve backwardated. The exception is the Myanmar-China supply chain, and we are wary that higher prices bring with them the threat of rising supply here. On balance, we have set our Q3 cash price forecast at \$18,450/tonne.

Zinc

Bull needs a breather

Zinc remains the best-performing base metal and is still the top pick of the funds. Prices tested \$2,200/tonne in mid-July for the first time in over a year. However, MBR is wary that prices are getting overextended because we are still waiting for signs that tightness in the concentrate market is spreading to the refined market. Physical premiums are depressed and there is no appetite for LME warrants, with only 4% cancelled – by far the lowest ratio of all the base metals. Miners' quarterly reporting season is now under way with Trevali starting off by raising its production guidance. It will be interesting to see if



other producers can do the same to benefit from higher prices and low TCs. Certainly we fear that miners in China are ramping up and we wait for reliable data to confirm this. A strong supply response will undermine zinc's bull story. Our Q3 price forecast is \$2,145/tonne, which leaves room for some corrective weakness.

Analysis by **Andy Cole**, base metals analyst and editor of MBR's *Base Metals Weekly Market Forecaster*. Email: Acole@metalbulletinresearch.com

Ask an analyst

What are the ramifications of Brexit for base metals?

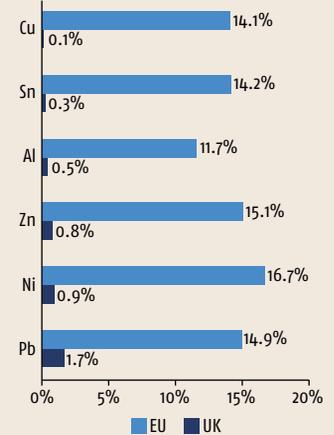
More than a month has passed since the surprise outcome of the UK's referendum on its EU membership. The shock result for Brexit had its biggest repercussions in Westminster and in equity and currency markets, but it is fair to say that initial panic has died down and concerns have eased. Markets may well start to get reactive again when negotiations start, but until then we have a lull in the volatility that allows us to take stock and, from our perspective, consider where the base metals fit in.

It was interesting, and surprising, that of all financial markets, the base metals were one of the least affected by the initial volatility in the aftermath of the result. It seems that for once metal market movers collectively took the very rational view that the UK is of course actually a very minor consumer of base metals and that global supply-demand balances will barely register any drop in UK metal consumption that may result from a Brexit-triggered economic slowdown or even recession.

The UK accounts for just 0.1% of global copper consumption, for example, and even if contagion ultimately spreads to the wider EU, the whole region only accounts for 14.1% of the global total. That figure is even less for aluminium, at just 11.7%.

So perhaps it is understandable that metal markets quickly turned their focus back to where it matters

UK/EU metal demand as % of global



– namely China – after the Brexit 'sideshow'. And sentiment towards China is somewhere between reassured that the economy has stabilised and optimistic that Beijing will still inject more metal-friendly stimulus to maintain that stability.

That view is enough to keep investors returning funds to industrial commodities, extending the price recovery that got under way earlier this year on the belief that the cyclical bottom has passed and the next bull market has begun. In fact, base metals have only rallied further in July, benefiting from many central banks moving to reopen the liquidity taps – ironically to mitigate against Brexit-related concerns.

Analysis by **Andy Cole**, Metal Bulletin Research

Every month an MBR analyst answers a question raised by readers. If you have a question for our analysts, please email: acole@metalbulletinresearch.com

provides independent, detailed and timely analysis on the latest data, price movements and developments that impact the market conditions and outlook for LME-traded base metals.

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MBR analysis

Steel

Supply side dominates the fundamentals

MBR's steel price index has been generally in decline since June. We had predicted that after a rare decline in steel consumption last year, there would be a slight recovery in 2016. This was the case even if Chinese demand fell for a third straight year. So far this year, however, while Chinese demand has declined further, as we expected, the rest of the world, en masse, is falling just as quickly, dragged down by a still-retreating USA.

The fundamental support to rising prices so far this year has come from supply-side discipline, including voluntary production restraint and, in the special case of the USA, the impact of prohibitive import duties. Indeed, US steel producers are starting to increase production, but from an apparent consumption perspective, the demand growth is merely consumers switching away from imports to cheaper domestic supply.

The turnaround has been so dramatic that local steel producers have had to import and roll slabs in order to keep up and they are understandably charging their customers for the privilege. Basic HR coil may have fallen slightly since late June but at the time of writing was still 72% higher than at the end of last year.

The US import duties have been so impressive that EU steel producers have been keen to follow suit. After first targeting HR coil import duties against only Chinese suppliers, in February, by July they decided to widen the remit to what amounts to just under



80% of traditional exporters to the EU. EU demand is again stronger than in the USA, if only because it is still on a very slow recovery path, which the USA completed a couple of years ago, but EU HR coil producers doubt, as we do, that a modest revival in demand can support the US-style margins they desire after years of financial turmoil.

While EU producers, like their US peers, have started to reduce prices again, we notice that in China a revival has again been under way. Judging by previous experience, supply-side dynamics will have been key to this. However, we also see that demand, over the last 10 days of June – the latest period we have – was much stronger than expected because not only did production recover strongly in the period among CISA member mills, but inventories were slashed, not only at mills but also distributors. Moreover, surveys suggest that production has been rising further in July. If we again have underestimated the strength in demand in China, so the upside risks to prices increase.

Analysis by **Alistair Ramsay**,
Metal Bulletin Research

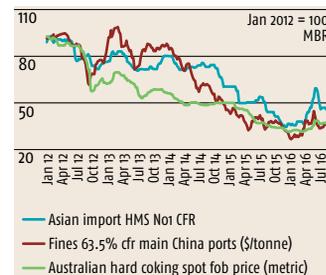
Steel raw materials

Signs of ore oversupply emerge

As we expected before the summer slowdown commenced, scrap prices have retreated more acutely than finished and semi-finished steels. Furthermore, the declines have been sharper than alternative steelmaking raw materials.

But this decline has not been seen with iron ore – over the last couple of months, iron ore import prices have broadly stabilised. Iron ore prices had of course fallen in advance of scrap, closely following developments in the Chinese domestic market, but there has been clear resistance to further iron ore reductions since early June. Furthermore, the third quarter, so far, started with prices rising back to levels around \$57/t, for the MBIOI62, compared with under \$52/t in June.

The uptrend was against our expectations but this is partly because the finished steel market recovery in China has also been against our expectations. The particular supply/demand dynamics that affect the Chinese iron ore market do not, by themselves, easily explain why prices have first stabilised and then revived. Underlying demand for blast furnace iron ore, after all, has clearly declined further so far this year. Indeed, China's National Bureau of Statistics (NBS), though prone to make large revisions to the provisional data most analysts refer to, estimates that in the first half of the year, pig iron production fell by 2.1% year-on-year. This relatively modest decline assumes that over the first half of last year production was 352.7 million



tonnes, as the latest revised data suggest, and not the 6 million tonnes more (10 million tonnes of iron ore) first recorded.

Whether demand for iron ore fell by 2.1% or closer to 3.7%, supply has not fallen at all. Indeed, production of ore in China, though arguably just a 30% share of Chinese supply, fell by little more than 1% so far this year at the same time as imports rose close to 10%. On an “apparent” consumption basis therefore, it is easy to conclude that demand for iron ore has surged but when the “real” consumption indicators are negative, it looks more likely that there has been a mismatch. Calculating absolute stock levels in China is hard but the rapid rise in port stocks so far this year does suggest that the market is becoming oversupplied again.

So while iron ore's resistance relates not so much to its own fundamental dynamics – though mining and delivered costs have increased with energy prices – the scrap market has shown that overreliance on the fortunes of the finished steel producers is unlikely to keep prices from falling sharply should those fortunes turn.

Analysis by **Alistair Ramsay**,
Metal Bulletin Research

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Metal Bulletin
Research

In this section, MBR's steel and steel raw materials team summarise their in-depth reports to highlight key factors driving the markets and short-term price forecasts. MBR is a leading independent supplier of product and regional price, supply and demand forecasts for steel and raw materials. For free samples of MBR's reports, call Harriet Hall (+44 (0)20 7779 8000) or access www.metalbulletinresearch.com/freesample

Regional review

North America

Myra Pinkham

Trading blows



All eyes in the North American steel industry remain firmly fixed on trade issues as the presidential election approaches. The leaders of the USA, Canada and Mexico, following their North American Leaders' Summit in late June, said they would hold regular Customs Steel Enforcement Dialogues in an effort to boost compliance of anti-dumping and countervailing duties on steel products. These dialogues are to be held in conjunction with meetings of the North American Trade Committee.

John P. McConnell, chairman and ceo of Worthington Industries, said during his company's earnings conference call that the flurry of recent steel trade cases could result in increased imports of finished steel-containing products as foreign producers look for alternative homes for their steel, regardless of trade cases. There are also concerns that a stronger US dollar could make imports of steel and steel-containing finished products more attractive.

Both US presumptive presidential nominees Hillary Clinton and Donald J. Trump have not only voiced opposition to the proposed Trans-Pacific Partnership (TPP), but have questioned the impact of the North American Free Trade Agreement (Nafta) and other trade deals on imports and the economy in general.

Trump has called the North American Free Trade Agreement "a disaster" that has cost US jobs, and indicated that if he is elected he would either break or renegotiate the deal.

Despite the fact that Nafta had been considered one of the signature achievements of Bill Clinton's administration, Hillary Clinton has recently stepped back from supporting it, saying it should be reassessed and adjusted. She is also calling for a "timeout" of any new trade accords.

But Philip K. Bell, president of the Steel Manufacturers Association, told *AMM* that repealing Nafta would be shortsighted, especially if the North American steel industry wants to continue to work together to fight unfair trade, excess capacity and dumping.

Europe

Richard Barrett

A turbulent summer



A sense of shock is the best description of the mood of many people in the UK on Friday 24 June – the day after the referendum about EU membership. By a relatively narrow overall margin of 52% to 48%, voters wanting Britain to leave the EU exceeded those wanting to stay, and so the potential 'Brexit' debated for months started to become a reality.

The shock applied to voters on both sides of the argument, since most pre-referendum-day polls, and bookmakers, had indicated that the 'remain' side had a slight lead. It was exacerbated by prime minister Cameron's prompt resignation when the result was declared, and reflected by the immediate initial response of other EU leaders, as well as volatile equity markets and the impact on exchange rates for the pound.

Several weeks later, analysts are continuing to work out the exact implications of the patterns of voting, which broadly show marked contrasts between older and younger

voters, significant regional variations, as well as differences between wealthier and poorer parts of the population.

Meanwhile, new prime minister Theresa May and her Cabinet have commenced work on dealing with the multiple ramifications of the referendum outcome. The UK remains a significant market for other EU member nations, but negotiations about future trade rules are set to be long and tough. To take just one key example, what the detailed terms for Britain's continued access to the single European market might be are unclear.

But other pressing priorities have come to the fore in the EU. Those include countering terrorist attacks, responding to a continuing migrant crisis, and considering the consequences of a failed military coup attempt in Turkey.

Aside from any potential repercussions of Brexit and its reverberations on Europe's steel sector, a question may also arise about its impact on base metals – to which the MBR analysis pages in this issue of *MB Magazine* provide an answer.

Asia

Juan Weik

Indonesia's tax amnesty



Indonesia, the biggest economy in Southeast Asia and the world's fourth-largest populous country, has long been trying to find ways to increase its tax base. It has a population of over 250 million people – but fewer than 30 million are registered taxpayers, and only about 1 million are regular payers, according to *The Economist*.

Things may start to change now, however, with the implementation of a tax amnesty scheme aimed at stimulating taxpayers to repatriate their overseas assets. Under the plan, Indonesians with undeclared assets abroad will have nine months, up to March 31 next year, to bring them back into the country. They will enjoy taxes as low as 2% to repatriate their assets during the first three months of the scheme.

For the Indonesian government, the programme is expected to generate up to 165 trillion rupiah (\$12.5 billion) of tax revenues, which would come from an estimated capital repatriation of around \$152 billion and the declaration of assets worth more than \$300 billion. This would be enough to solve a federal budget deficit this year.

But the effects of the scheme could go beyond that. In a report early in July, credit ratings agency Fitch said the amnesty would allow for increased public capex, benefiting a number of sectors in Indonesia. "Government revenues will be bolstered and allow for

increased infrastructure spend," it said, noting that authorities were preparing the investment platforms and financial instruments that will be used for the repatriated funds.

One of the industries more exposed to the positive benefits of the tax amnesty is the construction sector, particularly driven by infrastructure projects, Fitch noted. More recently, Indonesia's industry minister Saleh Husin said he also hoped that part of the repatriated funds would be invested in manufacturing industries, including steel.

Will the scheme be successful? The answer will come in the next few months.

Middle East

Serife Durmus

The pros and cons of import duties



Turkey has become a net steel importer in 2016 after 15 years of being a net exporter. Imported steel took a 55.50% share of Turkish steel consumption in 2015, and had a 56% share in January-April 2016. The country's steel imports increased by 13.30% in the first four months of 2016. Turkey set a definitive anti-dumping duty on June 24 of 23.40% for pre-painted galvanized iron (PPGI, or colour coated coil) imported from China. The Turkish Steel Producers' Association (TÇÜD) said that the country must take further measures to avoid increasing volumes of imports being brought in at 'dumped' prices.

On the other hand, The Turkish Steel Pipe Manufacturers' Association (CEBID) believes that Turkey could become the third-largest steel pipe producer in the world if import duties on flat steel products were removed. Turkey is currently the fifth-largest pipe producer in the world, making 4.5 million tpy of tubes and

pipes. CEBID complained that Turkey has import duties on flat-rolled steel products, but no import duties for steel tubes and pipes. "This results in high tube and pipe prices from Turkish producers and weakens competitiveness in global markets," general secretary Mehmet Zeren said.

Turkey imposes a 9% import duty on hot-rolled coil, although re-rollers pay 5%. Holders of the country's inward processing regime licence are exempt from the duty. This allows companies to avoid import duties on steel as long as the end product is exported.

Meanwhile, the US Department of Commerce announced a preliminary anti-dumping duty of 7.86% on radial-welded carbon steel pipes from Oman, and at different rates for other countries, including Pakistan and the UAE, in early June. Al Jazeera Steel of Oman said it was "determined [that the] margin will not have a material effect on the company's revenue and profit," and added that it will vigorously contest the preliminary dumping margin.

Latin America

Ana Paula Camargo

Trade protection measures have an impact



The volumes of steel imported from China into Latin America fell by 35% year-on-year in January-May 2016, reversing last year's upward trend, according to the latest data reported by the region's steel association, Alacero, at the beginning of July. The region imported 2.70 million tonnes of finished steel from China, compared with a total of 4.20 million tonnes in the corresponding period of last year.

In 2015 overall, Chinese finished steel export volumes to Latin America grew by 1% on an annual basis, to 9.40 million tonnes, Alacero data show. "The constant decline in imports of Chinese steel in the region [this year] is explained by the introduction of measures [against] China's unfair trade," the association said.

Brazil has imposed three trade measures against China, Colombia has imposed a total of six measures, Mexico has imposed 15 measures and the Dominican Republic has

imposed one, according to Alacero.

Mexico imported 225,000 tonnes of finished steel products from China from January to May, against 608,000 tonnes in this period a year earlier, and Colombian steel imports from China totalled 225,000 tonnes, a decline of 25% from the 299,000 tonnes in January-May 2015.

From January to May, imports of Chinese finished steel into Brazil reached 228,000 tonnes, down by 68% from the 708,000 tonnes a year earlier.

Mexico, certainly, is the Latin American country with the most stringent trade defence system, with shorter periods for the resolution of its trade cases.

But in Brazil, it is not only its trade defence measures that are protecting the steel market from imports. Poor domestic demand conditions and the strong devaluation of the country's Real against the US dollar this year have made steel imports much less viable as import prices are now much higher than those available locally.

Africa

Bianca Markram

Africa faces uncertainty over EU turmoil



Britain's shock exit vote from the European Union during its national referendum on June 23 is still rippling through the world, no less so in Africa, which has Britain and the EU as important trading partners.

Analysts can only speculate as to the effect that 'Brexit' will have on African economies. In the immediate aftermath of the voting

outcome, South Africa's exposed currency took the most knocks as the dollar strengthened, shaving 9% off the rand-dollar exchange rate on June 23.

However, South Africa's gold producers saw an uptick in sentiment for the yellow metal, creating the atypical situation where the gold price and the dollar currency moved in the same direction.

This creates, at least in the short term, more cash flow for

gold miners. Ratings agency Moody's released a note just after the vote outcome, stating that AngloGold Ashanti could generate an additional \$120 million free cash flow in the second half of 2016, while Gold Fields could have up to \$50 million in free cash flow.

However, for South Africa as a whole the Brexit vote could lead to further economic slowdown, with the risk heightened that the country's credit rating could be downgraded to subinvestment grade (or 'junk') status.

Economic slowdown for other African countries resulting from the UK vote is also possible for those that

export to the UK, and no-one knows what the repercussions will be when the UK renegotiates all of its trade agreements with the EU.

Analysts say Brexit could weaken commodity prices more, if the UK's economic growth slows as anticipated, but commodities are not weak because of Brexit, but because of general oversupply.

The UK vote could derail some mining projects, many of these in Africa, until uncertainty around its impact subsides, noted one analyst. However, many of these projects, she said, had "viability issues in the first place, with or without Brexit."

Profile



Heinrich Weiss

'You have to have trust'

At the helm of his family-owned business for 45 years, Heinrich Weiss tells Richard Barrett about the personal and business ethos he has adopted to grow SMS group revenue from 60 million euros to well over 3 billion euros a year today

SMS group supervisory board chairman Heinrich Weiss says that there is a very simple benchmark as to which types of company are more successful in machine building – and especially for contract machine building. “If you look over the past 30-40 years, nearly all the European rolling mill divisions which belonged to large groups other than ours failed. Only our group and Danieli developed dynamically,” he claims. “And both are family businesses.”

He puts that down in part to the ability of family businesses to take a long-term strategic view without the external influence of the short-term shareholders of listed companies. He also points out that SMS group is very customer-oriented and bespoke in terms of engineering for individual clients. “Unbureaucratic family companies are much more successful,” he asserts.

It is something that he has gone out of his way to preserve. Proffering a simple diagram, he briefly outlines the corporate structure. The Weiss Family Foundation, in which all of the family’s shares now reside, is at the top of the tree in order to ensure the future security of the group and to guard against any single future family member selling out to a

conglomerate. “I believe in family companies for this type of business,” he stresses.

Adventurous childhood

Heinrich is the fourth generation of the Weiss family to run the business since, in 1871, Carl Eberhard Weiss founded a forge deep in the steep forested valleys of Germany’s Siegerland – an old centre for metalworking based on the water mills, wood for charcoal and iron which the region offered.

The Weiss family home, where the young Heinrich grew up in that region during the 1950s, overlooked the company works in Hilchenbach. Weiss has very happy memories of his young days there: “They were wonderful times – I had a very nice childhood.”

An aptitude for technology and engineering emerged early and the company’s facilities gave him plenty of opportunities to cultivate those interests. “We had a car repair workshop. We had all types of vehicle, from big trucks and overhead cranes to locomotives for me to enjoy. I drove them all!” He helped to repair them too. “It was like a big adventure playground for me. I think I may have neglected

school! Every afternoon I was there, or with my neighbour.” He was a farmer: “I drove his tractor as well,” Weiss recalls with a chuckle.

“And I liked the people. That is one of the reasons that I came into this profession. Of course my father had expectations that I would come into the business too.”

Other careers considered were aircraft engineer, test pilot, car engineer and racing driver, or a doctor. “They were my alternatives,” says Weiss. “But growing up in this family and with these people, and having this wonderful playground, it was very clear to me that I wanted to continue to work with them.” He already knew a lot of the employees and it was clear that an emotional attachment meant that he would stay with the family company.

The Hilchenbach works have been modernised and reorganised in recent years, and Weiss’s childhood home is now a conference centre and academy for SMS staff.

Rapid rise to chief

Weiss studied electrical engineering at the Technical University in Munich, which he recalls was a big and exciting contrast to the far more rural setting of Hilchenbach. He ▶

'I believe in family companies for this type of business'

achieved his Dipl.-Ing. there in 1967.

Work for the family business started the following year. “The company was so much smaller in those days, so the ceo needed to have a closer knowledge of the products and plant technologies than today.” He admits that the breadth of the group’s range of technologies is too wide now for him to fully understand them all in detail. “If you want to understand the fundamentals of commerce and the fundamentals of technology, the technology you have to study. Commerce you can learn through experience,” he observes.

Weiss actually had a one-year period of practical commercial training and some private lessons in the fundamentals of economics after completing his technical training in Munich. He then spent half-a-year with a small machine-building company in Hannover. “I worked closely with the owner to see what landed on his desk. At that point I had ideas of going to somewhere like Harvard Business School and to see the world.” But Heinrich’s father had other ideas and gave him a job, at the age of 26, as ceo of a subsidiary that employed 300 people. “Too many,” Weiss recalls. “It was half bankrupt and not very well structured.”

He says that the company itself was not so bad, but also remembers that the people working there had been poorly treated after the Second World War. He recalls that the management there were very authoritative and says that the staff were badly managed.

“I know how to manage people and I knew that if I did that better, already we would be more successful.” It proved to be the case. “Especially at the end of the 1960s and early 1970s, when the business cycle was difficult, I quickly turned the company around into the black.”

