India rising: Can India's steel industry deliver on years of promise?

A REPORT BY GLOBAL BUSINESS REPORTS FOR STEEL TIMES INTERNATIONAL

India has seen crude steel production increase by 47Mt or 174% since the start of the 21st century an average annual increase in output of 14.5%. It now ranks as the fourth largest producer in the world. Much of this growth has come from the private sector which now accounts for three-quarters of total production. This Special Report compiled in India by Global Business Reports reveales through interviews with key industrial players how this remarkable growth has been achieved. Additional articles review India's passion for small and large scale DRI plants, its vast ore reserves but troubled development of these and how a 105 year old steel site has moved into modern times. **By Joseph Hincks and Pavlina Pavlova ***

Picture courtesy of Flickr: Himanshu Sarpotdar

Built in the days of the British Raj, the 'Gateway to India' is an impressive monument on the shore of the then city of Bombay – present day Mumbai – and remains a symbol to welcome foreign investment into India

Steel – The gateway to India's industrialisation

From the arrival of the Qilin in Nanjing, who were thought to herald the absolute harmony of the Yongle Emperor, to Halley's Comet foretelling the victory of William the Conqueror, portents of prosperity have transcended history and culture.

Today, the conventional assessment of a country's performance begins with reference to its Gross Domestic Product (GDP). GDP, however, is a rather turgid measurement. Examining a country's steel industry provides a more dynamic and expansive means of forecasting its economic future. Steel consumption per capita is directly related to the condition in which a population lives: it can be broken down regionally to depict discrepancies in economic development, it reflects patterns of urbanisation, infrastructure spend, the state of industry and manufacturing capacity. "Steel production and consumption is accepted as a barometer of any country's progress," says Dr Amit Chatterjee, consultant and former advisor to the managing director of Tata Steel, Jamshedpur.

In the case of India, an examination of the steel industry is particularly instructive. The country is now the world's third largest steel consumer yet, while production has increased steadily since economic liberalization, consumption per capita in India remains remarkably low. Average Indian steel consumption in 2011 stood at around 55kg per person per year, compared to the global average of 206kg and more than 500kg in mature economies countries such as the USA and Japan. What is especially relevant is that rural Indians, who constitute more than 70% of the country's population, consumed on average just 9.78kg in 2011 according to Sushim Banerjee, director general of Institute for Steel Development and Growth (INSDAG). For India to truly become a global leader in steel production, it must access its domestic market; meaning this figure has to increase drastically.

Dr Amit Chatterjee former Technical Director Tata Steel and recently retired advisor to the MD

In a sense, China's Qilin has already arrived. China reported produced of 695.5Mt of crude steel in 2011 (this figure being only that officially recorded) compared to India's 72.2Mt in that calendar year (**Table 1**). Once skyrocketing, China steel demand is expected to decelerate and the steel rolling industry is expected to experience stable but comparatively lower growth from 2012 to 2016.

Despite the obvious growth potential of Indian steel production and consumption, the trajectory of the country's steel industry over the next few years is more difficult to predict. On the one hand, India has signalled its intent through investing heavily in giant steel mills, continuous modernisation and the upgrading of old plants. Expectations are tempered, however, by concerns over access to raw materials, a complex land allocation process, and questions over the ability of India's infrastructure to keep up.

A roadmap to success

Economic reforms in 1991 ushered in a new era of growth and new capacity was piled onto India's steel scenario. Yet despite a succession of high profile investment announcements, the pace of development, especially relative to that of China, did not befit that of a waking giant. Although India's impressive economic growth rate made the country appear an ideal destination for FDI, discouraged investors repeated similar complaints: infrastructure was absent;

*Global Business Reports

ports and roads were needed; and things in the country just happened too slowly.

In 2005, the Indian Government, in its new role as a facilitator, came up with a directive that promised a solution: The National Steel Policy 2005. The policy envisaged steel production reaching 110Mt by Financial Year (FY) 2019-20 with an annual growth rate of 7.3%.

The 2005 Steel Plan was largely successful and by 2007 new investment had propelled India towards becoming the fifth largest producer of steel in the world and the largest producer of direct reduced iron (DRI, also referred to as sponge iron) in the world.

At the time of writing, the National Steel Policy 2005 was being reviewed in light of the rapid developments on both the supply and demand side of the domestic steel industry. The new steel policy, released in June 2012, will set production targets far exceeding those of the 2005 plan.

Based on an estimated infrastructure spend of nearly US$1tr, the projected growth of India's manufacturing industries, an increase in the country's urban population to 600 million by 2030, and the emergence of the rural market for steel consumption, the Ministry of Steel's Working Group on Steel for the 12th Five Year Plan April 2012-17 has projected that crude steel capacity in India is likely to reach 140Mt by FY2016-17. Furthermore, memorandums of understanding (MoUs) signed by private producers with the various state governments indicate that capacity might exceed 200Mt by 2020.