With that experience under his belt, Weiss’s father and his colleagues judged that Heinrich was mature enough to run the whole company. He was appointed ceo of Siemag, the company which later became the SMS group, on 1 January 1971 – a position that he held for more than 42 years – before moving to the role he has now in 2013.

Path to growth

At the time he took the helm, the company had a 120 million deutschmark (€ 60 million) annual turnover and employed 3,000 people. “All of the value addition was done in house, but to manage that many people was a big task at



Erection of a heavy-plate mill stand in one of SMS group’s workshops

that time,” Weiss recalls. “Then I knew that was the last of my freedom. From then on, for the rest of my life I would be on the treadmill,” he laughs.

Weiss’s father died unexpectedly two years later, “So it was good that I was already broken in.”

Turnover climbed but remained in the low hundreds of millions of euros throughout the recessionary 1970s. It grew steadily during the 1980s and broke through the 1 billion euro level in 1987. SMS group sales in 2015 were about 3.3 billion euros and employees, now based globally, numbered over 14,000.

“We had a big expansion,” he says. “It was all in one branch more or less. When I started, we were one of five German rolling mill builders that were left – about 25 in Europe and about 60 worldwide. We’re concentrated now into three big ones [SMS group, Danieli and Primetals]. Some went bankrupt. We took a few on. VAI took some on, but – beside the Japanese – it became just three big ones.”

He explains that the momentum behind this industry was that there were far too many companies and they were too small for the really big projects which came up at that time: “Rourkela in India, the big Soviet projects and the big China projects. For these I realised that we must be bigger for financing etc.”

Weiss recalls that within four months of becoming the Siemag ceo he started talks with Schloemann. A merger went ahead to form Schloemann-Siemag in 1973 and sales volumes more than doubled.

“It was the first big step and through this we became the critical size needed,” Weiss says. It was a complementary fit. “Schloemann had no workshops. Our workshop in Hilchenbach was a little too big. Schloemann had engineering and were strong in markets where we were not, and vice versa. They had more long product technology and we were strong on flat product technology. From then on we had a size that was sufficient to handle big projects ourselves: the China projects and so on.”

He stresses that the fundamental idea behind it was – and is up to this day – to specialise on small market

Workshop philosophy

There were times when the strategy for some major plantmakers was to have no workshops of their own – concentrating on engineering design but subcontracting component manufacture and assembly to others.

“German workshops are very expensive of course, so there were times when even here in Düsseldorf the question was asked as to why we didn’t buy in components from other workshops rather than having our own,” Weiss recalls. “This was influenced by the growth of the Chinese market because they wanted to manufacture everything themselves,” he adds.

It is a fundamental part of a metallurgical plantmaker’s approach to business and has a big impact on revenue. “Chinese orders even today are small orders because they want to subcontract the mechanical side to the local area. For example, if you sell a complete hot strip mill to Russia or India, which are countries that like German workmanship, it’s a volume of €250-300 million. If you sell a complete hot strip mill to China, it’s a volume of €30-35 million, because it is only the

engineering and might also need the electrical automation.”

“So when China was the centre of interest and was developing to become the biggest market, everyone was saying ‘We don’t need workshops.’”

Attitudes changed when the Russian and Indian customers came into the market again, says Weiss: “Suddenly your own workshop became of value again.” SMS group has invested in workshops in Russia and India, while its workshops in Germany have been modernised with the latest automated machine tools and tool management systems in the group’s main centres in Hilchenbach and Mönchengladbach.

“We maintained that certain ‘noble’ parts should be manufactured in Germany, where we have people in the second or third generation of manufacturing rolling mills and fully understand them,” Weiss explains. “Now with the cost crunch, again it is a question as to how much of our own workshop capacity we need.”

niches “Where you have a chance to be a world market leader” and then combine that strategy with the management advantages of a family company. “So I developed one master-plan and I have stuck to it through to this day. This is one principle that I have tried to keep all the time that I was ceo.”

At the end of the 1990s, Mannesmann gave SMS the opportunity to take on what was then Mannesmann Demag. “So we doubled our size again,” says Weiss. Thus SMS Demag was formed. The market for metallurgical projects was very poor at that time. “This was also the first time that we had to fire some people,” Weiss says. Demag simply had too many engineers for the market to support at that time, he recalls.

In a mark of how poor markets have become once again for steel plantmakers today, SMS is now in the process of reducing staff numbers. “The period we have now is only the second time in our history that we have had to fire people rather than make a mutual agreement that they leave,” says Weiss.

Compared with 5,250 jobs at the beginning of 2014, the workforce in Germany will be cut by 1,200 to 4,050 by 2017. Part-time work, early retirement, a recruitment freeze and transfers to the group’s expanding service business are being used to minimise forced redundancies. Active efforts are also being made to capture and pass on the knowledge of older staff leaving to the next generation.

While Demag was the “second big thing”, after Schloemann, SMS had also acquired some smaller press and other small technology companies to round out its portfolio. The group’s last big acquisition was Paul Wurth, based in Luxembourg, five years ago. “The idea was to have a whole value chain from iron ore and coal to the finished product. We did not have coke plants and blast furnaces. They are leading areas for Paul Wurth,” he says.

Despite SMS group’s increase in size, Weiss says that he is sticking to his principles: “I’m fighting still for my non-executive position and trying to maintain that culture. We have become very big now, compared with what we were. And

A need for speed

Heinrich Weiss’s childhood enthusiasm for driving any vehicle that he could get his hands on has carried on throughout his life. A modest, waist-high, glass cabinet in one corner of his – otherwise light, spacious, airy and uncluttered – office on the top floor of SMS group’s Düsseldorf HQ is testament to that.

A red Ferrari is amongst the models to catch the eye therein, but in the basement car park his collection of real cars includes an E-type Jaguar and his latest acquisition – an all-electric Tesla. “For shorter and middle distances they are excellent: nice to drive and ahead of some of the premium German cars in some aspects,” he opines on the Tesla.

He declares a long association with electric cars, because in 1966 he designed one for his Masters degree dissertation. It was based on a BMW 1500 – “the first of the larger BMWs,” Weiss recalls. “So together with BMW, AEG and a battery company, I developed and calculated how to make such a car. I am emotionally attached to this technology and over all these decades they have developed. Now the time has come when you can buy such a car.”

He denies having a high appetite for risk, but used to count being a DTM (German Touring Car Masters) racing car driver as one of his pastimes. “In the 12-13 years that I drove races I

never really hurt anything. For ten days I had to wear a collar after a crash. We had a lot of crashes, but I was never seriously injured,” he says.

He is similarly dismissive of the risks of being a pilot. He piloted his business jet in Europe for nearly 30 years and undertook an annual three-day simulator course in the USA. “The more flying hours I had, the safer I felt. And the one thing you learn from the simulator training is that when something goes wrong, you become very calm, you don’t get upset. The bigger the problem is the calmer you become. So from this point of view I would say it’s not risky.”

He says that keeping calm under pressure is also a quality of a ceo. “Just like my experience from simulator training, sitting around a boardroom table, the bigger the problem the quieter I became.”

Having reached his early 70s, and needing to make fewer trips on handing over the role of ceo, he gave up flying planes two years ago. But he still flies helicopters “for fun”. If any further evidence of his interest in transportation were needed, Weiss was a member of the board of Canada’s Bombardier for ten years, and member of the supervisory board of Germany’s nationwide railway company Deutsche Bahn for 15 years, both to 2015.

‘Now the unbureaucratic, decentralised management style is more and more difficult to keep up, but I am fighting for it’

now the unbureaucratic, decentralised management style is more and more difficult to keep up, but I am fighting for it,” says Weiss.

He also says that his successor as ceo, Burkhard Dahmen, supports that approach, having been steeped in the SMS group culture during his own 26 year career with the company.

An international outlook

As Weiss would stress to any group apprentice wanting to climb the management ladder (*see box*), an international outlook is key to making progress.

Weiss has combined a willingness to embrace other international cultures with what he describes as a certain talent for politics. “After the merger with Schloemann and when, in the early 1970s, we started our worldwide business, I enjoyed seeing different cultures and countries,” he recalls. He was invited to China in the early 1970s and started cultivating contacts in Russia as early as 1969.

“I was interested in these countries and I was able to make friends in the

Chinese government and the Russian government,” he says. He adds that it was particularly interesting to see both countries change from a planned economy to a market economy, especially in China.

Amongst several roles he has played on German trade committees in Berlin, for 15 years (1982-1997) he was the chairman of the China Group of the Asia Pacific Committee of German Business, helping to co-ordinate State visits as part of his responsibilities. “This was pure political interest, but of course it also helped the company because decisions about the big projects in China were taken by the government at that time.”

He says that he has retreated from the daily operating business quite far, but “If there is a Russian oligarch or a large Indian entrepreneur and they ask for me because they have a project worth millions and they want to see the owner on the other side, I go there.”

He says that it is all about trust. “If you’re investing in a big plant and for a large volume of money, for them ▶

it is a risk and for us a responsibility. If something goes wrong, there is the potential for big losses, so you have to have trust.”

For these types of big order, if something goes wrong it is important for the customer to have a partner who, if anything breaks, comes first and repairs it, and then discusses who has to pay afterwards. He says that by comparison with some companies, who would probably send their lawyers to discuss liabilities first, that is another advantage of being a family-owned company.

Top technologies

Looking back over his decades of experience, what would Weiss say are the top three technological advances for metallurgical plant that he has witnessed in his lifetime?

He is keen to answer this in terms of how he sees SMS group having achieved technical leadership, for which he says there were three main steps.

“Before compact strip production (CSP), the first was called CVC – continuously variable crown – in a big rolling mill, where we developed the idea to shift the rolls vertically and radially and thus control quality and surface precision. We had a hydraulic system for shifting the rolls, which was introduced in the early 1980s.”

Weiss notes that it was something which Demag – at that time still the group’s biggest competitor – did not have. “We sold some for the aluminium industry, which requires high-precision rolling. We sold some big mills and Demag could not follow us.”

He says that CSP was the most fundamental technical development made by SMS. “We made it possible to make flat steel products in mini-mills, which could only be made from integrated (blast-furnace-based) works before then. The ability to produce not only long products but also flat products from mini-mills changed the market.”

He says that in the 1990s CSP really “battered our bread.” He adds that the money the business made from the early CSP plants provided the resources needed to take over Demag. “Without the profit from CSP we would probably not have had the courage to take Demag on with

Advice for an apprentice

SMS group has 488 apprentices in training in Germany – over 7% of the group staff employed there. What advice would Weiss give to an apprentice keen to advance?

“A pre-condition is character – personality. Be upright, honest, and able to deal with people. Be socially competent. That is if you want to enter management.

“I would say ‘Young man, develop your personality. Try to take a leadership role, perhaps outside work in a volunteer firefighting brigade or perhaps in a church role to be a good speaker.’ Some of our staff were active in debating societies at school: good speakers. You must be warm with people: that is to the point. These are pre-conditions.

“Then it is a question of how good you are technically or commercially, your level of knowledge, and how good you are with

all the burden we were expecting with overstaffing and the cost of reducing levels... none of that would have been possible without CSP.”

The third big step was electrical automation, moving towards today’s digitisation. “Twenty years ago we were purely a mechanical supplier. We had some electrical engineers, but only for adapting our machines for motors and the like. Automation was provided for us by Siemens mainly.”

He says that he had encouraged his directors as early as the 1980s to develop the company’s own electrical automation capabilities in order to have control over the production system – not only the mechanical machinery, but also to have the process itself in hand through automation.

He also recalls that the management board were mechanical engineers then and says they did not really understand the chance that automation provided to expand the business – the value added. “I tried to push and push this idea, but I was not really successful.”

A watershed moment came when Siemens took over Austria’s VAI (in 2005). “Then everyone understood that we could not continue to order automation from our new competitor... Everyone in our company understood that we had to develop our own automation and then it developed very fast.” Weiss says that the group’s own rapid

development of electrical automation systems in house has made the business self-sufficient to install its own systems for all of its products.

languages. Everyone who wants to be in middle management here needs to be fluent in English. That is enough. You don’t need to have five languages, but you need to be fluent in English. “And be ambitious. There are many of our young people today who are not prepared to travel. In our business, you have to be prepared to do that. And for young engineers, they must be ready to spend 6 months in Russia or China at a plant. Some young people don’t want that any more – they are reluctant to leave their family and talk of work-life balance and wanting to be with their friends.”

He says that is a problem. “If any young person starting here wants to make progress, they need to be willing to travel and take responsibility in other countries. This is very important beside their technical knowledge,” he concludes.

development of electrical automation systems in house has made the business self-sufficient to install its own systems for all of its products.

Future technology

“Now that we have the complete process in hand and digitisation has become more important, we have a base to make a network for a full production line in a steel plant – not only to automate a rolling mill or a casting machine, but make complete production by networking together all of the machines. This is the future.”

Industrie 4.0 (or the fourth industrial revolution), the use of mobile devices, remote sensors, Big Data, the Internet of Things and digitization trends are all ‘buzz phrases’ around technology at present. Plantmakers speak of aiming to benchmark similar plants to guide their users on optimising performance, or to offer condition monitoring and predictive maintenance, but how feasible will it actually be for them to pull together all of the elements needed to practical advantage?

Surprisingly, Weiss answers: “This kind of thing was being done in the 1980s!” He remembers meeting a prominent computer pioneer who told him that he had installed a computer that would give its supplier a telephone call when it was about to fail – the idea then being to fix it



Rolling mill technology for flat products has been a key to SMS group’s evolution

before the customer even became aware that something was wrong.

“This was a wake-up call and we have developed monitoring systems already,” says Weiss. SMS group has a lot of sensor installations in bearings and elsewhere in the plants it has supplied, providing a lot of information on-line about temperatures and levels of wear. “It means that we can call the customer to say that ‘In one month your bearing will be going kaput and please give us the order to service it.’”

There is a competition going on for the middle ground between the big general internet companies, business software and web providers on the one hand, and with machine and automation builders on the other.

While their access to actual and historical plant production data in the steel and metallurgical sectors can give plantmakers an advantage, Weiss notes that not all plant users are willing to share their data. “Many of our customers in established industrialised countries are not willing to give us the data we need because they fear that we will give it to their competitors,” says Weiss. “The newcomers in this industry, who depend on us for the know-how, are more open,” he adds.

There is also a geographical divide when it comes to the level of interest in plantmakers’ service offerings – an area in which SMS group and others are keen to expand business as orders for new plants have diminished. While orders for metallurgical plant and machinery construction for SMS group fell to €2.48 billion for 2015, from €2.92 billion during the previous year, service business increased to €594 million, which was a 15% increase on €515 million in 2014.

“The Americans are much more open and the Russians are grateful for help and our services,” says Weiss, explaining that in some older industrialised nations, plants with their own maintenance crews do not want a service contract. India is another country where service contracts are more commonly provided with a mill.

While electrical automation and services are existing areas of growth, Weiss is hopeful that, in a couple of

‘We are depending on human capital, rather than being a mass production company that has capital investments’

years, digitisation will become a third area.

Digitisation is significant both internally and externally, says Weiss: “It goes in two directions.” Internally, those are to become more efficient in contract handling, manufacturing and design work. While externally there is the business model for customers: to have a whole steel plant connected up rather than single islands of machinery.

The first priority is on the customer side, stresses Weiss: “Because it would be terrible if a company like [equivalent to] ‘airbnb’ or ‘uber’ or another similar company were to come and hire two or three steel experts and then develop a platform on how to optimise a steel plant.”

A disruptive technology like that could push plantmakers back towards only supplying components and the mechanical parts. “Everything that is really interesting would be taken away,” says Weiss.

Wary of fads

Weiss says that SMS group experts have been following the potential of additive manufacturing (3D printing) and other technologies that could refine group products or widen its product range. However, he is very wary of investing in any trend that could be just a temporary latest fashion: “Everybody jumps on it and nobody makes any money.”

He says that he has often seen that happen before. “The first example I will never forget was in the 1960s, when suddenly every steel manufacturing company had the same idea to make the extendable passenger foot-bridges that temporarily connect planes to air terminal buildings. Air transportation was growing fast and everyone thought it was a good market to enter. But nobody ever made any money out of that – I observed that very clearly,” he recalls.

“Then in the 1970s, after the first energy crisis in 1973-74, everyone thought that heat pumps would be the future for homes. Every pump producer made heat pumps, but nobody made any money out of it.”

He also stresses the opportunities that can be found by supporting less fashionable, but nevertheless still essential, areas – rather than

following the herd. “In the 1980s, when everyone in the USA was saying that nobody wanted to invest in ‘smoke-stack’ industries any more, we made a lot of money in the shadow, outside the limelight. This is very fundamental,” he observes. “So in summary, if we are looking at anything that everyone is discussing, then we are very cautious.”

He does not see SMS group making any money by providing 3D printing machinery – only by looking at very specific niches. “There are too many people in that business now already,” he opines.

Put people first

Weiss summarises his thoughts on the future by emphasising the importance of managing people over technology: getting the business culture right in order to have the corporate resilience to thrive whatever specific developments the future may bring.

“The thing I would like to stress is making sure that you have the right management system – be friends with your colleagues. We are depending on human capital, rather than being a mass production company that has capital investments. We have human capital.”

In an echo of the successful approach he adopted when he took his own very first practical step in management, he says that it is all about finding ways to treat and keep people better, to find young people that can be developed into managers: “If you handle this right, that is the easiest way to be better than your competitor.”

He stresses that strategy as an important means to differentiate the group from other technically competent competitors: “For technology you may have an advantage, but you can never keep that for more than a couple of years.”

Weiss adds that it is important that both the company and its employees are constantly learning. “Older, particularly successful older, people often stick to what they have done and are not flexible enough. I tell my people: ‘Until one week before retirement you need to learn some new things. Even at my age, where I partly stick to my old methods, I try to think modern and to be flexible.’”



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People moves

Kleinhempel joins Cronimet

Stainless raw materials supplier Cronimet has appointed Oliver Kleinhempel as ceo for Asia, and also as an additional managing director of Cronimet Holding. For the past three years he was with the Ferrostaal Group, where he was responsible for business in Indonesia.



ALCOA

Karl Tragl

Constellium nominates new ceo

Constellium has selected Jean-Marc Germain as successor to outgoing ceo Pierre Vareille, who is retiring. Germain will take up his post in mid-2016. He was previously the ceo of Algeco Scotsman Group of Baltimore, and before that served in multiple executive positions in the aluminium industry, including as Novelis's president of North American operations from 2008 to 2012.



ALCOA

Tim Meyers

Girsky elected to US Steel board

Stephen J Girsky was elected to the board of directors of US Steel, effective 26 April. Girsky is president of S.J. Girsky & Company, an independent advisory firm. He has been a member of the General Motors board of directors since 2009 and has served as a senior advisor to General Motors Company since 2014. From 2011 to 2013, Girsky also held responsibility for GM's global purchasing and supply chain function.



HYDRO

Hilde Merete Aasheim

Novelis names Satpute as senior vp

Novelis has appointed Sachin Satpute as senior vice-president of Novelis Inc, and president of Novelis Asia, effective 1 June, and based in Seoul, South Korea. Satpute has nearly 30 years of experience in the aluminium industry and previously served as chief marketing officer, Hindalco Industries. Prior to this, Satpute held roles of increasing responsibility within Novelis,

including director, business development & innovation, for Novelis Asia.

Stuart appointed as LME and LME Clear director

The boards of the London Metal Exchange and LME Clear have appointed Antony Stuart as an independent non-executive director. Stuart is a chartered accountant with 30 years' experience as an investment banker and corporate adviser. Before his retirement in 2011, he was managing director at NM Rothschild. He replaces Nat le Roux, who has resigned as an independent director of both boards, after some seven-and-a-half years as an LME board member.

European Copper Institute elects new posts

The board of the European Copper Institute (ECI) has elected Gonzalo Cuadra, general manager of Codelco Services, as its new chairman, and Oriol Guixà, president and ceo of La Farga, as its new vice-chairman, for the next two-year term.

Cuadra has been an executive director of Codelco's subsidiaries in London for the last 20 years, and is a past board member of the LME. He is an ECI director. Guixà developed the patent for La Farga Lacambra's copper recycling process, and created three subsidiary companies of La Farga. He has been a director of ECI since 2010.

Alcoa names new group presidents

Alcoa has appointed Karl Tragl as president of its engineered products and solutions (EPS) group, having been group president of transportation and construction solutions (TCS). Tim Meyers succeeds Tragl as president of TCS, having previously been president of the company's wheel and transportation products (AWTP) division.

Prior to joining Alcoa in February, Tragl was ceo of

automation solutions company Bosch Rexroth, while he has also had senior roles in Siemens.

Fernandes heads Anglo's Brazilian operations

Anglo American has appointed Ruben Fernandes president of its operations in Brazil. Fernandes, who already serves as president of the company's nickel, niobium and phosphate operations, will also lead the firm's Brazilian Minas-Rio iron ore business from June 20. He takes over from Pedro Borrego, who was appointed interim president of the iron ore division in Brazil in January, and who takes on a new role at the miner's HQ in London.

Guo leads China Minmetals

Guo Wenqing has been appointed as the new head of China Minmetals Corporation, taking up the positions of board director, general manager and vice-secretary of the party committee. Prior to the appointment, he worked as chairman, gm and deputy party secretary of China Metallurgical Group (CMC), which merged with China Minmetals late last year and is now a subsidiary.

Aasheim is chairman of IAI

Hilde Merete Aasheim, executive vp of Hydro's primary metal business, has been appointed chairman of the International Aluminium Institute, IAI. She replaces Abdulla Kalban, ceo of Emirates Global Aluminium, who is stepping down at the end of his two-year term. Aasheim has been a member of Hydro's corporate management board since March 2009, and prior to joining Hydro in 2005, she worked at Elkem.

Chew becomes chairman of MSC

Chew Gek Khim was named as chairman of Malaysian Smelting Corporation, effective 11 May. She was appointed as a non-independent non-executive director from March, and takes over from Ng Jui Sa, who will remain on the board as director.

Extracting value from data at all levels



SHUTTERSTOCK

Software to handle, store and analyse Big Data is closing the gap between management- and shop-floor-level strategy, reports Gregory DL Morris

Stefan Koch, global lead for metals at major software business SAP, says that every company has a basement full of data. “I just got a call from a big steel company – not previously a customer of ours – saying that they have the tools and the platforms to collect and store data, but that they need help in making it useful,” he says.

‘Big Data’ is not new, Koch states, but what is new is how large “Big” actually means now. “The amount of data is growing very fast. Part of the reason is that sensors are becoming so cheap – even for ones with good quality. Mill operators need ways to pool and harmonise all the data that they are now

collecting, and then a screen for particular purposes.”

The initial focus at many mills is predictive maintenance, says Koch. “Across the industry there are many specialists in that. You have the engineers talking to the machines. If it is a bearing, is it vibrating? If it is a battery, is it getting hot? The next step that we are seeing in some instances is using Big Data to improve the metal they are making. That means taking the data and applying analytics down on the shop floor. The focus is shifting to the metal itself, rather than the machine that is making it.”

While that is a great concept, it can be very tricky to execute

because of the knock-on effect of optimisation. When a system is optimised for any one unit, reactor, line or process, that inherently imposes inefficiencies on units upstream and downstream.

“Processing lines are very tightly optimised,” Koch notes, and that is where Big Data analytics come in. That analysis can provide the operating, or quality, or financial evidence for setting the optimisation parameters.

“There is still a gap between operations and business,” says Koch. “At least today both sides know they need to talk to each other. Business knows they have to drive sales, and operations know that they need to secure a budget for investment.”

Keeping track

One challenge of data analytics is variously called tracking, correlation, or harmonisation. It means ensuring that time and date stamps on the data are accurate and can be used to identify patterns and the relationships between cause and effect. It also means tracking specific places on the metal itself as it passes through the process. For example, one sample every metre on a hot slab can become one sample every 10 metres on a rolled sheet.

Given the capacity of data storage media, it might seem cheap and easy for operators to store data on site. Koch acknowledges that is a viable option, but urges loftier considerations. “If you are already storing data on the ground at the plant, do you keep it as it is or is it cost-effective to change? That is the rise of the cloud.” The operator still owns the data, even if not physically on site, and in the cloud the data are more accessible for analysis.

The more data that are accessible, and the more analytics that are run, the better the opportunity is for benchmarking. “We can analyse data for a blast furnace, or a rolling mill, and compare those against each other within the plant, or with other such units, or to the business process,” says Koch. That allows operators to improve operations, life-cycle efficiency, quality, and profitability. The goal is real-time business decisions coming from those analytics, and then looping back into the analytics.

Setting an ambitious goal, Koch suggests: “Ultimately, if you have a particularly good slab, in all its metrics, you can designate that processing to the customer for which it would be best suited. Now that sort of thing is much more complex than just root-cause analysis, but we have some mill customers that are about to try to do things like that.”

Koch also notes an extra benefit from using data analytics to improve both operations and quality of the metal. “Quality itself is the benefit, but there are costs related to quality. You can reduce your quality checking by 20-30%. For one mill customer that alone amounted to a seven-digit saving in euros.”

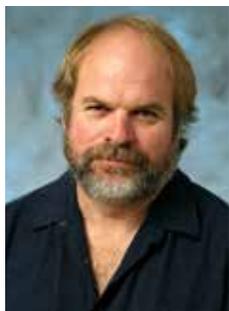
Preserving knowledge

Data management is often a corporate function, but not always. “Other organisations try to centralise things, but we believe in autonomy,” says Mark Millett, president and ceo of Steel Dynamics. “Our mills are free to operate as they think best, and that applies to our approach to data as well. To the extent that Big Data addresses a practical need or creates value we will apply it. That particularly applies to predictive maintenance.”

Millett adds that “We tend to shy away from company-wide ERP systems, but we certainly want to apply our resources practically, and that includes data. I have to say that is one area that we have yet to conclude a good solution. Part of the challenge is that there are so many options. The creativity available is phenomenal, yet it has



“Mill operators need ways to pool and harmonise all the data that they are now collecting, and then a screen for particular purposes,” says Stefan Koch, global lead for metals at SAP



“The intuitive knowledge that the veteran process operator has is now available to the newer hires through the system,” says Tim Sowell, chief architect for software industry solutions at Invensys

not really penetrated very far through the steel industry. It takes young blood. We as an industry have to accelerate that infiltration.”

At the operational level, the young blood coming into the industry naturally has less experience than older departing staff members. “As the workforce changes it is becoming less experienced, less knowledgeable,” says Tim Sowell, chief architect for software industry solutions at Invensys, a major process-control company which was acquired by Schneider Electric in 2014. “That means that the experience and knowledge must go into the systems.” He notes that “while the metallurgy is the same everywhere, the manufacturing system has its own nuances. The intuitive knowledge that the veteran process operator has is now available to the newer hires through the system.”

Invensys has been a leading player in the energy sector, from oil and gas through control systems for refineries and chemical plants. “We have been doing oil and gas for a long time,” says Sowell, “and now we are putting that operating expertise into mining and primary metals.”

That is a meaningful transfer, because refining and petrochemical plants were early adopters of advanced process control in the 1980s and then Big Data when that came on the scene more recently. As has been widely noted, primary metals have generally been slow to adopt similar systems. Often, for lack of exact benchmarking data within metals, the few pioneering operators have been benchmarked against refining and petrochemicals instead.

But it only goes so far, says Sowell. “The number one type of resistance we get in primary metals is the culture, willingness to change, to put teams into play on continuous improvement. It’s not a process, it’s a culture. The key thing is optimising business practices through the supply chain and across all sites, and that is where Big Data has taken off. Now we are going down a layer into the operational world, trying to understand the assets earlier. That is essential to operational continuity.”

Sowell details that “We are now tapping data from multiple sources: current meters and sensors, but also alarms and all the historic data that have been accumulated for a long time.” Many companies have both current and legacy data, and the scale of the question of what to do with it all becomes overwhelming. “The easiest thing to do is nothing,” Sowell laments.

Predictive maintenance

“We have seen both the promise and the shortfalls so far in adopting and applying Big Data in the metals sector,” says Burt Hurlock, ceo of predictive maintenance services firm Azima DLI. The causes include widely varying appetite for Big Data among metals firms but also the variation in products and services from providers. “There are some software companies that will sell stuff and then you have to pay to figure out how to use it. That is why we sell our services as a multi-year subscription, including hardware, software and diagnostics.”

Hurlock adds that “We are all still in very early days. For both vendors and operators we don’t know what we don’t know. We started down this path and at first people frowned on what Big Data could be worth. We are only now getting to learn that value.”

The most common point of departure for Big Data in metals is in break-fix diagnostics, which seems like a straightforward proposition, but Hurlock says there are often questions about avoided costs. He explains that everyone understands the concept of lost time and productivity and costs to repair and replace, but that there are variations within that equation.

“Because we host the data we can provide the operator with analytics comparing costs to actions. Then they can determine what level of spending versus avoided costs they can tolerate,” says Hurlock. “For example, in pharmaceuticals, they require perfect operations all the time. That can be done, but it is expensive. In other industries operators can live with half their machines having some degradation that will ultimately lead to a fault.”

Hurlock explains the hierarchy of applying Big Data analytics, ▶

starting with mechanical and moving to economic, and eventually to behavioural. “Making those leaps can be uncomfortable for some companies,” he adds. But the ones that can make and sustain the move up that hierarchy have a competitive advantage.

Data analysis

In storage there is “an abundance of service providers and vendors,” says Tyler Pietri, program engineer at Azima DLI. “In analytics there is a much smaller subset; fewer providers who understand how to interpret the data in relation to the physical model that the operator is trying to accomplish. That gets to business intelligence engineering.”

For the most part that means working with current, structured data. Unstructured legacy data can be helpful, even insightful, but takes extra handling. “In predictive analytics data hygiene is very important,” says Pietri. “Analytics do not work well with missing or uneven data. It is essential at the very least to pre-screen data to make it usable.”

Storage is cheap and easy, so Pietri recommends what is known as a data lake for storing legacy data for future use. “It may be relevant someday, but in its current form it is not. Don’t take up too much time and effort trying to secure an undefined, possible benefit from it.”

Acknowledging that operators have security concerns with cloud storage, Pietri nevertheless urges its use. “That is where everything is going. It is more accessible and processing today is split horizontally among multiple units, so there are fewer delays.”

One of the small ironies of Big Data is that in developing analytics to handle it, service providers have evolved systems that can work from small sets of data. That is good for metals companies because, as late adopters, there are not yet large bodies of structured data from which to work.

There are practical challenges to interrogating vast and growing sets of data to filter out useful trends. “Some of the cutting

manufacturers are getting into the Internet of Things (IoT), but most of this is still only data and not necessarily useful information,” says Abhi Sharma, director of integrated cutting solutions at software and equipment provider Hypertherm.

He explains that, “in its most basic form, software within the cutting/welding system spits out data to the cloud, primarily hosted by a third party, which then pushes that data to a mobile device that the steel companies can access. However, quantity doesn’t necessarily imply usefulness. For example, you could have 100 good data points for a system but unless that is collated into a cohesive whole, it may end up being wasteful for a plant manager or owner. So success depends on security, speed, accuracy and relevance of the data.”

As the new data pour in, that highlights the challenge of what to do with old data. Many metal makers have vast hoards of legacy data that is usable, but unstructured.

Sharma says that legacy data are useful only if the information can be correlated with current data. “For example, if the testing protocol has changed over time, the total data will not correlate well, resulting in inaccurate trend lines. For IoT to be useful, documentation of testing protocol for the key data points and their changes over time will be critical. This revision control is especially important as people switch jobs. Accuracy and relevance will differentiate one provider from another, while third-party hosting services can ensure security and speed to complete the value proposition.”

Sharma explains that two kinds of investment are needed: investment in documenting outcomes and acceptance criteria. “This terminology has come to the fore with the advent of outcome-driven design. That starts with the user outcomes and then the tool is designed with some acceptance criteria to serve as a check list to ensure the outcomes.”

For example, rather than simply starting with a list of assumed data



AZIMA DLI

“In predictive analytics, data hygiene is very important,” says Tyler Pietri, program engineer at Azima DLI

points – temperature, cutting time, arc-on time, edge quality, etc – the design would start from a plant manager wanting to have a view of material flow.

“The IoT will require investment in a third-party provider of cloud services,” says Sharma. “Although it is possible to store the data in a local intranet, using scalable cloud services avoids unnecessary capital investment in servers and generates a faster payback. In addition, managing cloud data is not the core competency of a steel company.”

Joining it all up

Jennifer Bennett, general manager for GE Digital’s Manufacturing Software initiatives, says that, in the past, manufacturers may have put sensors on a critical piece of equipment or optimised one aspect of the manufacturing process. “However, what we have learned is that connecting information upstream and downstream is critical when optimising the factory. It is important to create a repeatable, consistent and cost-effective approach to connecting machines thereby providing the visibility necessary to form the foundation of the digital thread across the complete enterprise where projects flex with business changes and priorities.”

GE calls its offering in the field its ‘Brilliant’ manufacturing suite. A new generation of the software was released last autumn at the Minds + Machines conference in San Francisco. Amongst many features, the new version includes a performance analyser that turns real-time machine data into production efficiency metrics so that plant managers can reduce unplanned downtime, maximise yield, and increase equipment use.

“We believe that the key to optimising the full product life cycle from design to service is through analytics of data that has been traditionally locked inside corporate silos,” says Bennett.

The author is a business journalist based in New York.



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Data, design, digitisation and decision-making

Major plantmakers are exploiting the new opportunities that digital technologies are opening up

Danieli develops proactive plants that learn

What has become known as Industry 4.0 or the fourth industrial revolution – and the challenge of market globalisation generating the need to make production processes consistently and continually more cost-effective and profitable – has led the Danieli Group to a new concept for the business, development and management of its products and services.

The company is switching from a conventional three-dimensional, or ‘geometrical’, physical design to a ‘four-dimensional’ design, which includes logistics, and even a ‘five-dimensional’ design, driven by costs. “This will bring the design concept, which already automatically manages the geometry of the plant and products, to also consider

management of timing and costs,” explains Marco Ometto, executive vice-president, Danieli Automation’s business unit for Steelmaking & DA Research Centre.

Put simply, Danieli wants to build (and retrofit) plants that will include a statistical approach to plant behaviour to assist more traditional physically based modelling. The key word will be “Predictability,” says Ometto.

“There are no known techniques, beyond simulation, that will identify the behaviour of a physical phenomenon even before it manifests itself,” he notes. “For this reason, Danieli Automation is proceeding to develop a technology that, assisted by and integrated with a modern automation system, is able to prevent and/or correct deviations from the desired process profile,” he explains.

Fundamentally, this is a move from a reactive to a proactive

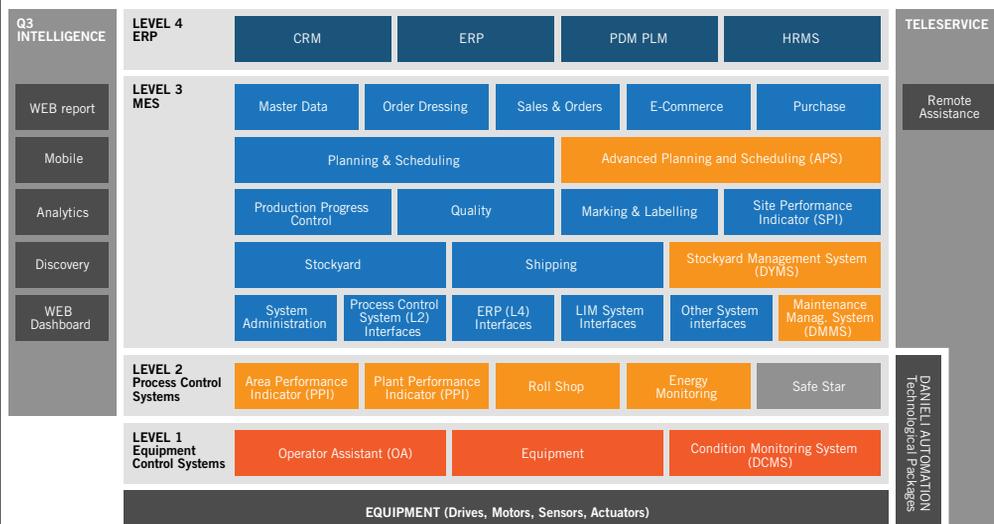
design, achievable now owing to the complete digitisation of processes. In other words, plant equipped with the knowledge of past performance trends can adjust itself at any given point in time to prepare for future output according to its current operating conditions.

The complexity and variability of the electric arc furnace process is a good example. It calls for advanced process monitoring and control. Through chemical energy management and off-gas analysis, a robust statistical approach was developed to cluster the available process data, generate the expected trends of key process variables and thus identify process deviations in real time. A ‘Melt model’ application (part of Danieli’s Q-MELT technological package) was developed to apply this strategy to oxygen injection management during the refining phase. With this solution, the decarburization process can be monitored and optimised to enhance furnace performance.

Based on the same principle, a rolling mill automation and control system that is equipped with the experience and ‘understanding’ of the mill’s past performance history, which is also ‘conscious’ of its current fundamental operating parameters, such as temperatures, pressures, roll conditions, forces and roll gaps – as well as the details of the semis to be rolled into products and the schedule for product orders – will adjust the process ‘itself’ to optimise production costs, product quality and timely delivery.

“Danieli Automation is implementing the use of innovative

Danieli’s Q3-Intelligence operator interface



technical decision-making based on 'data driven' methodology," says Ometto. By taking this approach, Danieli actually predicts a substantial drop in transformation costs while maintaining the same level of productivity, increasing the level of product quality and reducing the consumption of resources.

Humans still needed?

Other than for essential maintenance, the question arises as to whether such highly automated plants, which can learn, adjust and operate themselves, would need any human intervention. "The new-generation systems will have to be seen as they are in reality – as powerful decision-making tools supporting humans, of whom only some functions and operability are replaced," says Ometto.

He adds that the operator will remain the ultimate decision-maker to control and improve the process in a different role: "He will be the director." Collaborative robots and mobile equipment devices, supporting the operators' usual functions, will help them to avoid mistakes, increasing the product quality level and workplace safety.

In Danieli's vision for future plant technology, dedicated sensors widely distributed on key components throughout a plant will become increasingly important as the 'Internet of Things' becomes increasingly adopted and further value is extracted from interdisciplinary analysis based on 'business intelligence' technology. By learning human behaviour during normal plant operation, it is also possible to study and predict the best countermeasures to apply if abnormal operating conditions were to arise.

"All these will improve and increase the level of know-how resident in the computer system, giving new targets to R&D and opening the market to new opportunities," says Ometto.

In Danieli's future vision, just as retail digital technology is rapidly and continuously improving for consumers, so steel and metal producers will similarly be able to gain the benefit of continuous

SMS digital diversifies product range

SMS group has recently set up SMS digital – an independently operating subsidiary of SMS Holding – to build on work already done to develop and market further digital products through direct contact with customers.

Speaking at the SMS group Annual Report press conference on 23 June, Burkhard Dahmen, chairman of the managing board of SMS group, said that: "The elements of digital transformation that are crucial to success in industry are the Internet of Things in the industrial value creation chain, new business opportunities from digital platforms and services, plus extensive use of Big Data for advance analysis."

He is conscious that major software houses are also looking at this space, but said that SMS group offers customers added value beyond the scope of classic web companies. "What makes this possible is its many years of cooperation with customers," he said. "Consequently, it can react more flexibly and quickly to industry-specific requirements," he added.

In discussion with *MB Magazine* after presenting the SMS group report, he explained further. "Data is the key," he stressed – something to which SMS group can get access as the partner of customers. "We can offer data analytics too."

In response to the competition between business software houses and plantmakers for the same data handling and analysis space – entailing the different levels of data handled from machine-level up to enterprise-wide – he explained: "We come from the bottom, not the top." He added that sometimes customers are not even aware of the data they have available to them, offering a plantmaker like SMS group an advantage in helping them to analyse and exploit the information they already have in hand.

improvement to their automation and process control systems devices by regularly upgrading their computer systems.

Towards this, Danieli already has several dedicated technological packages available and the company has formed a working group (DIGIMET) to pursue it. With long experience in process control and product technology, the whole team is included in a programme to transform the team members' existing set of skills.

Fitting the concept of 'product as a service', the 'DIGIMET Platform' is under construction in a special dedicated laboratory, using the same principles and basis already applied in the recent past to

In a project phase prior to setting SMS digital up, ten group engineers carried out over 120 interviews with customers to identify what digital products and services they would actually find most useful. Several emerged as priorities:

- Spare parts and how to identify and order them digitally. (A non-trivial task given the tens, or even hundreds, of thousands of components used to build a large works.)

- Making repair and replacement manuals readily available in a digital format.

- A 'smart alarm', which not only alerts operators to the failure of a piece of equipment or component, but also identifies the cause of a failure so that it can swiftly be put right.

- A platform to contact experts from the SMS group with specific questions.

SMS digital already has a client for each of its priority products and the number of new products is growing, Dahmen added.

Plant condition monitoring and predictive maintenance, plus predictive mill performance capabilities, are an existing part of SMS group's technologies. These need to be sorted out at levels 2 & 3 before the new advantages of digitisation can be extracted afterwards, Dahmen explained.

E-service for the regular supply of consumable parts is another area within the sphere of SMS digital. He gave the example of piercing mandrels for seamless tube production. A mill might use hundreds of them in a year and needs to keep track of their rate of consumption, inventory on site, stock availability at SMS and the number being manufactured by SMS group for future supply. Transparency of all of that data and a straightforward direct ordering process for people at a plant are all part of the e-service package.

successfully develop Danieli's 3Q automation platform – one of the first bricks laid in the process of plant digitisation. The services provided will be grouped into four different disciplines – manufacturing, maintenance, energy and process – and will include the company's steel and aluminium businesses.

As well as Q-MELT, other examples of technological packages include Q-CQE (a coil quality estimator, which estimates the properties of strip) and Q-CMS (a condition monitoring system which estimates the behaviour of assets). They use the same approach and many more are under development.

'All these will improve and increase the level of know-how resident in the computer system'

Danieli technological layouts and process know-how fully satisfy the widest market demand in terms of product mix, high productivity and flexibility, tight geometrical tolerances. As of March 2016 Fata Hunter is part of the Danieli Team.



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Digitisation of trade documents

Over 15 years since the dotcom bubble burst, the push to get more business done via digital technology is still on. Richard Barrett asks Ian Kerr, ceo of specialist trade-software-as-a-service supplier Bolero, to outline key trends in his company's e-business

The basic physical steps of getting commodities like copper concentrates or iron ore from seller to buyer are easy to describe. Transfer the material from mine to port by road, rail, barge or conveyor; load it on to a ship; and reverse that process to deliver to a smelter or steelworks from the port of receipt.

Many parties have an interest in every shipment going smoothly. Aside from the buyer and seller, their banks or other suppliers of trade finance, port and customs authorities, the carriers and insurers all have a stake. So what starts as a straightforward commercial agreement between a buyer and a seller actually becomes a more complex network of interactions between multiple parties.

The aggregated total risk of lost paperwork, inadvertent errors, delays (which for settlement of payment can result in poor cash flow and increased working capital requirements), failure to comply with local regulations, or even potential fraud occasionally arising at the interfaces between the parties, consequently climbs.

Paperwork required by each interested party needs to be in order and ready for inspection at the right place and time to ensure ease of transit. The transmission and acceptance of many types of document also transfers risk along the supply chain.

By some estimates, a single shipment will generate several dozen documents on average, with perhaps as many as 250 copies needed to satisfy all the participants in the supply chain. Paper documents used to be required by everyone concerned. And even now, the comfort of printed legal and

commercial documents – particularly those confirming ownership – is demanded by some participants, despite the potential for delay that can generate.

Bolero ceo Ian Kerr says that electronically recorded and transferred documentation is an alternative that is now increasingly being taken up by large international miners, trading houses, steelmakers and their financiers, but he stresses that a surprising volume of trade is still administered through the traditional hard-copy route. “We are still at an embryonic stage of digitisation... We are evangelists for digitisation,” he says.

In Kerr's view, the technologies needed to bring all of the advantages that modern computer systems and telecommunication systems can deliver are already available, but legal, customs and regulatory considerations for both finance and commerce can act as a drag on digital advances for international trade.

Progress to date

Bolero has been in the business of the electronic transfer of documents for almost 20 years, notably starting well before the peak of the dotcom bubble burst at the turn of the millennium and growing to handle over \$80 billion of annual transaction value and millions of documents a year now. The software-as-a-service business has users operating in more than 50 countries.

It all started from an EU-funded research initiative set up to establish a global cross-industry solution to ‘dematerialise’ cross-border trade processes. This gave birth to the Bolero Association and the platform grew from there.

The ‘global solution’ provided by Bolero is hosted on UK-based and replicated servers in separate geographical locations to ensure a secure platform and continuity of service. Its head office is also in the UK. Established international offices in Hong Kong and Singapore have recently been complemented by a new office opened in Shanghai. The company notes that the Bank of China is ‘Bolero-enabling’ over 400 domestic and international branches; also that Bolero is developing partnerships with other Chinese financial institutions. Bolero itself is backed by Azini Capital and Baring Private Equity Asia.

Renewed interest

In an echo of the excitement generated by e-commerce at the end of the 1990s, Kerr says that renewed interest in the electronic recording and management of transactions has been stimulated by recent developments, such as the potential adoption of the distributed ledger concept, used in the ‘blockchain’ to record all transactions undertaken in bitcoins, for other financial transactions. Bolero believes it is well placed to support a new wave of e-business.

Through its own cloud-based ‘Bolero Exchange’, the company's core business is a secure messaging, document transfer and title registry service, which it provides to its users on a subscription and/or a transaction fee basis. The commercial model is based on a reflection of the business case which is more towards the seller so right now buyers, their banks and the carriers do not pay a fee. “But of course buyers can become sellers too,” Kerr stresses. “Our business case is connectivity. We effectively charge on the basis of the number of transacting parties we connect up.”

The company's system handles over 100 different types of document in XML format – “this gives us a lot of flexibility in data management in integration with adjacent space solutions such as document preparation,” Kerr explains. He adds that the exact shape of document preparation and design varies significantly according to the geographical location of the counterparties

and the business sector of the transaction. Documents include purchase orders, invoices, receipts, letters of credit (LCs), letters of indemnity, guarantees, shipping and insurance paperwork.

A key feature is the ability Bolero gives its users to interact with each other via a single shared platform regardless of the differing detailed specifics of their own computer and software systems. The nature of the business clearly demands straightforward connectivity with clients' and 'adjacent' systems. Bolero's vision is end to end connectivity with sellers' back-office, ERP systems.

Kerr says that a conventional paper trail transaction, which might take 20-30 days or even longer to complete, can be completed electronically in as little as a day. Giving an example of just one of the unnecessary costs that can arise if something goes wrong, he notes the demurrage incurred if a ship is delayed from unloading and left to queue because the right documents are not available when it arrives at port. The additional time and cost of issuing Letters of Indemnity also arise in those circumstances.

Bolero's title registry maintains a continuously updated dynamic database to record and track the current rights to any particular consignment – ownership of which can change in transit. It acts as a reference point for the current situation in terms of title to the goods.

A hub and club

In a sense, Bolero users are members of an international 'club', within which every member is required to agree to abide by the same rules. Many of Bolero's users are over \$1 billion per year businesses. The platform is used by about 300 corporate clients (*see metal trade examples in box*) and 120 carriers. "Commodity companies have been leading the charge to adopt electronic documents up to now," says Kerr. BHP Billiton, for example, have said that they want to be totally electronic within 5 years' time, he reports.

It seems that the platform's original rule-makers did a good job because Kerr says that the rules have not fundamentally changed since the technology was conceived. The rulebook clearly covers the transition of ownership of goods, which can of course be worth many millions of dollars, and also the roles and responsibilities of all connected Bolero parties: "Our users find this very useful as it ensures that everyone plays by the same set of rules and interactions are assured."

The system can handle transactions settled on open account, but also manages LCs and electronic Bills of Lading, through its own

Examples of metal e-commerce through Bolero

- A recent transaction between BHP Billiton and Angang Steel was settled through a LC issued by a local Bank of China branch
- The Development Bank of Singapore recently signed a partnership with Bolero, which will see the bank support the company's electronic presentation system through a series of phases
- Newcrest Mining signed a new deal with the platform early last year
- It was confirmed in March last year that four major steel mills in Japan are using the e-Presentation platform for trading hubs in Australia and South America (Nippon Steel Sumitomo Metal Corp, JFE Corp, Nisshin Steel and Kobe Steel) for trade in iron ore, nickel, manganese and coal
- Chile's Codelco adopted the platform earlier this year to manage sales and payments, including electronic Bills of Lading
- Baosteel Resources has increased automation of its LC processes through Bolero

central documentation exchange and data matching engine at the hub of the network.

A key role played by the platform is its ability to provide a single portal through which a large international company can connect with multiple banks in the countries in which it operates. Engineering major ABB, for example, connects with many banks through the Bolero network to manage bank guarantees.

The platform's e-Presentation capability enables trade documents to be presented at the right place and time: "We bring them together more efficiently," says Kerr. For example, a steelmaker, its bank of choice to issue a LC, a miner supplying iron ore, the miner's own bank and the shipping carrier to move the ore can all be linked up through the system.

Bolero reports that e-Presentation can dramatically cut dependency on Letters of Indemnity – typically achieving a 90% reduction in the number issued against transactions if electronic presentation is used with electronic Bills of Lading. The e-Presentation process manages the lifecycle of LCs from application through to any notifications and amendments coming back from the issuing bank.

A tough climate

Kerr reckons that the tough times resulting from low and volatile commodity prices, plus very low freight rates, are encouraging all the players in the supply chain to find operational efficiencies. And he claims that the time and cost savings that Bolero's platform achieves can contribute to those. Electronic collections and settlements using the platform are an example. "If you can complete a deal promptly, you can insulate yourself from price volatility," he notes.

Through electronic collections, physical documents sent between collecting and presenting, or via remitting, banks, paper is replaced by electronic documents. Bolero is

developing its electronic settlement and financing capabilities through its unique trade finance matching engine.

Future vision

Given all of the advantages which Bolero claims for its system, why has the business-to-business sector not adopted digital technology for physical trade even more enthusiastically? Kerr blames it in part on inertia and human nature's desire to stick with existing systems and/or the comfort of a piece of paper.

He also notes the complexities of different nations' customs practices and the very conservative outlook of some shipping lines. Nevertheless, attitudes appear to be changing. The World Customs Organization, for example, has declared 2016 to be the year of digital customs, dedicating the year to promoting the digitisation of customs processes under the slogan "Digital Customs: Progressive Engagement."

Former J.P.Morgan executive Daniel Cotti became Bolero chairman in February 2016. "We are actively searching for strategic partnerships with finance, payment and adjacent solution-providers and networks," he stated on appointment. "We will drive the automation of all aspects of trade finance," he added.

In a recent interview with *Global Trade Review*, Cotti said: "Our ultimate goal is the digitisation of global trade by taking a buyer/seller centric approach to the settlement of commercial contracts," adding that integration with banks, "adjacent space applications", networks and technologies will be pivotal to achieving that vision.

"We need partnerships with complementary organisations and especially the banks," he said, adding that Bolero is a non-threatening partner to banks, insurers, buyers and sellers in its role of spreading digitisation. "We are just connecting them and making the process more efficient," he summarised.

The 'Holy Grail' of production management: seamless integration

PSI explains the advantages that its own standards for integrating production management systems can bring to the metals industry

Within a highly standardized industry, the topic of connecting different IT systems seems to be like the Gallic village surrounded by the Roman Empire in the famous comic *Asterix & Obelix*.

Despite decades of usage of automation systems in metals production, data and information exchange between them is not easy. Existing standards for system interfaces are based on discrete production, they lack flexibility and are not universally global.

The consequences are clear: a high level of complexity and uncertainty in setting up vertically and horizontally integrated IT landscapes, which increases the costs of implementation and maintenance for their users.

Production management solutions are a victim of this situation, but also provide answers to it. They are the backbone of Industry 4.0 in the metals industry as a strong production management solution closes the gaps between shop floor automation systems and business-oriented software (ERP) to enable seamless tracking of all production events throughout the production lifecycle.

Once running, production management systems serve as a reliable information broker, but they suffer from interface incompatibility during the implementation phase – just as a USB cable simply cannot plug directly into a standard power socket.

How can this challenge be overcome? PSI – a leader in production management for the metals industry – has defined, and has started to implement, its own standard in line with the functionality of existing industry standards. PSI can provide a standard description that defines how information needs to be fed into the system and how information can be gathered from it.

While PSI already provides standardized ERP interfaces, due to its long-term relationship with SAP and extensive experience with other ERP vendors, this approach is new for shop floor automation and other systems like crane-tracking solutions.

The PSI standard is vendor-independent and



The PSI standard interface is vendor-independent – just like an adapter used to connect a USB cable with a standard power socket

based on over 40 years of experience in connecting nearly every kind of system available on the market within metals production – acting like an adapter which can be used to connect USB cables with power sockets. By comparison with existing standards, the PSI approach respects metals-specific production and is derived from metals-specific content. The results are promising: reduced project lead times, resulting in lower project implementation costs and faster Return on Investment (RoI) rates.

Besides the pure technological advantages, the timing of implementation is crucial. Successful companies are aware of the role of production management solutions and consider them in their overall production and IT layout from the beginning. Those companies exploit the full capacity of production management software as an integration layer between the shop floor and the business world on the one hand, and as a data

back-bone for sophisticated approaches to quality and supply chain optimization on the other.

Whereas the connection with the shop floor is mainly production-driven and determined by the plant configuration, the harmonization between production-oriented business processes and the commercial ones – meaning specifically the connection with ERP systems – is very dependent on the process design before the actual system integration.

Top producers have realised that knowledge about, and the control of, these processes is tremendously important for their further success. Consequently, experts of all domains need to come together at an early stage to guarantee seamless integration and secure the high investments made into the overall IT-landscape.

For aspects of integration on the automation level, PSI is proud that Primetals Technologies has decided to add PSI *metals* to their product and service portfolio. Primetals Technologies will act as a sales and implementation partner of PSI, bringing together unique process know-how within the metals industry.

This partnership will provide new possibilities to harmonize the interfaces between Primetals Technologies' automation solutions and PSI's production management software to push the effort to reduce integration costs. Customers of Primetals Technologies and PSI will benefit from seamless integration between these currently separated worlds.

This is the first step to realize the vision of Industry 4.0: "Identification and usage of any kind of networking possibilities within and between factories and towards customers and suppliers."

PSI Metals
Detlef Schmitz
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CTRM

A growing range of commodity trading tools is available

There are a number of reasons why metals trading is becoming more complex: the rise of globalisation and the spread of logistics and inventories around the world; a rising number of exchanges and bilateral trade deals leading to more non-dollar contracts and exchange rate issues; and the use of commodities – including some metals – as investment vehicles by funds.

In this environment, the market for CTRM software has become very competitive, with over 90 suppliers now offering products, and this has exerted downward pressure on the prices for such services.

Overall, economic conditions resulted in the global market for CTRM products falling slightly last year to \$1.59 billion, from \$1.62 billion in 2014, according to the 2016 *CTRM Market Update* published by USA- and Czech Republic-based analysts Commodity Technology (ComTech) Advisory (see tables). Comparing these updated figures and

Total CTRM market value by commodity*

	2014	2015	2016f
Natural gas	380	367	382
Power	405	393	407
Oil and products	238	240	246
Natural gas liquids	112	113	116
Coal	27	26	27
Precious metals	41	41	43
Other metals + ores	115	113	116
Agricultural/softs	272	269	284
Other (freight, etc)	28	27	28
Total	1,679	1,591	1,648

*\$ millions.

Source: Commodity Technology Advisory, 2016 Update

Total CTRM market by region*

	2015	2016f	2017f
North America	760	788	840
South America	50	51	52
Europe	585	606	632
Middle East/Africa	52	53	55
Asia Pacific	144	149	158
Total	1,591	1,648	1,737

*\$ millions.

Source: Commodity Technology Advisory, 2016 Update

forecasts with the original ones issued a year ago, there have been downward adjustments across the board as the world economy has continued to lag. The original forecast for the 2015 market, for example, was \$1.68 billion, compared with the newly published figure of \$1.59 billion.

The driving force for this fall is the collapse in commodity prices, observes Patrick Reames, managing partner of Comtech Advisory. This has pressured companies into spending less on IT, although another factor is the parallel downward pressure on CTRM costs, he comments.

Comtech Advisory, however, expects the CTRM market to grow again this year, to reach \$1.65 billion (original forecast \$1.74 billion). Continuing expansion is forecast for the rest of the decade, to reach \$2.06 billion in 2020.

The consultancy forecasts steady growth across all the measured commodities up to 2020, including metals and ores, and the separate category of precious metals. When combined, all metals and ores are the fifth biggest category in the CTRM sector, after power, natural gas, agricultural and softs, and oil, and this pecking order is seen as continuing up to 2020.

Regionally, North America and Europe dominate the CTRM sector with a combined value of \$1.35 billion out of the total \$1.59 billion last year.

Reames notes that cloud-based solutions have been growing by more than 15% annually, while on-premise software has a more modest 3% growth.

He also points out another trend: traders – especially larger traders in Europe – are developing ‘hybrid’ solutions to meet their requirements. Thus software from one vendor may be deemed particularly suitable for one commodity, but another commodity may best be suited to product from a different vendor. Some traders are now combining solutions from multiple vendors to form a hybrid system that more closely meets their needs. This solution could also combine on-premise and cloud-based products, he says.

The deployment of analytical software is another factor that is making significant inroads. In a survey of traders carried out by ComTech Advisory in April and May, some 50% of them described ‘comprehensive analytics’ as a ‘critical’ tool in their work. At present, it is not clear overall how much of this is provided by CTRM vendors, and how much is outsourced elsewhere, notes Reames: analytics could be an integral part of the product, or an adjunct to it.

Brady's experience

Harry Knott, head of product management, Brady Risk & Derivatives, stresses the need for companies to use the right tools for the job from the start, and not try to adapt generic products that cannot easily cover requirements: “Some use inappropriate products, such as ERP [enterprise resource planning] systems for risk management or very specialised processes such as recycling: the cost to customise these systems is often significantly higher than buying solutions designed specifically for these purposes.”

Knott observes that the current extended period of low commodity prices and economic uncertainty is resulting in some companies spending less on software, or delaying investment decisions. However, it is necessary for companies to look beyond the immediate reaction to current circumstances, he adds, because better trading and risk management strategy can still improve profitability, whatever the market situation.

Software can be installed on a customer's own server, or accessed via the supplier in the ‘cloud’, as software-as-a-service (SaaS). Mark Valdes, Brady's head of product recycling suite, says that almost 80% of recent deals globally have been cloud-based solutions, and these were not just confined to small businesses without their own IT departments to maintain the system. He points out that cloud solutions, while based on a standard architecture, are configurable to a significant extent to suit the needs of the customer.

Brady has recently announced new business solutions – all cloud-based – with several steel and metals companies. One contract is a system to manage the global metal hedging and risk management for aluminium rolled products supplier Aleris. It will enable the company to consolidate its metal hedging across the USA, Europe and China.

Steelmaker Evraz North America has chosen Brady's Raw Material Management System to fully optimise the purchasing process for its plant in Pueblo, Colorado.

In the pure trading sector, category 2 LME member Toyota Tsusho Metals has selected Brady's CTRM solution to facilitate its commodity trading operations across several exchanges around the world.

Another base and precious metals trader, Metallica Commodities Corporation, has also chosen a Brady solution – interfaced with its own physical trading platform – to manage its hedging and derivative trade activities.

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Challenges to growth



India's steel sector is determined to invest to accommodate growing demand, but various obstacles can obstruct progress, reports Kunal Bose

Back in November 2004, Tata Steel signed an agreement with the government of Orissa to build a 3 million tpy steel plant in the first phase of a 6 million tpy project at Kalinganagar. Exactly 11 years later, the first phase was commissioned. This length of time confirmed the fears of foreign investors that the gestation periods of India's greenfield steel projects requiring a few thousand acres of land will always test their patience.

It was a greater test than that for Tata Steel, which experienced periods of violent demonstrations by the people who occupied the land intended for the plant, even though the 3,000 acres of land it acquired belonged to the state government.

"We didn't allow any land-related incidents to wear us down. All through we were engaged with local community leaders and the state administration trying to convince them that our resettlement and rehabilitation (R&R) package would give the 1,234 land-occupying

families a good place to live with better income opportunities for both men and women," says Rajiv Kumar, Tata Steel vice-president in charge of the Kalinganagar project.

But even while the 3 million tpy plant is ramped up, the company has to negotiate with 120 families who still remain in occupation of 900 acres. According to Kumar, this area is earmarked for building a 6 million tpy pellet plant as part of the next phase of the 3 million tpy steelmaking capacity. "We are committed to using iron ore sinter and pellets in our blast furnaces. The supply of lump iron ore from Indian mines is falling and the steel industry here must be ready to use more and more fines," he says.

"We are sure that at some point soon, the remaining land-occupying families will accept our R&R package, for they are seeing how better off are the ones who left," says Kumar. After getting possession of the 900 acres, the company will still need another couple of thousand

acres to double the capacity at Kalinganagar. It is mandatory for a new steel project to leave 33% of land as green cover. With such a big slice of land being left open, Tata Steel has set a new benchmark in land use efficiency in the country during the planning and building of the 3 million tpy mill.

Additional costs

Recently, when the government of Jharkhand, another mineral-rich state, gave environmental clearance to JSW Steel's 10 million tpy mill project, it laid down conditions in addition to the mandatory 33% green cover of the plant, including allocating 2.5% of the project cost for "enterprise social commitment" to be based on public hearings in the seven villages where land for the plant is being acquired, and a five-year "corporate social responsibility plan".

The Jharkhand government will also keep a keen eye on the company's pollution control system and employee welfare. These steps push up the cost of new steel projects, but the government is determined to make steel mills "community-, employee- and environment-friendly" in the country's radically changing environment.

Requirements for large tracts of land that are already inhabited make the launch of greenfield steel projects a challenge in India. Both ArcelorMittal and Posco, which were drawn to India because of its large iron ore and thermal coal resources, were left disappointed when they did not get iron ore deposits they were promised initially. The mine allotment promises could not be kept because in the meantime the country's Supreme Court had passed an order for the auctioning of mines. This was to eliminate any arbitrariness in mine allotments.

"At meetings with central and state ministers, we see them making impromptu statements about

Tata Steel's 3 million tpy steel plant in Kalinganagar will see its capacity doubled

smoothing the process of big investments in steel. But the overweening bureaucrats at all levels remain a drag on rapid steel capacity growth," says a disappointed industry official. Orissa steel and mines ministry officials do not agree that world steel leaders have retreated from India because of bureaucratic red tape, but rather it was due to a global metals meltdown.

Steel project implementation delays are not solely due to the very long times taken to acquire land. Electrosteel Steels' plans to build a 2.51 million tpy capacity plant at Bokaro in Jharkhand, for example, were delayed by time and cost overruns deriving from changes in government policy on visas for Chinese workers (project construction and technology relied heavily on Chinese workers and equipment). As a result, the lending banks became wary of the project and the company found it difficult to raise additional funds needed for project completion. Electrosteel Steels is now in production, but below planned capacity. Under the rules laid down by India's central bank last year, the banks are now asking for change of company management.

Some other steel companies are also under pressure from lenders owing to difficulties in servicing loans, and are finding it difficult to acquire strategic partners demanded by banks. "The shyness of global and domestic investors to become partners of stressed steel groups is because while the global industry is nursing a surplus capacity of 600 million tonnes, world steel demand will once again see negative growth this year following a 3% contraction in 2015. As a result, world prices continue to remain depressed. Except for a few Indian groups such as Tata Steel and JSW Steel, which manage to run a tight ship, the others all lost heavily in the final quarter of 2015-16 [January to March]," says independent steel industry analyst Sarvadaman Roy.

In a statement to parliament, Arun Jaitley, finance minister, said: "The steel sector has the biggest share in the non-performing assets of Indian banks." He further said

that if steelmakers were not able to sell their products at the right prices then their capacity to repay bank loans and interest would be compromised.

Imports hurt

Large import volumes continue to harm the domestic industry. In fact, in order to cut imports of steel, the Indian government first imposed a safeguard duty of 20% on alloy and non-alloy hot-rolled flat steel with a width of 600 mm or more in the middle of September 2015 for 200 days. But it was later extended up to March 2018.

In response to the industry's pleading that domestic steelmakers needed further protection from imports to cut losses, the government introduced on 5 February a minimum import price (MIP) on 173 steel products ranging from \$341 to \$752 a tonne for a period of six months. The relief that MIP is giving to domestic steelmakers comes to an end in August, but the industry, led by PK Singh, chairman of Steel Authority of India, is already lobbying for its extension.

Two things have happened since the introduction of MIP. First, steel imports in April, the first month of the current financial year, were down 15.5% year-on-year to 654,000 tonnes. In May, the imports fall was sharper at 41%, to 546,000 tonnes, compared with the same month last year.

Secondly, the industry took seriously the advice of Aruna Sundararajan, steel secretary, that: "MIP is intended to create a level playing field. There must not be sudden and arbitrary price increases that might undermine other sections of the economy." Nevertheless, steel prices have risen since the introduction of MIP, but moderately. Even though Sundararajan describes MIP as an emergency measure, it now looks almost certain that it will remain in force beyond August.

Apart from an MIP extension, Singh wants a review of the "comprehensive economic partnership agreement (CEPA) with Japan and South Korea as this has resulted in cheap steel imports from the two countries." Imports

Indian steel data, Apr 2015-Mar 2016

		Y-o-y change, %
Crude production	89.78M	+0.9
Crude capacity	118.20M	+7.6
Finished consumption	80.45M	+4.5
Per capita consumption	61.9 kg	+1.8
Finished imports	11.71M	+25.6
Finished exports	4.08M	-27.1

Source: Steel Ministry Joint Plant Committee

from South Korea jumped 60% to 3.084 million tonnes in 2015-16 from 1.927 million tonnes in 2014-15. In the same period, India's imports from Japan rose 37% to 2.195 million tonnes, up from 1.602 million tonnes.

The consensus in India's industry is that New Delhi should make attempts to take steel out from the scope of CEPA with the two countries. This is because CEPA provides for bringing down import duty to nil over a given number of years. Steel imports into India from South Korea and Japan already attract duty close to nil. India's total steel imports rose 25.6% to 11.71 million tonnes in 2015-16 when exports suffered a decline of 27.1% to 4.08 million tonnes.

Rising consumption

According to a steel ministry official, "India's steel consumption rose 4.5% to 80.45 million tonnes in 2015-16 and the World Steel Association has predicted 5.4% demand growth in both 2016 and 2017. While major investments in infrastructure development and the manufacturing sector – taking off on prime minister Narendra Modi's 'Make in India' programme – will boost steel demand, the forecast of a good monsoon after two consecutive years of deficient rains will lift rural steel use." The problem is that since India is one of the few places to record fairly strong demand growth, it remains the natural target for export by countries with a steel surplus.

Referring to demand growth, the Joint Plant Committee, which is the research arm of the steel ministry, says that whatever growth happened in India last year, "It was mostly led by imports, which accounted for 14% of total steel consumed." An official of the Confederation of Indian Industry says: "If the fortunes of steelmakers do not revive soon, it will become impossible for the country to be anywhere near the targeted capacity of 300 million tonnes by 2025." Present Indian steel capacity is 118.2 million tonnes.

The author is a specialist writer based in Kolkata.

'The steel sector has the biggest share in the non-performing assets of Indian banks'

Developing downstream

India's primary aluminium sector intends to help set up more downstream value-adding industries near smelters, reports Kunal Bose

In India's 4.129 million tpy capacity primary aluminium industry, there is a growing intent to set up aluminium-processing industrial parks on land adjacent to smelters. Both Vedanta Aluminium, which owns a smelting capacity of 1.75 million tpy at Jharsuguda in Orissa and 600,000 tpy at Korba in Chhattisgarh, and Orissa-based 460,000 tpy capacity National Aluminium Company (Nalco), have now both given high priority to building such industrial parks for hosting small and medium-size units that will add value to primary metal. Nalco has already made a start.

Possessing 160 acres of land next to its smelter at Angul for the first phase of a park, Nalco has invited Orissa state agency Industrial Infrastructure Development Corporation (IIDCO) as a majority partner. IIDCO's presence as a partner in the special purpose vehicle (SPV) created to build the park guarantees that the project will not suffer from delays in securing government clearances.

To the satisfaction of the two promoters, ahead of starting the construction, Midal Cables of Bahrain has sought allocation of a 40 acre plot for setting up an aluminium conductor and rod manufacturing unit at an investment of \$45 million. The SPV has so far received more than a dozen investment proposals from national and foreign groups. Nalco has made a commitment to supply 50,000 tpy of liquid metal to the small- and medium-size units in the park, which will be built in two or three phases and occupy 450 acres.

Vedanta, whose smelting capacity in Orissa alone is nearly four times



India's primary aluminium production in 2015-16 was less than 60% of installed capacity

that of Nalco, has planned ambitious aluminium industrial parks at Jharsuguda and Korba. Abhijit Pati, ceo of Vedanta Aluminium, says: "We shall be ready to give 10% to 15% of our primary hot metal production to downstream units for value addition in the proposed parks. The Orissa and Chhattisgarh governments have promised us help in securing large parcels of land for the two parks where we will offer the same kind of infrastructure and logistics support to makers of aluminium value-added products as is available in Dubai and Sohar."

An official of the Confederation of Indian Industry says that local governments are supportive of aluminium park ventures because of the large numbers of downstream jobs which will be created: "The parks will secure for the states significant investments in downstream manufacturing units."

Pati, who is leading the industry campaign for value addition next to smelters, says: "Making cables, conductors and extruded products straight from hot metal leads to big savings in energy. When ingots are moved to factories where they are remelted to make aluminium semis, the energy use goes up by 30%."

An official of Shakti Engineering, which wants to build a cable and conductor plant at the proposed Korba aluminium park, says: "The attraction for converters is the 'plug and produce' system that guarantees a regular supply of hot metal, electricity and water."

Both Vedanta and Nalco have made commitments to provide logistics support to the campus units for moving goods to consumption

centres within the country and also to ports for exporting. Orissa is a good place for such projects as it has three year-round sea ports and good road and rail connectivity to the rest of the country.

"While the industry in India is getting ready to build three aluminium parks, China is already making value-added products using nearly 40% of its hot metal. I think the Chinese success in exports of aluminium foils and extrusions has got much to do with highly cost-effective production that aluminium parks enable, plus export incentives ranging from 11% to 13%," says Pati.

A nagging concern

Growing imports of primary aluminium, particularly from China and the Middle East, remain a nagging concern for India's domestic industry. Indian imports registered a compound annual growth of 13%, from 881,000 tonnes in 2010-11 (April to March) to 1.607 million tonnes in 2015-16 (see table). With imports meeting nearly half of Indian domestic demand, Aluminium Association of India (AAI) data show that the local industry could produce only 2.372 million tonnes in 2015-16 against its 4.129 million tpy capacity. The combination of large idle capacity, a debt overhang of Rs700 billion (\$10.47 billion) for aluminium producers and a 16% year-on-year fall in metal prices in 2015-16, together with a collapse in premiums, left the Indian industry with losses of over Rs40 billion (\$599 million) in the last financial year.

After much pleading by an industry seeking protection from imports, the government, which has a commitment to strike a balance between the demand of aluminium producers and interests of fabricators, raised the aluminium import duty to 7.5% from 5% in the 2016-17 budget.

"Not only will the modest revision in customs duty not discourage imports but the doubling of green tax on coal to Rs400 a tonne has added to our costs. All the smelters in the country use coal-fired power, and electricity has around a 40% share in aluminium production costs in the country," says an official of

Aluminium Association of India (AAI).

Except for Nalco, which being a government-owned company is constrained from lobbying, the other three producers, Hindalco, Vedanta and Balco, have petitioned the government for immediate introduction of a provisional safeguard duty of 20% on primary aluminium and downstream value-added products.

“We have told New Delhi that, since the demand for aluminium in India will continue to grow at a minimum annual rate of 10% on the back of infrastructure development, the creation of 100 smart cities, an indigenous space programme and power sector reforms, the country will be targeted for the unloading of surplus metal by China and the Middle East,” says Vedanta’s Pati.

“Between the two, they accounted for 44% of Indian imports of aluminium during 2015-16. We are saying the industry here is up against formidable competition from China, where a subsidy of about \$200 a tonne, including \$100 on electricity is available. You have smelters in the Middle East, which benefit from cheap gas-based electricity and freight advantages, making aluminium at around \$1,150 a tonne against the average cost in India of \$1,500 a tonne,” Pati adds. Last year India imported 491,283 tonnes of primary

Aluminium imports*

	2014-15	2015-16	2016-17 Apr-May
Total	1,562,823	1,607,330	280,731
From China	213,152	220,431	38,061
From Middle East	526,190	491,283	85,778
% share, China + ME	47	44	44

*tonnes.

Source: Commerce Ministry and primary producers

Comparisons of Indian aluminium and steel

	Aluminium	Steel
Capacity utilisation	<60%	80%
Import market share	50%	14%
Import duties	7.5% ⁽¹⁾	12.5% ⁽²⁾
		10% ⁽³⁾
Safeguard duty	0%	20% ⁽⁴⁾
Minimum import price?	None	⁽⁵⁾

⁽¹⁾Primary metal ⁽²⁾Flat products ⁽³⁾Long products ⁽⁴⁾Hot rolled flat products

⁽⁵⁾Applies to 173 steel products

Source: Primary producers

aluminium from the Middle East and 220,431 tonnes from China (see table).

As it pushes for a safeguard duty, the Indian industry is arguing it needs the relief to neutralise subsidies and cheap power available elsewhere, and improve domestic smelters’ capacity use, which is now less than 60%. According to industry officials, the department concerned in the government has completed the “verification” of the demand for safeguard duty and issued a notice of “initiation of suitable steps.”

Satish Pai, vice-president of the AAI says: “We have also filed for

anti-dumping duty on aluminium foil and the inquiry is in progress. We are also considering filing for countervailing duty as well.”

Capacity potential

Anil Agarwal, chairman of Vedanta Resources, believes that India has “abundant requisite natural resources to support lifting smelting capacity to 20 million tonnes in the years ahead.” The question is – will local demand for aluminium be there to support that kind of capacity build-up?

Vedanta Resources ceo Tom Albanese told *MB Magazine*: “For local demand to support that kind of smelting capacity, we have to have a very long-term perspective, pitched on multiple decades of 8% gross domestic product growth. Now the issue is: from where will India get that big volume of aluminium? Will it import the white metal from China and the Middle East, both nursing surplus capacity, or will there be big enough indigenous capacity to take care of growing demand? I very strongly believe aluminium demand growth stands to get a major boost from prime minister Narendra Modi’s ‘Make in India’ programme and India’s focus on infrastructure development.”

The author is a specialist writer based in Kolkata.

Bauxite supplies

For Vedanta Aluminium it remains a challenge to get supplies of bauxite to feed its 1 million tpy refinery at Lanjigarh in Orissa’s Kalahandi district. The company is living with uncertainty over its bauxite supply despite the Orissa government’s commitment in 2014 to supply 150 million tpy of bauxite to the refinery when Vedanta was finalising the over Rs500 billion aluminium-plus-power complex in the state. Attempts to open a mine at Niyamgiri hills by Vedanta ended because of fierce protests by the Dongaria Kondh tribal people inhabiting the areas, which hold 72 million tonnes of bauxite deposits. In addition, the state government has since dropped its bauxite supply commitment to the Lanjigarh refinery.

Will Vedanta still go ahead with refinery capacity expansion to 6 million tpy for

which it has got the important environment clearances from the state pollution control board? “For Vedanta, hope always triumphs over ground reality, which keeps on changing. In a few months, state undertaking Orissa Mining Corporation (OMC) will start mining bauxite at Kodingamali with deposits estimated at 90 million tonnes. We should be getting regular supplies of bauxite from there. OMC is also moving fast to develop a mine at Karlapat with deposits of 180 million tonnes. Vedanta has the assurance to get supplies from there too,” says Vedanta Aluminium ceo Abhijit Pati.

Bauxite supplies from OMC to Vedanta’s refinery will be on a negotiated cost-plus basis. Nalco, which gets bauxite for its 2.275 million tpy refinery at Damanjodi from its captive mines at Panchpatmali hills by a

14.6 km conveyor, and Hindalco, which sources bauxite for its 1.5 million tpy Utkal refinery at Raygada from its own mine at Baphimali via a 21 km long-distance conveyor, may have cost advantages. Debnarayan Bhattacharya, vice-chairman of Hindalco, says: “With tight logistics, Utkal has one of the most cost-competitive structures” in the global alumina industry. Commissioned two years ago, Hindalco’s Utkal Alumina, now running at near-capacity, will have its capacity doubled to 3 million tpy in the second phase.

“We can’t help that our alumina cost will be still higher when we start getting bauxite supplies from OMC. But we will try to make that good by raising the efficiency bar at smelting,” says Vedanta’s Pati. Vedanta also still has chances of winning bauxite deposit blocks by participating in future auctions.

The printing revolution

3D printing of metals is advancing rapidly and could revolutionise many end-use markets, reports Myra Pinkham

Metals additive manufacturing has begun to make the leap from prototyping to commercial production. In fact 3D printing using such non-ferrous metals as titanium, nickel- and cobalt-based superalloys, aluminium and copper, is expected to see annual double-digit growth for at least the next five years, limited only by production capacity and the speed by which regulatory agencies certify or qualify additively-manufactured parts and components.

“We are at an exciting time for metals additive manufacturing right now,” says Ryan Dehoff, the metals additive manufacturing lead at the US Department of Energy’s Oak Ridge National Laboratory (ORNL) in Tennessee. “We are seeing a lot of new processes emerge, a lot of new materials emerge and we are starting to see some 3D printed components that have been talked about for a long time starting to go into commercial production.”

Some others go even further. “We are at the beginning of a revolution,” maintains Warren Boley, ceo and president of Oslo, Norway, based Norsk Titanium (NTi). “The technology’s validity isn’t being debated at this point. It has been proven and is now being accepted and the transformational opportunities that it represents are now in the process of being fully recognized and appreciated.”

The additive manufacturing industry has been printing with metals for many years, even decades, using titanium and other high-end metal feedstock, largely in the form of powders and wire, points out Scott Deutsch, a spokesman for America Makes, which is also known as the National Additive Manufacturing Innovation Institute. Dedicated to accelerate additive manufacturing in the USA, America Makes was the first institute



This motorcycle part shows the complexity that can be achieved with 3D printing

established by the Obama administration as part of its National Network for Manufacturing Innovation.

The overall additive manufacturing industry has already become a \$5 billion per year market and is expected to continue to grow by about 30% per year for at least the next five years, observes Kartik Rao, director of business development for UK-based MetalYSIS Ltd.

Fast metal growth

While much of the growth in the past had been from the use of plastics, at present the use of non-ferrous metals, especially so-called exotic metals, is growing at a much faster rate – about 40-50% per year, according to Richard Grylls, technical director for SLM Solutions North America.

“Non-ferrous metals are generally only used for very high-performance applications that require a high degree of engineering,” said Grylls. He says there is amazing promise in the production of those non-ferrous parts using additive manufacturing given that it has such potential to improve the performance, to reduce production lead times and to reduce engineering requirements for certain parts.

With additive manufacturing we are able to make things that we were

not able to make before, including geometrically interesting shapes and features that could not be made with other manufacturing techniques, says Jay Littles, director of the advanced launch programme at aerospace propulsion systems producer Aerojet Rocketdyne. For example, designers could put internal channels and passages into parts using additive technologies, which, according to Grylls, is something that is difficult to do by traditional manufacturing processes.

The high inherent cost of certain non-ferrous metals, such as titanium, helps to make a business case for the use of additive manufacturing for certain applications, ORNL’s Dehoff says, pointing out that the cost of printing a titanium part is not much different than that of printing a steel part since the cost associated with 3D printing is more in the building up of the component than in the material used. There is also a saving given that there is little or no scrap generation with 3D printing. By comparison, in the aerospace sector the average buy-to-fly ratio for aerospace parts is generally about 10 to 1.

Titanium is also a good candidate for additive manufacturing because it is difficult to machine. Dehoff says a similar case could be made for nickel- and cobalt-based superalloys, which are also high-cost.

Grylls says that nickel- and cobalt-based superalloys are increasingly being used for high-temperature applications where an OEM is looking to redesign parts to accomplish something that would be difficult with a conventionally produced part.

Difficult geometries

Recently, even less costly non-ferrous metals, such as aluminium, are being used in additive manufacturing. Dehoff says that while it is not as

hard to machine as titanium and superalloys, with additive manufacturing it is possible to make geometries using aluminum that are nearly impossible to fabricate any other way, resulting in extremely lightweight, organic-looking structures that actually perform better than conventionally manufactured assemblies.

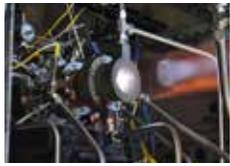
While there has also been some interest – at least from a research perspective – for the use of ferrous metals in additive manufacturing, to date, other than for stainless steel or other special alloys, much of that interest has been more related to part repair than part production, John Wilczynski, America Makes' deputy director for technology development, says.

Dehoff says that with machine costs going down significantly at the same time as their capabilities are increasing dramatically: "We are able to do things with metals that we couldn't do previously." He says that while it is not a 'silver bullet', it has already begun to morph into a more mainstream manufacturing technology. "If you understand the technology and understand what the potential is, you can do some amazing things with it," Dehoff says.

He notes that companies are starting to understand the additive manufacturing processes a lot better. "Also the processes themselves are getting a lot better. They are more repeatable and more reliable. And, with the material performance getting much closer to that of wrought and cast materials, companies are now better able to design parts for additive manufacturing."

Dehoff says that while there are times that companies could save money with direct substitution of current parts with a similar one that has been additively manufactured, using the technology to combine multiple parts or systems into a single component is often more ideal. "That could allow them to potentially decrease weight, increase performance and make a better functioning part," he points out.

Dehoff says that while five to ten years ago there were not a lot of powder vendors interested in the additive manufacturing market, that has changed. They now see it as a



Demonstration firing of a rocket engine comprising additive-manufactured components

fairly sizeable market and are changing some of their processes in order to make better powders that are aimed specifically at additive manufacturing.

Dan Greenfield, vp of investor relations and corporate communications for Allegheny Technologies, says that most of the powders his company already produces are very similar to those used for 3D printed parts and it is expected that over time powders to be used in additive manufacturing will become a much bigger part of ATI's business.

Specialised powders

Some other companies have introduced special non-ferrous metal powders aimed at additive manufacturing. Rod Heiple, Alcoa's director of research and development for engineered products and solutions, says Alcoa plans to produce proprietary titanium, nickel and aluminium powders optimised to produce higher strength 3D printed aerospace parts at its new, state-of-the-art 3D printing metal powder production facility located at the Alcoa Technical Center outside Pittsburgh.

Heiple says the powder facility is part of Alcoa's \$60 million investment in advanced 3D printing materials and processes that build upon its existing additive manufacturing capabilities. In addition to producing powders, Alcoa has introduced a number of additive techniques including Ampliforge – a hybrid process that combines additive and traditional manufacturing. He notes that Alcoa had gained 3D printing capabilities in titanium and other specialty metals for both aerospace and other end markets through its acquisition of RTI International Metals last year.

Germany-based Airbus APWorks recently introduced a powder metal version of Scalmalloy, an aluminium-magnesium-scandium alloy, specifically for 3D printing. While originally developed by APWorks' parent company, Airbus Group, as a sheet product, spokeswoman Angela Gruenewald says the company realised that the alloy, which, while having almost the same density as conventional aluminium alloys used

in 3D printing with almost as high specific strength as titanium, it had even better mechanical properties in powder form. Given that the alloy is not only high strength but also has a high level of ductility, APWorks, which is currently at the cusp of going from prototyping to commercial production with its direct laser-sintered additively manufactured products, uses Scalmalloy for parts for various markets including the aerospace, robotics and automotive sectors.

Boley says that NTI's wire-based plasma arc deposition technology, which is conducted in an inert argon environment (as opposed to a vacuum as is the case for laser- or electron beam-based powder bed additive manufacturing technologies), is able to use commercially available wire. Currently NTI is exclusively using titanium wire, although Boley says it is looking to develop the capability to eventually use nickel wire as well, for additively manufactured parts for the aerospace industry.

Industrial scale production

In addition to its new technology centre in Norway, where it has installed three production machines, NTI, in cooperation with the State of New York, is building what Boley says would be the world's first industrial-scale metals 3D printing facility in Plattsburgh, NY, which is expected to be up and running in late 2017 or early 2018. It will initially house 40 large printers, although the company plans to expand that to as many as 100 printers over time.

SLM's Grylls observes that while the major OEMs have a large number of components that could be made additively, very few are actually in production today. Part of that is because of what it takes to get parts qualified and certified – not just in aerospace but other markets as well.

Metalysis' Rao observes that dental additive manufacturing is already a mature process, with tens of thousands of dental implants already being additively manufactured in Europe alone every year. There has, in fact, been expanded interest in using titanium alloys and other biomedical grade materials, such as cobalt-chrome, for

'The processes themselves are getting a lot better. They are more repeatable and more reliable'

medical implants, notes Jorge Mireles, research manager at the W.M. Keck Center for 3D Innovation at the University of Texas-El Paso.

Magnus Rene, president and ceo of Sweden's Arcam, notes that additive manufacturing has been used for medical implants for some time. "Not only have medical implants been already been produced using additive manufacturing for about ten years, but already about 3% of all hip implant procedures being conducted worldwide use components made on Arcam EBM electron beam melting additive manufacturing machines."

Customisation is not the only advantage to 3D printing of medical implants. Rene says there are also performance and design freedom advantages, including the ability to design implant parts so that the bone could go into the structure. Also, while more customisation is possible, most implants are actually generic in nature and therefore could be mass produced.

Robotics

Gruenewald says the robotics industry is a good match for additive manufacturing as it requires certain really complex parts that are difficult to manufacture, including parts that require hydraulic channels and connections to electric cables.

"With additive manufacturing, the designer could be given the freedom to go wild in their designing software and then print it out," Grylls says, noting that the result could be amazing either from a prototyping or actual commercial production perspective.

Additive manufacturing is just starting to have a big impact in the aerospace market, which, according to Prabhjot Singh, senior principal scientist in General Electric's (GE's) advanced technology programme for material systems and nanotechnology, tends to use expensive components made from titanium and nickel- and cobalt-based superalloys.

While aerospace has been slow to make the transition from development work and prototyping to actual commercial use of additively manufactured parts,



An additive-manufactured titanium aerospace component

largely due to rigorous certification and qualification procedures required, Arcam's Rene says there are signs that the aerospace industry is now ready to commercially produce some significant additive manufactured non-critical structural and engine parts and components. A market research company, Technavio, has projected that the global aerospace-related additive manufacturing market will grow at a compounded annual growth rate of 20.47% from 2014 to 2017.

Metalysis' Rao says that there are numerous advantages to using additive manufacturing for aerospace, including weight reduction, greater design freedom – including building complex parts with hollows and other complexities – and allowing OEMs to reduce their supply chain and to enable the production of parts in fewer steps. That, Boley says, could save companies a lot of time, noting that as part of its recent qualification work NTI was able to make 2.5 months' of titanium part production for one large OEM in just 17 hours.

One of the most notable examples of production of one complex component that comprises what had previously been numerous individually produced parts is the new cobalt-chrome GE LEAP engine fuel nozzle, which received FAA certification last year after "a very extensive" several year period of testing and will shortly be in production at GE's new Auburn, Alabama, production facility, where it will eventually produce 30,000 to 40,000 fuel nozzles per year. This makes it one of the first examples of large-scale deployment of aerospace additive manufacturing.

Many advantages

Singh says that not only did additive manufacturing allow GE to take 18 parts that were previously brazed together and shrink it down to one piece, but the part now has a better design. "The new nozzle is five times as durable and 35% lower weight, so it is a big win for us."

Alcoa, which has produced 3D printed parts for the past 20 years and operates one of the world's largest hot isostatic pressing (HIP) complexes in aerospace, has already taken 3D printing out of the lab and

into the skies, Heiple says. "Our 3D-printed parts orbited the Earth on the Orion spacecraft and will take flight with our first agreement for series production of 3D printed titanium fuselage and engine pylon components for Airbus' commercial aircraft – the first of which is expected to be delivered later this year. APWorks' Gruenewald notes that there are already 3D printed parts flying on the Airbus A350.

Little's says Aerojet Rocketdyne, which is also working with titanium and copper alloys, recently manufactured its first nickel-alloy production rocket engine components, which are still working through the final approval and qualification process.

Another area of growing interest is automotive, says Jim Withers, ceo of Materials and Electrochemicals Research (MER) Corporation, Tucson, Arizona, which has been working on several titanium, aluminium and magnesium automotive parts, including brakes, connector rods and pistons, using a plasma arc or electron beam fusion process.

Grylls says that while in the USA most additive manufacturing for the automotive market is still in the prototyping stage, there has been more of a transition for production parts by European, and particularly German, automakers.

Through its new Center for Additive Technology Advancement, GE is also pushing other uses of additive manufacturing, Singh says, including for components for medical imaging equipment, which has improved some of its imaging outcomes by using precise additively manufactured parts, and natural gas turbines used for power generation, where additive manufacturing could increase durability, improve performance and shorten part lead times.

"I believe that additive manufacturing will be a key part of the factory of the future," summarises Dion Vaughan, Metalysis' ceo, enabling greater use of niche non-ferrous metals which had previously been seen as being prohibitively expensive.

The author is a specialist writer based in New York.

Innovation picks

Innovations in non-ferrous metal production technology are driven by cost reduction, efficiency, product quality and environmental regulations. Here are several topical examples

Ready to roll magnesium?

As plenty of *Metal Bulletin* articles have covered in the past year or two, aluminium sheet has made significant in-roads into markets for which strong but lightweight materials are required. The automotive sector is at the forefront of that trend, as both US and European vehicle emission regulations progressively tighten.

The question arises then as to whether magnesium – an even lighter metal that has already seen use in castings for the sector – could also see wider growth in sheet demand for vehicle production. A presentation* which was given by several Danieli FATA Hunter (DFH) engineers at the International Magnesium Association's annual conference held in May gave key answers, which are summarised here.

They explained that, based on the company's decades of twin-roll caster technology and previous experience of smaller scale plants for magnesium sheet production, the company has developed a full-size mill to produce 30,000 tpy of 2,000 mm wide, 2,500 mm outside diameter, coils of magnesium alloy sheet.

The full-scale mill design overcomes the disadvantages of early conventional methods for producing magnesium sheet and, in particular, builds on the experience of constructing a 600 mm wide casting line for the production of magnesium alloy sheet for personal electronic equipment. It was designed in co-operation with Posco-affiliate Research Institute of Industrial Science and Technology (RIST) in South Korea.

RIST then invested in a 2 metre

wide full-scale production caster to supply wide magnesium alloy sheet for transportation. A bulkhead for the new Renault Samsung SM7 vehicle and the roof of the new Porsche GT3 use metal from that mill.

More recently, DFH developed an advanced rolling process based on a reversing mill that uses asymmetric roll speeds to modify the alloy microstructure and improve the formability of the rolled sheet. Oak Ridge National Laboratories in the USA, working with Magnesium Elektron North America, built and tested a pilot mill.

It demonstrated that it was possible to produce sheet with properties matching those of magnesium alloys containing rare earths made by conventional processes. The full-scale 30,000 tpy mill is based on that pilot plant.

DFH says that its technology thus significantly reduces the cost of converting magnesium ingot to wrought magnesium sheet.

Commercial factors

While DFH has already developed casting and rolling designs for high-volume magnesium sheet production, its presenters noted that other parts of the magnesium supply chain have discouraged the automotive sector from deploying it. In particular, there is the Pidgeon process, which uses the silico-thermic reduction of dolomite and is the main method of magnesium production in China – the world's dominant producer.

While the method is an established technique to produce good-quality magnesium at a competitive cost, its disadvantage is a very high carbon footprint. DFH's presenters noted that overall carbon



Samsung SM7 magnesium panel



The Porsche GT3 has a magnesium alloy roof panel



Pilot magnesium rolling mill at Oak Ridge National Laboratories, USA

dioxide emissions for older plants are in the range of 37-47 tonnes of carbon dioxide equivalent per tonne of magnesium ingot produced, although newer plants have reduced emissions to between 19.9 and 25.8 tonnes of CO₂e.

"The high carbon footprint of the Pidgeon process profoundly impacts the overall life-cycle assessment of wrought magnesium sheet and has discouraged many of the European carmakers from considering the incorporation of significant quantities of magnesium sheet in the structure of their cars," they explained.

To meet the sustainability requirements of European carmakers, magnesium ingot needs to be sourced from electrolytic reduction plants, but they tend to have a high capital cost of 5-10 times more than the Pidgeon process and existing plants also tend to have a higher operating cost by comparison with China's production through the latter process.

Outlook

What may change the economics of volume production of magnesium sheet is growth in upstream electrolytic output of the metal in China.

For example, the new Qinghai smelter near Golmud in China is set to produce hundreds of thousands of tonnes of magnesium per year from magnesium chloride, with a much lower carbon footprint.

Locating a low-cost wrought magnesium sheet plant at a smelter like Qinghai would have the added cost saving of feeding the twin-roll caster directly with molten metal, rather than needing to remelt ingot, DFH's engineers said.

They concluded that magnesium sheet delivered to US and European markets from such a plant would not only be competitive with aluminium on a pure mechanical property per unit weight basis, but that it would also help the automotive industry cost-effectively meet fuel economy standards.

**Danieli FATA Hunter process technology, market drivers and target customers for magnesium alloy sheet by Anthony Tropeano, Enrico Romano and Chris Romanowski.*

Multiple metal solutions

The formation in May of a 50:50 joint venture called PolyMet Solutions GmbH, between Germany's SMS group and Austria's Mettop, has created an independent company with headquarters in Leoben, Austria. Andreas Filzwieser, founding director with fellow director Iris Filzwieser when Mettop was set up in 2005, is ceo of the new joint venture.

SMS group says that the new company will be able to expand its product and service range by the planning and supply of plant and equipment for the production of copper, lead, zinc, tin and other non-ferrous metals. It says the new joint venture will offer innovative technologies for primary concentrate smelters, converters and anode furnaces. "In the future it will thus be possible to supply complete process routes, extending as far as electrolysis and the subsequent processing of semi-finished products," stated SMS group in mid-June.

Mettop's expertise is in metallurgical process design, optimisation and engineering. In addition to acting as an advisor and consultant in these areas, it also develops, produces and supplies electronic measurement, control devices, and cooling elements.

Refractory and cooling element design for furnaces is one of its specialities. Its patented ILTEC Ionic Liquid Cooling Technology, which avoids the use – and potential hazards – of cooling water in furnaces is one of the company's specialities.

METTOP-BRX electrolysis technology is another developed and patented by the company, with Montanwerke Brixlegg AG, to improve productivity. It introduces fresh electrolyte in an upward flow between each pair of electrodes in a copper tankhouse, thereby increasing current density by up to 50% while maintaining or improving cathode quality.

Controlling cooling water

Combined with the exact aluminium alloy composition, the design and process control of a direct chill caster (DC) determines the quality of the ingots, logs or slabs produced. Optimum casting results and product quality are achieved by the application of consistent proprietary processes by the casting team at every DC plant.

Reliable and consistent cooling water chemistry is among the many process variables controlled and managed. It is needed to ensure that quench (cooling rate) characteristics remain uniform and that recovery rates (plant yield) are maximized.

An Ecolab company, NALCO Water's NalQuench programme removes variability in cooling water chemistry by incorporating some of the latest chemistries available into the water treatment regime and controls the following critical water variables: pH, conductivity, alkalinity, hardness, oxidation-reduction potential (ORP) and inhibitor residuals. Depending on the chemistry of the water at any given caster, between three and six additives are typically used, including scale and corrosion inhibitors, microbiological and alkalinity controls. The typical working volume of water needed by a DC caster covers a wide range from 1,000 to 10,000 cubic metres,

depending on system age and products cast.

The quench effects of each additive which NALCO Water puts into the DC process cooling water have been carefully characterised. And these additives are used exclusively with the NalQuench programme, notes the company.

Critical water parameters and treatment additives are controlled through NALCO Water's patented 3D Trasar™ technology. It monitors and controls chemical feed and dosing levels in the DC water circuit. Casthouse operators are alerted if any levels depart from norms.

NALCO Water says that full implementation of NalQuench achieves efficiencies that include water consumption reduction, recovery rate improvements, energy savings and carbon dioxide reductions. Control of the casting circuit enables the caster to optimise water usage and improve overall plant water management – an aim of many aluminium companies.

The DC casting process is generally an open recirculating circuit, therefore evaporation and 'blow down' occur, requiring additional make up water to replace the evaporative loss across the cooling tower. NALCO Water has a programme goal of achieving at least a 20% or greater cycle increase of water when installing a full NalQuench system. Another

interesting side benefit of reducing water usage is the impact it has on the plant's carbon footprint. A rule of thumb is that for every cubic metre of water reduced, 87g of CO₂ are saved. For large plants, this can help them meet some of their sustainability goals.

Additionally, energy costs and carbon footprint reductions will occur if the plant's recovery rate improves because remelt of the final shape is not necessary. NALCO Water states that recovery rate improvements are a standard part of the NalQuench programme implementation goals and that plant throughput increases should be expected. A wide variation of the energy savings and CO₂ reductions may result depending upon the shape cast and plant production rates. Billet plant remelt energy costs and produced tonnes are generally lower than a sheet ingot plant. Therefore if you improve the recovery rate (reduced remelt of scrap) by 1%, the net annualised energy savings could vary from about \$20,000/yr for a billet production plant to well over \$500,000 for a sheet ingot producing plant.

While NalQuench focuses on the consistency of cooling water for a caster, its supplier also provides other technologies to reduce the costs of operation in other parts of an aluminium plant. For example, its Pareto® polymer injection system improves polymer efficiency in the removal process of total suspended solids (TSS) and total oil and grease (TOG). Since cooling water in aluminium casters comes into direct contact with the cooling metal, TSS and TOG control are very important. The company can also recommend and/or provide various micro- and macro-filtration systems if required. Ultra-Sand high-efficiency filtration systems are said to be very effective for TSS removal. Special engineering and design are required for these units to remove TOG.

NALCO Water has also begun to investigate how 3D Trasar based control for dissolved air flotation systems and Purate (chlorine dioxide) could have further advantages with regard to improving process efficiencies and control of the water treatment objectives.



Critical water parameters and treatment additives are controlled through NALCO Water's patented 3D Trasar™ technology

NALCO

New plant orders

Metal Bulletin Magazine's quarterly review of recent orders announced for both new and upgraded plant

Customer	Supplier	Order details	Start-up
ALGERIA			
Algerian-Qatari Steel	Midrex Technologies; Paul Wurth	2.5 million tpy NG TM DRI plant for Bellara, with capacity to make hot DRI and cold DRI simultaneously	–
AUSTRIA			
Buntmetall Amstetten	SMS group	50 MN extrusion press for copper and copper alloys, replacing 25 MN press. Also inductive billet heater comprising four vertical induction furnaces	Spring 2017
BAHRAIN			
Aluminium Bahrain	Bechtel	Construct 6th potline for Alba aluminium smelter. Raises capacity by 540,000 tpy to 1.5 million tpy	Early 2019
BRAZIL			
Novelis do Brasil	Primetals Technologies	Modernise automation system in aluminium hot strip mill in Pindamonhangaba, to improve reliability and availability	Mid-2017
BURKINA FASO			
Houndé Gold Operation	Outotec	6 MW grinding mill, 6 MW ball mill, preleach thickener and services for Houndé gold project, processing 3 million tpy of ore	2017
CANADA			
ArcelorMittal Long Products Canada	Danieli	New finishing end for rolling mill at Longueuil, including water-forced cooling system, cooling bed exit table, 10-roll multistrand straightener, 1,100 short ton cold shear, 80 ft automatic magnetic stacker	Mar 2017
CHINA			
Baosteel	Primetals Technologies	Modernise DC twin EAF in Shanghai works, improving power efficiency and productivity. Includes redesign of upper and lower vessels, new anodes, new burner systems. It will be possible to operate EAF with up to 90% hot metal content, charged via top or side-wall	End-2016
Henan Zhongfu Industrial Co	Danieli	Cut-to-length (CTL) line and tension-levelling (TL) line for processing wide and thick aluminium strip	Q1/Q2 2017
Jiangyin Xingcheng	Danieli	HGS16 billet grinder for spring and bearing steels. 200 kW power, over 50,000 tpy capacity, with new Hi-Corner system for consistent corner grinding	Q1 2017
Ningbo Jintian Copper (Group) Co	Primetals Technologies	SCR 3000 copper rod mill for ETP copper. Capacity 160,000 tpy. 10 rolling stands producing 8, 9.5, 12.7, 16 and 18 mm dia rods, from 3,800 sq mm cast bar. Includes entry shear and table, roughing mill, finishing mill, pickling line, pinch roll, coiler, conveyor system	Q3 2017
Shanghai Stal Precision Stainless Steel	Fives	80,000 tpy 20-high cold rolling mill for stainless steel, for producing strip 0.040–1.20 mm thick. Max width 1,250 mm, including for minimum gauge	2017
Shougang Jingtang United Iron & Steel	Danieli	Danieli Universal Endless (DUE TM) plant for Gaofeidian. Thin slab casting and rolling, total capacity 2.1 million tpy of hot rolled coils, for strip 0.80–12.7 mm thick, 900–1,600 mm wide. Includes vertical curved caster, 5.5 metre radius, producing 110 mm thick slab after soft reduction, high reduction and finishing mill stands, tunnel furnace, laminar cooling system, high speed shear for endless mode. To supply all flat product market niches from a single mill	Q2 2018
EGYPT			
National Port Said Steel	Danieli	Auxiliary equipment for MI.DA Micromill project, including provision for DRI feeding into EAF	Q2 2017
FINLAND			
Boliden	Outotec	Gas-cleaning and sulphuric acid plant for nickel-copper smelter in Harjavalta. Includes efficient heat recovery systems for sulphur dioxide converter and drying/absorption section	Mid-2018
GERMANY			
ArcelorMittal Ruhrort	Sund Birsta	Revamp coil compactor with SBHX5 strapping heads	Mid-2016
BGH Edelstahlwerke	Primetals Technologies	Modernise EAF at Freital, including furnace rocker, roof raising and tilting system, tapping system	Mid-2017
DK Recycling und Roheisen	Danieli Corus	Reline hearth of blast furnace no. 3 in Duisburg. Capacity 1,200 tpd of speciality pig iron	–
Elbe Stahlwerke Feralpi	Danieli	3-stand CSB Compact Sizing Block for wire rod mill, enabling rolling of 5.5–16 mm dia plain and deformed wire rod into 2,400 kg coils at up to 115 m/min	Early 2017

Customer	Supplier	Order details	Start-up
Hüttenwerke Krupp Mannesmann	Danieli	Revamp single strand caster	Q1 2017
Salzgitter Mannesmann Precision	Danieli	Quick change for high-frequency tube mill 60/6-120	Q1 2017
INDIA			
Bhushan Power & Steel	Danieli	Revamp fume treatment plant for EAF	Q1 2018
Tata Steel	Fives Group	Upgrade level 1 control on gas-fired pusher furnace at Jamshedpur rolling mill	-
Varron Auto Kast	SMS group	Two aluminium extrusion lines, one 18 MN and one 10 MN short-stroke front-loading press. For processing 7in billets 300-1,000 mm long, and 5in billets 300-600 mm long. Combined annual capacity of 20,000 tpy. Plus complete handling system: billet cutter, reheating furnaces, cooling table, stretchers, final cutting saw, ageing oven and die oven	Q3 2016
IRAN			
Pars Kohan Diar Parsian Steel (PKP)	Posco	1.6 million tpy integrated steel mill with Finex and compact endless cast-and-rolling mill (CEM) technology. Total cost \$1.6 billion. Phase 2 will add cold rolling and plating line with capacity of 600,000 tpy	-
ITALY			
Acciaierie e Ferriere di Piombino (Aferpi)	SMS group	New steel complex replacing outdated facilities: 1 million tpy meltshop and 700,000 tpy rail and section mill. Includes 140t Sharc DC EAF, twin ladle furnace, twin vacuum degasser, bloom caster, billet caster. Blooms will be processed in rail/section mill, making 120 metre rails, beams, sections and sheet piles: comprises tandem reversing mill and compact roller straightener. Plus RailCool® head hardening line, finishing line	-
Acciaierie Valbruna	Primetals Technologies	Modernise 3-strand billet caster at Bolzano, to make stainless and special alloy billets up to 180 mm sq cross section. Radius will be increased from 7 to 9 metres, allowing for cross sections up to 200 mm at a later date	2016
Arvedi Group	Tenova; Turboden	iRecovery® system for steel works in Cremona. Implemented to existing Consteel® system, it will recover 34.3 MW average thermal power from the EAF, which will feed an Organic Rankine Cycle turbo-generator that will produce up to 7.5 MW of electrical energy	Early 2017
Foma	Danieli	Chain track drawing line for copper tube, up to 55 mm diameter	Q2 2017
Iiva	SMS group	Two hot metal desulphurization plants for steelworks nos. 1 and 2 at Taranto. With flexible injection systems for lime-only or lime plus magnesium. Includes hoppers, pneumatic conveying system, injection system with automatic lance-changing, hot metal treatment station, robotic system for sampling and temperature measurement	Early 2017
Nivsa	Danieli	Combined drawing line: CTDM 6 tonnes	Q1 2017
MEXICO			
Indalum	Danieli Breda	Aluminium extrusion plant equipped with 28 MN 3100UST front loading press, independent heating zones, cooling box	Q3 2017
PHILIPPINES			
Capitol Steel	Primetals Technologies	Bar rolling mill for 500,000 tpy of 8-50 mm dia rebar, with 7-stand roughing mill, 6-stand intermediate mill, 6-stand finishing mill, inline quenching system, 84 metre cooling bed, bundling system	H2 2017
POLAND			
ArcelorMittal Poland	Primetals Technologies	Replace nos. 1 and 3 BOF converters at Dabrowa Górnica works. New converters with tapping weight 325 tonnes, with maintenance-free Vaicon Link 2.0 suspension	End-2016/mid-2017
RUSSIA			
Abinsk Electric Steel Works	Primetals Technologies	Modernise mini-mill to raise capacity of 130/150 mm sq billets from 0.95M to 1.5M tpy. Includes PLC-based electrode control system, new oxygen injection system, new cabling, EAF pressure control, modified EAF hydraulics, modernised ladle furnace, revamped 6-strand billet caster with stopper casting equipment, new tube moulds and DynaFlex mould oscillators, electromagnetic stirrers, modernised cooling bed	Q1 2017
MMK	Sund Birsta	PC H-Alfa2 coil compactor for two-strand wire rod mill	Q3 2016
NLMK	Paul Wurth	Rebuild no.6 blast furnace at Lipetsk, including shell, lining, cooling elements, low-energy tuyere stocks and bustle pipe. Hearth diameter 12.0 metres, volume 3,818 cu metres, capacity 3.38 million tpy	Early 2018
Seversky Tube Works	SMS group	Heat treatment line for 265,000 tpy of tubes. Includes austenitizing furnace, quenching head, walking beam tempering furnace, cooling bed, water treatment system	Q1 2018
Severstal	Primetals Technologies	Twin-ladle converter furnace for treating 375 tonnes of steel in 45 mins max. Capacity 4.8 million tpy, at Cherepovets works. Includes alloying and dedusting systems, automation	Early 2017
Severstal	SMS group	Automatic setting control double-head side-trimming unit for no. 3 continuous pickling line in Cherepovets. Will also cut 1.2-6.0 mm thick strip to 700-1,650 mm width, at up to 360 m/min speed	-

Mining Strategic Excellence: South America

On September 6–7 in Santiago, Chile, the South American mining industry will gather to outline the strategic direction for increasing productivity and profitability. To give a foretaste of the event, MB Events' programme manager Ben Graham asks three keynote speakers about innovation

The mining industry has fallen upon tough times, exhausting cost-cutting measures and looking for new and innovative ways to move forward. Against that landscape, MB Events asked the CEOs of Codelco, Antofagasta and Collahuasi to indicate the single most exciting innovation each of their companies is using right now to increase productivity.

CODELCO – NELSON PIZARRO

"The most significant challenge Codelco is currently embarking upon is a new type of mining. One of the initiatives to change our technology, increase productivity, cut costs and make resources more viable, is the incorporation of Big Data and Data Analytics tools so as to broaden our operational decision-making systems currently in place. By processing large amounts of data, we can improve our analysis of the whole process, perform predictive maintenance and relate the downstream impact of certain processes. Furthermore, we have also tested our operating distance where we have been able to give continuity to one of our operations by providing support over 1,500 km, from a replica of our integrated operations centre located at the mine."

ANTOFAGASTA – IVAN ARRIGADA

"On cost competitiveness we are working on the following key areas: improving productivity of services, upgrading our maintenance processes across all operations, reducing energy costs and improving energy efficiency and in organisational effectiveness, with special focus on streamlining support functions and ensuring clear focus on sustainability, production and cost. Some of the more exciting innovations we're working on are in relation to sustainability, a key aspect in our business' competitiveness.

In Minera los Pelambres we have made a step change in the way we engage with communities around our operations, through a model based on

participation and an open dialogue between neighbours, authorities and other companies. The goal is to agree on a shared vision for development and to join forces to make this vision a reality. In addition, we continue innovating to integrate renewable energy sources, such as solar and wind. In areas where water is scarce, our operations mostly use seawater. We're also pioneering the use of thickened tailings, which are more stable and allow for a greater water re-utilisation rate, reducing the space needed for the tailings."

COLLAHUASI – JORGE GÓMEZ

"Innovation isn't just technology; I see innovation as the development of ideas, and that happens where there is collaboration and where people can interact. Most innovation comes not from a research centre but from the workers themselves, and that's our case.

We've put all our efforts into minimising the variability of processes and therefore the probability of incidents, which explains the difference between actual and expected performance. Our strength has been in understanding our processes, drawing up risk matrices so as to have a relatively deep understanding of them and focusing on things that aren't up to the standard we need or want.

We also saw the need to create a scientific platform that would help us to put order into our ideas. The result was a computer program called c+. It's installed in all our employees' mobile phones. Here they can post ideas for improvements and other employees can then improve or question their suggestions. It includes our contractors' employees and it makes no distinction between workers and supervisors because in our experience the best ideas come from those closest to the job."

For more information about the conference please visit metalbulletin.com/events/miningsa or contact marketing@metalbulletin.com



Nelson Pizarro, CEO, Codelco



Ivan Arriagada, CEO, Antofagasta



Jorge Gómez, CEO, Collahuasi

New orders

Customer	Supplier	Order details	Start-up
SERBIA			
Impol	SMS group	Revamp aluminium rolling mill supplied in 1972, to improve production and quality. Includes new X-ray shape and gauge unit, new cooling headers, additional bending cylinders for backup rolls, high-pressure cleaning system, and AluControl® X-Pact® automation	End-2017
SOUTH KOREA			
Novelis	Primetals Technologies	Roll coolant spray system for aluminium hot strip mill in Yeongju. Includes new coolant spray bars with Integral Solenoid Valve for roughing stand and four finishing stands	July 2017
Posco	ABB	Revamp hot rolling mill at Pohang with new AC motor and drive technology, replacing twin DC motors. Also low voltage motors for down-coilers and other ancillary equipment	June 2017
Posco	Paul Wurth	Revamp no.3 blast furnace at Pohang, including expanding to 14,000 tpd, relining, changing to parallel hopper top with 108 cu metre hopper volumes	Early 2017
SPAIN			
Acerinox	SMS group	20-high cold rolling mill at Los Barrios, Cadiz. MonoBlock design, with X-Pact automation. Includes pay-off unit, two reversing reels with paper feed, a Supafine® rolling oil plant, fume exhaust and filter. Designed to roll variety of stainless grades with high pass reductions to 0.15 mm gauge. Strip width up to 1,320 mm, rolling speed up to 800 metres/min	End-2017
ArcelorMittal Avilés	SMS group	Rebuild 2-strand bow-type slab caster no. 1 into vertical bending plant. No. 2 will follow in phase II. To improve slab quality for premium grade automotive sheet, tinplate and plate. No. 1 caster will have 8 metre radius with vertical length 2.4 metres. Casting speed raised to 1.95 m/min	–
ArcelorMittal Espana	SMS group	Revamp rail rolling mill in Gijón, including conversion to universal rolling method, with universal stands plus edger. Increases rail lengths from 90 to 108 metres	–
SRI LANKA			
Melwire Rolling	Danieli	250,000 tpy rebar mill	Q3 2017
TAIWAN			
China Steel Corporation	SMS group	Revamp continuous slab caster no. 4 at Kaohsiung. Includes new oscillator drive, thermocouples, and technological process models with breakout prediction system	End-2016
THAILAND			
Kobelco Millcon Steel	Primetals Technologies	Modernise wire rod mill in Rayong, including new mill stand gear drives, water boxes, pinch rolls, laying heads and Morgan Reducing Sizing Mill	May 2017
TURKEY			
Yildiz Demir Çelik	Danieli	1.5 million tpy cold mill complex in Kocaeli, producing pickled/cold rolled/galvanized/annealed/skin-passed coils from hot-rolled coils. Includes 1.5 million tpy continuous pickling line; 400,000 tpy hot dip galvanizing line; 300,000 tpy bell annealing furnace, 450,000 tpy temper mill	Q1 2018
UK			
Goodwin Steel Castings	Inteco	30-tonne VODC converter for carrying out AOD and vacuum treatments in the same plant	Dec 2016
USA			
AM/NS	SMS group	Upgrade furnace on HDG line no. 3 at Calvert, Alabama, to handle 3rd generation AHSS. Includes additional seal roll assemblies, new deflector roll boxes, induction heaters, partitioning section, final cooling section and exit section	End-2016
LIFT	Danieli	12 MN extrusion press	Q4 2017
Service Center Metals (SCM)	Hertwich Engineering	Compact remelt plant for aluminium extrusion billets. Capacity 45,000 tpy, for billets up to 356 mm dia. Includes Ecomelt PS melting furnace, two horizontal continuous casters; it is possible to cast two different diameters at the same time. Plus flying saw, ultrasonic inspection, continuous homogenisation furnace, cooling station	End-2016
VIETNAM			
Fuco Steel	Danieli	600,000 tpy rolling mill for rebar, wire rod and small sections, from 150 mm sq billet. 18 SHS+ stands, plus cutting, bundling, stacking and strapping	Q4 2017
Vietnam-Japan Steel	Danieli	Mi.Da Micromill in Hai Phong for 350,000 tpy of rebar, 10-41 mm dia, 9-15 metres long. Single-strand caster for 150 mm sq billet, plus connected rolling mill with 18 housingless stands, quenching system, cooling bed with cutting-to-length, bundling and tying	–
Viet Nhat Advanced Steel	Danieli	Continuous caster and 350,000 tpy rolling mill	Q2 2017

Metal Bulletin Magazine welcomes and encourages companies signing contracts for new plant orders – as supplier or customer – to contact us with key details for inclusion in this feature.

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Supply chain services

UK's first fully-automated steel terminal opens

Peel Ports, one of the UK's largest port groups, formally opened the UK's first fully-automated steel terminal in Liverpool on 8 June, following a £9 million (\$13 million) upgrade. This investment is a response to increasing demand for shipping via Liverpool, and for improved handling facilities at the existing terminal. Liverpool is the nearest deep sea port to the West Midlands, where about half of the UK's steel is consumed.

The terminal, located at the Port of Liverpool's Canada Dock, has a fully automated warehouse and interactive customer web portal, which gives customers round-the-clock access to the ordering process. Efficiency is enhanced by real-time stock availability, precision coil selection



PEEL PORTS

and a vehicle booking system, which minimise paperwork and hauler turn-round time. Instant reporting means that customers are able to track their

The Liverpool investment will 'revolutionise the efficiency of the UK steel supply chain'

Autonomous drilling for BHP Billiton

Sweden-based Atlas Copco has won an order from BHP Billiton to upgrade its drill rigs to autonomous operation at its iron ore mines in Western Australia. For the past two years, the mining company has been running a trial of Atlas Copco's autonomous technology on two Pit Viper 271 drill rigs at the Yandi mine. The machines have drilled over 1 million metres, operating autonomously for over 15,000 hours.

As a result of this successful trial, BHP Billiton has ordered autonomous upgrade packages for 18 drill rigs, in addition to the two trial rigs. The 20 rigs will initially be controlled from the company's five iron ore mines in Pilbara, with the aim of remote operation from Perth, over a thousand kilometres away, in the longer term.

Last year, Atlas Copco supplied automated Simba rigs for underground long hole drilling at LKAB's Malmberget iron ore

mine in Sweden. Six new Simba WL6 C rigs were supplied to replace the existing 'BK' rigs. The new drilling plant is more powerful and equipped for remote operation using a new data system and interface, taking operators out of hazardous mining areas, says Atlas Copco.



ATLAS COPCO

Pit Viper 271 drill rigs in Pilbara will be upgraded to autonomous operation

orders in real time from ship to door.

The facility results from a partnership with logistics company Denholm Handling, which provides warehousing, handling and distribution services across the UK. Accredited to ISO 9000, 11000 and 18000, the site provides 24,200 sq metres of internal storage and 9,300 sq metres of external storage. The automated coil facilities can handle 80,000 tonnes of capacity and a total throughput capacity of 500,000 tpy.

David Huck, Port Director of Peel Ports, said: "This is very exciting and significant milestone for Peel Ports because it puts us at the leading edge of steel storage and distribution. The facility will revolutionise the efficiency of the UK steel supply chain as no other port in the UK is currently able to offer a comparable service."

Peel Ports has confirmed that a similar development is planned for its other steel terminal in Sheerness in Kent, UK.

More stainless information available

The International Stainless Steel Forum (ISSF) has issued several new publications. To commemorate its 20th anniversary, the ISSF has published a fifth edition of its *Book of New Applications*. This records a number of projects that have expanded the market for stainless steels.

There is also a new publication called *Stainless Steel in Infrastructure*, which gives various examples of the use of stainless in this sector. It is available in English and Chinese.

Aside from its corrosion-resistant properties, stainless alloys also have other important properties that receive less attention, says ISSF. The brochure *Stainless Steel for Designers* lists influential and reliable publications that deal authoritatively with the most significant properties of the alloys.

These publications can be downloaded from the ISSF website.

Advantages of AC coil pickling

An AC electrolytic pickling process for flat products (ACE-PICK) was initially developed on a laboratory scale by Centro Sviluppo Materiali in Italy, and the process is now being tested on a commercial scale by Marcegaglia at its main site at Gazoldo degli Ippoliti in northern Italy. Other active partners in the ACE-PICK project include ArcelorMittal Bremen, Tenova and Scanacon.

The technology has shown positive results after a 15-month trial, Marcegaglia reported recently at the annual meeting of Technical Group no. 5 (Finishing and Coating), of the European Commission (Research Fund for Coal and Steel), held at Gazoldo degli Ippoliti.

ACE-PICK is the world's first alternating current pickling process, and is stated to be a 'major

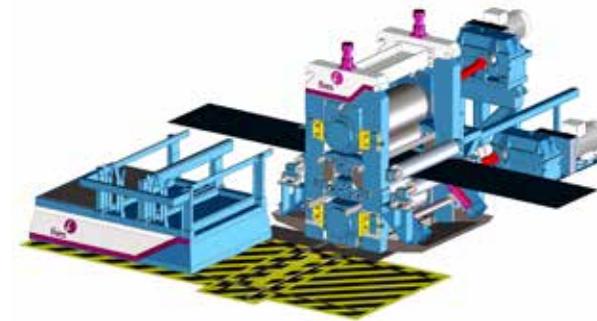
breakthrough' since it can significantly reduce – by up to 50% – the treatment times required with conventional processes, on both hot- and cold-rolled products. It also makes the use of sandblasters and scale-breakers optional or unnecessary, with ensuing benefits for surface quality, especially for bright-annealed products.

For stainless steels, the process has delivered a significant reduction in environmental impact, says Marcegaglia, owing to the lower consumption of reagents like hydrofluoric and nitric acids.

A radical new skin-pass mill

Fives Group has developed what it describes as a radical new design for a skin-pass mill. Its DMS SkinPass 4Hi mill can process steel sheets up to 1,600 mm wide at a speed of 300 metres/min, with a maximum roll force of 5,500 kN. The new design has been optimised to minimise operating costs while obtaining the best performance, and is subject to a patent application.

The company's DMS SkinPass 4Hi and 6Hi mills are said to be suitable for a wide range of galvanized or continuous annealed



steel products, from very low to very high strength, while the SkinPass 2Hi mill is designed for stainless steel applications requiring high brightness.

The new 4Hi skin-pass mill

FIVES GROUP

Sweden pursues CO₂-free ironmaking

The Swedish Energy Agency will contribute SEK 6.7 million (\$0.8 million) to support the pre-feasibility study of carbon-dioxide-free ironmaking, a joint project in Sweden of steelmaker SSAB, iron ore miner LKAB and energy supplier Vattenfall. In early April, the three companies announced their joint initiative to remove carbon dioxide emission in the Swedish steel industry. By using hydrogen in a direct iron ore reduction process instead of blast furnaces using coal and coke, the goal is to create a steelmaking process that releases only water instead of carbon dioxide.

"This project could be the starting point of radical change in the Swedish steel industry. In the long run, it can mean Sweden becoming the first country in the world to use hydrogen in ironmaking on an industrial-scale," said Klara Helstad, head of the Sustainable Energy Unit at the Swedish Energy Agency.

The initiative is split into three phases beginning with a pre-feasibility study, which will analyse all the conditions and which will continue until the end of 2017. This will be followed by a more concrete research and development programme in a pilot study which will last until 2024, before finally progressing to demonstration plant trials, which will continue until 2035.

Spotting corrosion from a distance

Scientists are developing technology capable of detecting the level of rust on steel structures from up to 100 metres away. The project – involving Nottingham Trent University, UK, and global infrastructure consultancy Opus International Consultants – could save tens of millions of dollars a year in surveying costs and remove the need for often laborious and potentially dangerous inspections.

The three-year project, which has just started, involves the creation of a remote imaging system which simultaneously performs both 3D and spectral imaging, providing important information about the physical

and chemical characteristics of the structure. The 'RustScan' instrument and accompanying 'RustDetect' software – which will be used via hand-held or tripod-mounted cameras, or even drones – will be able to generate detailed data regarding surface blistering and corrosion. It will help to inform crucial decisions about when to repair or decommission structures such as bridges, pylons, culverts, station canopies, roof structures and tunnel linings.

There is currently no technology that combines 3D and spectral imaging in one instrument in this way, says a university spokesman.

Steel for the world's largest cruise ship

ArcelorMittal supplied all the steel required to construct the recently launched *Harmony of the Seas*, described as the largest cruise ship ever built. The ship is 362 metres long and 65 metres wide, and was built from heavy plate produced at the steelmaker's site in Gijón, Spain, plus coils produced at Fos-sur-Mer and subsequently processed at ArcelorMittal's service centre in Saint-Nazaire, both in France.

Harmony of the Seas was built by STX France in Saint-Nazaire, and had a maiden voyage to Rotterdam on 22 May. It is

operated by Royal Caribbean International. ArcelorMittal was contracted by STX France in 2013 to supply the steel for the ship, making up the hull and 18 decks. The vessel has around 2,700 staterooms, 20 restaurants and 23 swimming pools. It carries nearly 6,800 passengers and over 2,000 crew.

The ship is the first of two 'Oasis class' cruise vessels to be built by STX France, and the second is now under construction. All of its steel will also be sourced from ArcelorMittal, with deliveries continuing until Spring 2017.



ROYAL CARIBBEAN INTERNATIONAL

An inside view of the *Harmony of the Seas*

Novelis aluminium lightens Cadillac

General Motors' new 2016 Cadillac CT6 features a substantial proportion of aluminium in its body to effect weight savings. This 'mixed material' vehicle represents a first for General Motors in North America and China. In North America, Novelis' plant in Kingston, Ontario, will supply GM's plant in Detroit, Michigan. Novelis' plant in Changzhou, China, will supply GM's Shanghai plant, which will produce the CT6 manufactured locally in China.

The Cadillac CT6 has a body that is 62% aluminium, making this full-size luxury sedan comparable in weight to the smaller CTS sedan. When compared with a similar size

vehicle using predominantly high-strength steel, the CT6 is about 220 lb (99.8 kg) lighter, says Novelis.

The CT6 features aluminium in the passenger and rear compartments, roof, outer body panels and door and deck-lid structures.

GM's advanced joining methods are employed, including its proprietary aluminium spot welding technology. Laser welding, flow drill fasteners and self-piercing rivets are also used, along with nearly 600 ft (183 metres) of advanced structural adhesives.

Novelis states that its automotive aluminium sheet is used in 180 vehicle models now in production.



CADILLAC

The aluminium-intensive CT6 sedan

British Steel launches new zinc-coated rail

British Steel, formerly Tata Steel Long Products Europe, has started production of a premium zinc-coated rail product, Zinoco[®], and supply contracts have been secured in the UK, France and the Republic of Ireland. This product "will typically outlast traditional uncoated rail by around five times in a broad range of aggressive environments," British Steel's rail sector head Richard Bell said. Moreover, it is claimed to offer superior corrosion resistance to all other current rail coating systems on the market.

Zinoco was developed in response to UK Network Rail's requirements for a more durable corrosion resistance that can withstand minor damage and offer sacrificial long-term protection, especially against stray current corrosion.

The new Zinoco plant has been built at British Steel's Scunthorpe Rail and Section Mill (SRSM) and the automated facility means that these rails can be coated more efficiently than the previous coated rail product.



BRITISH STEEL

Zinoco: extended corrosion protection for rail

Umicore to triple battery cathode material capacity

Umicore is speeding up its capacity expansion for NMC (nickel manganese cobalt) materials, which are processed to produce the cathodes in lithium-ion batteries. This acceleration is needed to meet a surge in demand for lithium-ion batteries used in hybrid and electric vehicles, says the company.

The expansion involves investments of about €160 million over a period of three years at Umicore's existing facilities in Cheonan, South Korea, and Jiangmen, China. There will also be greenfield investments on adjacent lands at these locations. The company says that it will deploy its latest generation of proprietary technologies that will enable it to triple its existing capacity across a broad range of material grades by the end of 2018. The new capacity should come on stream from the second half of 2017.

Umicore says that its NMC cathode materials are key ingredients that enable improvements in battery technology, increasing driving range and reducing the total cost of electric vehicle ownership.

Iranian Base Metals Conference

6 – 7 September 2016

Parsian Azadi Hotel, Tehran, Iran

MB's inaugural Iranian Base Metals Conference will examine the market dynamics for aluminium, copper, lead and zinc, and how Iranian base metal industries fit into the global picture. The impact of sanctions lifting will be discussed, along with guidance on conducting business in Iran.

metalbulletin.com/event



SHUTTERSTOCK

Melbourne

Mining Strategic Excellence: South America

6 – 7 September 2016

Sheraton Santiago Hotel and Convention Centre, Santiago, Chile

This inaugural conference addresses innovation and operational excellence from a strategic perspective. It will look at case studies drawn from base metals, ferrous metals, precious metals, industrial minerals and coal.

metalbulletin.com/events



SHUTTERSTOCK

Chicago

21st Galvanizing and Coil Coating Conference

6 – 7 September 2016

Bratislava, Slovakia

Key topics to be discussed at this flagship event include supply and demand balance, developments in coatings and technologies, zinc supply, demand outlook and the effect of trade cases.

metalbulletin.com/events

15th International Stainless and Special Steel Summit

6 – 8 September 2016

Hotel Intercontinental Lisbon, Portugal

Over 200 top executives from around the world and from all tiers of the global supply chain are expected to convene in Lisbon to discuss the world stainless and special steel sectors.

metalbulletin.com/events

North American Automotive Metals Conference

14 – 15 September 2016

The Dearborn Inn, Michigan, USA

The second event in this series will focus on the lightweighting debate, the latest OEM user preferences, supply chain issues and the latest developments happening across the US and Mexican markets.

amm.com/events

North American Ferroalloys Conference

19 – 21 September 2016

Eaglewood Resort and Spa, Chicago, USA

This new event from AMM Events will facilitate vital networking and business connections in this sector, with purchasing individuals from steel mills, speciality metals producers and foundries.

metalbulletin.com/events

4th Asian Nickel Conference

20 – 21 September 2016

Jakarta, Indonesia

This conference will address many vital aspects of the Asian nickel industry, including the Indonesian export ban, local project investment, future policy in the Philippines, stockpiling in China and the future of NPI production.

metalbulletin.com/events

9th Indian Iron and Steel Conference

20 – 21 September 2016

ITC Maurya, New Delhi, India

The Ministries of Mines and Steel will give the latest information about government plans for the steel sector, and a wide range of key issues will be addressed by senior figures from the steel supply chain.

metalbulletin.com/events

2nd Iranian Iron & Steel Conference

26 – 28 September 2016

Abbasi Hotel, Esfahan, Iran

Connecting the Iranian iron ore and steel markets with the world, this conference will be the ideal place to learn about Iranian markets and create international links.

metalbulletin.com/event

31st International Aluminium Conference

27 – 29 September 2016

Melia Avenida America, Madrid, Spain

This major aluminium conference will cover the difficult issues facing the industry, including capacity cutbacks, weak prices, and uncertain future demand growth. Discussion and debate will take place across the entire value chain, with ample opportunity for networking and negotiation.

metalbulletin.com/events

30th Stainless and its Alloys Conference

17 – 18 October 2016

Hilton Philadelphia, Philadelphia, USA

This conference will bring together over 150 industry executives from the entire supply chain, from raw materials (nickel, chrome, molybdenum and scrap), to US and global mills, distributors and fabricators.

amm.com/events

20th Met Coke World Summit

18 – 20 October 2016

Pittsburgh, USA

This summit convenes hundreds of international coke, coal and steel decision makers, and connects the leading companies with the most informed industry analysts to address critical issues in the sector.

<https://www.metcoke.com>

LME Week Seminar

31 October 2016

QEIL Centre, London, UK

At the start of LME Week, this seminar gives an essential overview of all aspects of the metals market, including base and precious metals, commodity financing, regulations and the global economic outlook.

lme.com/en-gb/news-and-events/events

32nd International Ferroalloys Conference

6 – 8 November 2016

Hilton Prague, Czech Republic

The premier meeting place for senior executives in the ferro-alloys market features a number of extra benefits this year, including bespoke packages, free registration for steel mill buyers, enhanced networking and a streamlined programme.

metalbulletin.com/events

International Mining and Resources Conference

7 – 10 November 2016

Melbourne Convention & Exhibition Centre, Australia

IMARC is Australia's only one-stop, truly international mining event, where over 2,500 mining leaders, policy makers, financiers, technical experts, innovators and educators are brought together under one roof.

<http://imarcmelbourne.com>

Monthly prices

For the latest prices see
www.metalbulletin.com/my-price-book

May averages

	Low	High
Aluminium		
Aluminium P1020A, in-warehouse premium		
Rotterdam duty unpaid spot \$/tonne	73.18	84.55
Aluminium P1020A, in-warehouse premium		
Rotterdam duty paid spot \$/tonne	123.75	143.75
Alumina		
Index fob Australia	259.41	
Antimony		
MB free market		
Regulus 99.65%, max Se 50ppm, \$/tonne in warehouse	6,268.75	6,587.50
MMTA Standard grade II \$/tonne	6,112.50	6,418.75
Bismuth		
MB free market		
min. 99.99%, \$/lb, tonne lots in warehouse	4.31	4.78
Cadmium		
MB free market		
min 99.95%, cents/lb in warehouse	70.00	76.00
min 99.99%, cents/lb in warehouse	73.00	80.00
Cobalt		
MB free market		
High Grade, \$/lb in warehouse	10.68	11.43
Low Grade, \$/lb in warehouse	10.58	11.19
Copper		
US High-grade cathode premium indicator, \$/tonne		
	132.28	143.30
Germanium Dioxide		
MB free market min 99.99%, \$/kg		
Rotterdam \$/kg	1,181.25	1,381.25
Gold		
London \$/troy oz		
Morning	1,259.76	
Afternoon	1,259.40	
Morning	867.57	
Afternoon	867.07	
Handy/Harman	1,260.95	
Indium		
MB free market		
Ingot min 99.97%, \$/kg in warehouse	238.75	278.75
Magnesium		
MB free market		
min 99.8%, \$/tonne	2,150.00	2,300.00
China free market min 99.8%	2,122.50	2,150.00
Mercury		
MB free market		
min 99.99%, \$/flask in warehouse	1,150.00	1,550.00
Molybdenum		
Free market in warehouse		
Europe drummed molybdic oxide \$/lb Mo	7.26	7.69
US canned molybdic oxide \$/lb Mo	6.96	7.20
Nickel		
Free market in warehouse premium		
Europe \$/tonne		
uncut cathodes	45.00	125.00
4x4 cathodes	150.00	250.00
briquettes	125.00	225.00
US		
Melting \$/lb	0.16	0.20
Palladium		
Morning \$/troy oz	577.50	
Afternoon \$/troy oz	576.75	
Platinum: per troy oz		
Morning \$/troy oz	1,035.85	
Afternoon \$/troy oz	1,033.70	

	Low	High
Rhodium		
European free market		
min 99.9% in warehouse, \$/troy oz	637.73	737.73
Selenium		
MB free market		
min 99.5% in warehouse \$/lb	4.91	6.13
Silicon		
MB free market €/tonne		
	1,600.00	1,700.00
Silver		
London		
spot pence/troy oz	1,162.88	
spot cents/troy oz	1,688.88	
Handy/Harman cents/troy oz	1,694.71	
Tin		
European free market		
Spot Premium 99.9% \$/tonne	400.00	500.00
Spot premium 99.85% \$/tonne	325.00	375.00
Kuala Lumpur (ex-smelter) \$/tonne	16,854.76	
Titanium		
Ferro-Titanium		
70% (max 4.5% Al), \$/kg d/d Europe	3.64	3.93
Tungsten		
European free market APT \$/mtu	214.00	225.00

FOUNDRY INGOTS

Aluminium		
LM24	1,250.00	1,320.00
LM6/LM25	1,490.00	1,540.00
Aluminium Europe €/tonne	1,607.50	1,695.00
Phosphor Bronze		
PBI ex-works £/tonne	5,125.00	
Zinc Alloy		
10 tonne lots Z13 £/tonne	1,860.00	

LONDON METAL EXCHANGE

High, low and average May (20 days)

LME averages are mean of buyers and sellers except for settlement and 3 months sellers.

	May 2016	Low	High	May average
	\$	\$	\$	\$
Copper Grade A (\$)				
Cash	4,310.25	5,102.50	4,707.85	
3 months	4,320.25	5,070.25	4,694.00	
Settlement	4,310.50	5,103.00	4,708.35	
3 months seller	4,320.50	5,070.50	4,695.00	
Copper Grade A (£)				
Settlement	3,005.51	3,576.58	3,240.57	
3 months seller	3,012.06	3,562.95	3,230.04	
Tin (\$)				
Cash	13,225.00	17,622.50	16,737.38	
3 months	13,212.50	17,497.50	16,691.00	
Settlement	13,235.00	17,625.00	16,745.75	
3 months seller	13,225.00	17,500.00	16,701.75	

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	May 2016		May Average
	Low	High	Average
	\$	\$	\$
Lead (\$)			
Cash	1,596.50	1,896.25	1,714.05
3 months	1,597.50	1,887.75	1,715.70
Settlement	1,597.00	1,896.50	1,714.43
3 months seller	1,598.00	1,888.00	1,716.50
Lead (£)			
Settlement	1,098.84	1,340.38	1,180.06
3 months seller	1,100.75	1,333.90	1,181.00
Zinc (\$)			
Cash	1,453.25	1,942.50	1,870.86
3 months	1,466.50	1,945.00	1,876.68
Settlement	1,453.50	1,943.00	1,871.20
3 months seller	1,467.00	1,946.00	1,877.53
Aluminium (\$)			
Cash	1,452.50	1,672.75	1,555.95
3 months	1,451.25	1,674.50	1,569.00
Settlement	1,453.00	1,673.00	1,556.33
3 months seller	1,451.50	1,675.00	1,569.33
Aluminium Alloy (\$)			
Cash	1,507.50	1,610.00	1,533.28
3 months	1,535.00	1,625.00	1,561.88
Settlement	1,510.00	1,615.00	1,538.05
3 months seller	1,540.00	1,630.00	1,566.75
Nickel (\$)			
Cash	7,705.00	9,552.50	8,685.88
3 months	7,737.50	9,570.00	8,732.38
Settlement	7,710.00	9,555.00	8,689.25
3 months seller	7,750.00	9,575.00	8,737.50
Nasaa (\$)			
Cash	1,660.25	1,739.50	1,671.74
3 months	1,667.50	1,760.00	1,705.88
Settlement	1,660.50	1,740.00	1,672.95
3 months seller	1,670.00	1,765.00	1,709.80
Cobalt (\$)			
Cash	21,702.50	24,000.00	23,463.38
3 months	21,800.00	23,875.00	23,475.00
Settlement	21,705.00	24,100.00	23,589.25
3 months seller	21,850.00	24,000.00	23,705.00
Molybdenum (\$)			
Cash	11,500.00	15,150.00	14,687.50
3 months	11,500.00	15,150.00	14,727.50
Settlement	11,750.00	15,300.00	14,932.50
3 months seller	11,750.00	15,300.00	14,972.50
Steel Billet (\$)			
Cash	75.00	195.00	75.00
3 months	90.00	210.00	90.00
Settlement	100.00	220.00	100.00
3 months seller	115.00	235.00	115.00
LME Settlement Conversion Rates			
\$/£	1.45		
\$/yen	108.95		
\$/€	1.13		

Monthly prices

For the latest prices see
www.metalbulletin.com/my-price-book

June averages

	Low	High
Aluminium		
Aluminium Pro20A, in-warehouse premium		
Rotterdam duty unpaid spot \$/tonne	62.05	78.82
Aluminium Pro20A, in-warehouse premium		
Rotterdam duty paid spot \$/tonne	114.44	132.22
Alumina		
Index fob Australia	245.48	
Antimony		
MB free market		
Regulus 99.65%, max Se 50ppm, \$/tonne in warehouse	6,322.22	6,583.33
MMTA Standard grade II \$/tonne	6,283.33	6,566.67
Bismuth		
MB free market		
min. 99.99%, \$/lb, tonne lots in warehouse	4.29	4.66
Cadmium		
MB free market		
min 99.95%, cents/lb in warehouse	68.67	74.67
min 99.99%, cents/lb in warehouse	72.89	78.33
Cobalt		
MB free market		
High Grade, \$/lb in warehouse	10.69	11.25
Low Grade, \$/lb in warehouse	10.54	11.14
Copper		
US High-grade cathode premium indicator, \$/tonne		
	132.28	143.30
Germanium Dioxide		
MB free market min 99.99%, \$/kg		
Rotterdam \$/kg	1,150.00	1,350.00
Gold		
London \$/troy oz		
	Morning	1,273.58
	Afternoon	1,276.40
	Morning	896.73
	Afternoon	898.68
	Handy/Harman	1,276.40
Indium		
MB free market		
Ingots min 99.97%, \$/kg in warehouse	229.44	271.67
Magnesium		
MB free market		
min 99.8%, \$/tonne	1,950.00	2,050.00
China free market min 99.8%	1,968.00	1,996.00
Mercury		
MB free market		
min 99.99%, \$/flask in warehouse	1,125.00	1,450.00
Molybdenum		
Free market in warehouse		
Europe drummed molybdc oxide \$/lb Mo	7.84	8.08
US canned molybdc oxide \$/lb Mo	7.70	8.03
Nickel		
Free market in warehouse premium		
Europe \$/tonne		
uncut cathodes	61.25	125.00
4x4 cathodes	150.00	250.00
brquettes	125.00	212.50
US		
Melting \$/lb	0.16	0.20
Palladium		
Morning \$/troy oz	551.32	
Afternoon \$/troy oz	553.09	
Platinum: per troy oz		
Morning \$/troy oz	984.32	
Afternoon \$/troy oz	984.14	

	Low	High
Rhodium		
European free market		
min 99.9% in warehouse, \$/troy oz	609.77	709.77
Selenium		
MB free market		
min 99.5% in warehouse \$/lb	7.50	8.79
Silicon		
MB free market €/tonne		
	1,600.00	1,700.00
Silver		
London		
spot pence/troy oz	1,211.01	
spot cents/troy oz	1,718.11	
Handy/Harman cents/troy oz	1,728.61	
Tin		
European free market		
Spot Premium 99.9% \$/tonne	400.00	510.00
Spot premium 99.85% \$/tonne	325.00	362.50
Kuala Lumpur (ex-smelter) \$/tonne	16,885.24	
Titanium		
Ferro-Titanium		
70% (max 4.5% Al), \$/kg d/d Europe	3.53	3.83
Tungsten		
European free market APT \$/mtu	203.25	221.00

FOUNDRY INGOTS

Aluminium		
LM24	1,254.00	1,320.00
LM6/LM25	1,494.00	1,542.00
Aluminium Europe €/tonne	1,585.00	1,665.00
Phosphor Bronze		
PB1 ex-works £/tonne	5,162.50	
Zinc Alloy		
10 tonne lots L3 £/tonne	1,945.00	

LONDON METAL EXCHANGE

High, low and average June (22 days)

LME averages are mean of buyers and sellers except for settlement and 3 months sellers.

	June 2016	June	
	Low	High	Average
	\$	\$	\$
Copper Grade A (\$)			
Cash	4,310.25	5,102.50	4,630.26
3 months	4,320.25	5,070.25	4,637.35
Settlement	4,310.50	5,103.00	4,630.64
3 months seller	4,320.50	5,070.50	4,638.09
Copper Grade A (£)			
Settlement	3,005.51	3,595.26	3,263.63
3 months seller	3,012.06	3,598.54	3,266.59
Tin (\$)			
Cash	13,225.00	17,622.50	16,980.80
3 months	13,212.50	17,497.50	16,942.50
Settlement	13,235.00	17,625.00	16,985.23
3 months seller	13,225.00	17,500.00	16,962.73

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	June 2016		June
	Low	High	Average
	\$	\$	\$
Lead (\$)			
Cash	1,596.50	1,896.25	1,713.60
3 months	1,597.50	1,887.75	1,719.78
Settlement	1,597.00	1,896.50	1,713.91
3 months seller	1,598.00	1,888.00	1,720.41
Lead (£)			
Settlement	1,098.84	1,340.38	1,207.59
3 months seller	1,100.75	1,333.90	1,211.29
Zinc (\$)			
Cash	1,453.25	2,102.25	2,022.59
3 months	1,466.50	2,097.50	2,027.80
Settlement	1,453.50	2,102.50	2,023.00
3 months seller	1,467.00	2,098.00	2,028.48
Aluminium (\$)			
Cash	1,452.50	1,672.75	1,591.83
3 months	1,451.25	1,674.50	1,600.51
Settlement	1,453.00	1,673.00	1,592.20
3 months seller	1,451.50	1,675.00	1,600.91
Aluminium Alloy (\$)			
Cash	1,492.50	1,610.00	1,527.61
3 months	1,535.00	1,625.00	1,556.36
Settlement	1,495.00	1,615.00	1,532.50
3 months seller	1,540.00	1,630.00	1,561.36
Nickel (\$)			
Cash	7,705.00	9,552.50	8,911.70
3 months	7,737.50	9,570.00	8,957.27
Settlement	7,710.00	9,555.00	8,915.45
3 months seller	7,750.00	9,575.00	8,961.59
Nasaa (\$)			
Cash	1,650.00	1,739.50	1,679.92
3 months	1,667.50	1,760.00	1,703.82
Settlement	1,651.00	1,740.00	1,684.16
3 months seller	1,670.00	1,765.00	1,708.27
Cobalt (\$)			
Cash	21,702.50	24,000.00	23,794.77
3 months	21,800.00	24,000.00	23,789.77
Settlement	21,705.00	24,250.00	23,925.91
3 months seller	21,850.00	24,500.00	24,040.91
Molybdenum (\$)			
Cash	11,500.00	16,750.00	15,822.73
3 months	11,500.00	16,750.00	15,822.73
Settlement	11,750.00	17,000.00	16,072.73
3 months seller	11,750.00	17,000.00	16,072.73
Steel Billet (\$)			
Cash	75.00	312.50	239.77
3 months	90.00	315.00	246.59
Settlement	100.00	325.00	257.95
3 months seller	115.00	340.00	264.77
LME Settlement Conversion Rates			
\$/£	1.42		
\$/yen	105.47		
\$/€	1.12		

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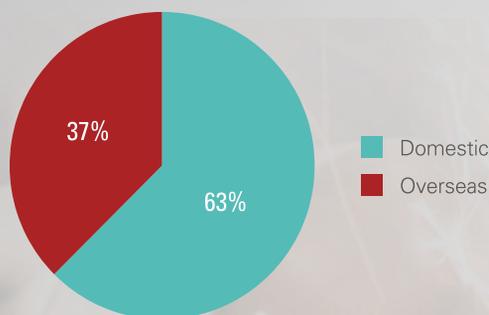
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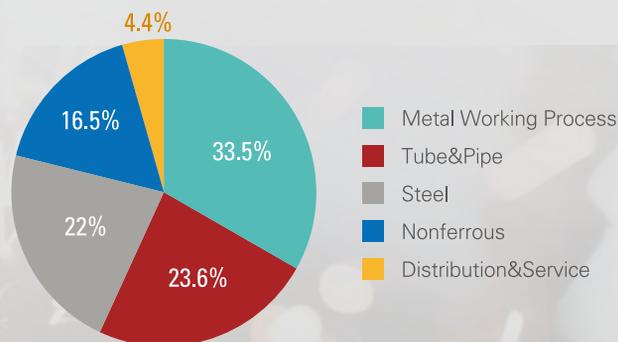
Leading Exhibitors (Last Show)

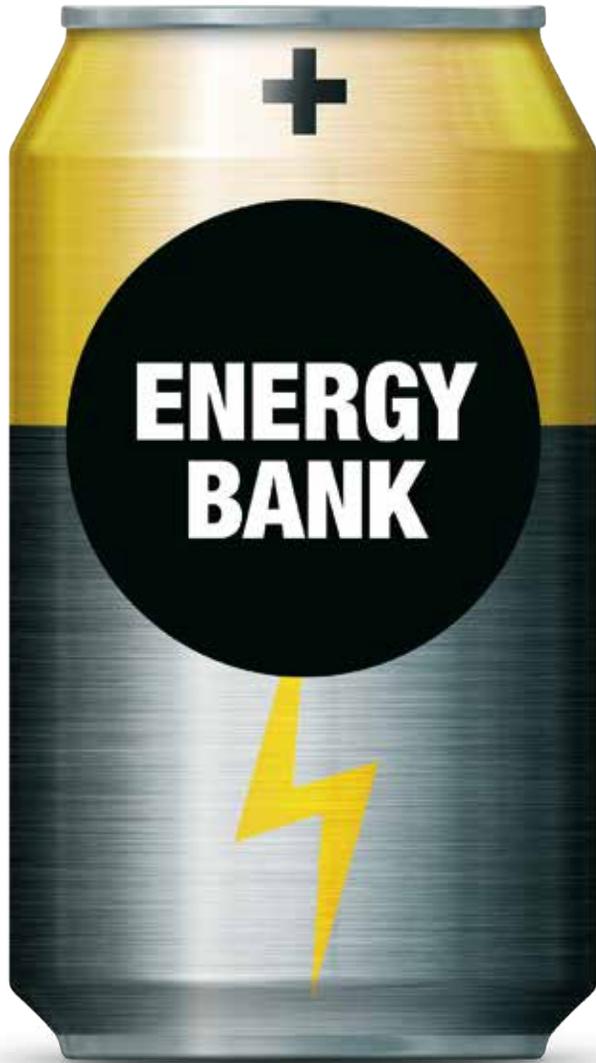
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