"The next five year plan includes infrastructure investment, financed by taxes on the steel industry, and commitment to research and development," the Joint Plant Committee told us. "In general, we expect demand to grow at around 8.5%, although this year the manufacturing sector slowed down slightly and growth will only be around 6%."

Table 2 shows apparent steel consumption (ie Production + Imports – Exports) of carbon steels since 2000. Consumption has grown over the period by 36.5Mt or 130% an average annual growth in demand of 10.8%.

Raw materials for steelmaking

India's growth prognosis should, in theory, prove a huge spur for foreign direct investment (FDI) in the steel industry. Yet a simplistic inclusion of just infrastructure plans and domestic market potential is not enough; an examination of industry sentiment elicits a more multifarious response. Indeed, each one of the vital ingredients for steelmaking – iron-ore, coking coal, and, we must not forget land, – is in its own way, compromised in India.

Land

Back in 2005, Lakshmi Mittal, the head of the world's largest steel company ArcelorMittal rescinded on an alleged promise he had made never to do business in his own country and flew into the state of Jharkhand to announce a $9bn investment to build a greenfield steel plant with a 12Mt/y production capacity. In June of the same year, the South Korean company, Posco, the world's fifth largest steel maker, signed a MoU with the Orissa (now renamed Odisha) government for an eventual investment of $12bn for setting up a steel plant in the state. At the time, this represented the largest FDI in Indian history.

Financial year (April-March)	Quantity (Mt)
2000-01	26.89
2001-02	27.94
2002-03	30.44
2003-04	34.25
2004-05	38.49
2005-06	46.46
2006-07	50.82
2007-08	53.86
2008-09	58.44
2009-10	65.84
2010-11	69.58
2011-12	73.79(p)

Source: Joint Plant Committee (JPC)

(p) Provisional

Table 1 Crude steel production in India (Million metric tonnes in Financial Year)

Financial year	Quantity
1999-00	28.03
2000-01	28.00
2001-02	29.19
2002-03	30.63
2003-04	33.62
2004-05	37.73
2005-06	43.91
2006-07	49.67
2007-08	55.23
2008-09	55.09
2009-10	60.00
2010-11*	64.56

*Provisional

Source Steel Scenario Yearbook

Table 2 Apparent steel consumption of carbon steels by Financial Year (Mt)

Product	Production for sale	% change over prev FY
Cold Pig Iron*	5881	1.66
of which ISP's	502	(-)13.30
Secondary	5379	3.32
Less IPT/Own consumption	98	(-)2.97
Production for sale	**5783**	**1.74**
Sponge Iron (DRI)	24 834	(-)2.00
of which ISP's	--	--
Secondary	24 834	(-)2.00
Less IPT/Own consumption	4462	1616.15
Production for sale	**20 372**	**(-)18.78**
Carbon Finished Steel	77 946	9.33
of which ISP's	17 577	(-)3.27
Secondary	60 369	13.64
Less IPT/Own consumption	9016	27.96
Production for sale	**68 930**	**7.28**

Notes: *Surplus of steel making requirements supplied to foundries.

Source : Joint Plant Committee (P) = Provisional

Table 3 Saleable product in FY 2011-12 (kt)

ArcelorMittal and Posco's monumental investments reflected the optimistic climate in which they were conceived. However, as of February 2012 neither project had begun substantial construction and, at the time of writing, Lakshmi Mittal has suspended activities on all proposed projects in India and Posco is still awaiting the land allocated to its mill to be approved pending various counter claims and environmental concerns.

In Posco's case, of the 4004 acres required for the project 3586 acres belong to the state and approvals pertaining to forested land in particular have been shunted back and forth between the federal and state governments.

"There is no point in selling India as an investment destination at Davros when the investments which have already come are facing multiple problems and not able to move forward," vice president corporate affairs Posco India, Vikash Sharan, told journalists in January 2012.

Although in many ways India's democratic approach to land allocation is to be lauded, the government must be seen to be taking steps towards streamlining the process if it expects to garner future greenfield project investment.

"Land acquisition is a problem and is the main reason for investors shifting their focus to brownfield projects. The governments of the five or six states that are major steel producers need to make brave decisions, otherwise India will not have an industry. We are hopeful of a practical approach being taken," India's government supported Joint Plant Committee told us.

In February 2012, signs were emerging that Posco could soon see a resolution to some of these land issues, and there are hopes that the new steel policy will expedite a more efficient approach to land acquisition. Purshopam Agarwal, vice president, projects advisory and structured finance, of SB Capital Markets at the State Bank of India is optimistic about future foreign investment in the country. "I think we will see more foreign steel players in India in the near future," said Agarwal. "Everybody is eyeing India in terms of further growth in business. With some more clarity in terms of policy issues, I am hoping more and more players will be interested in coming here."

Coking coal

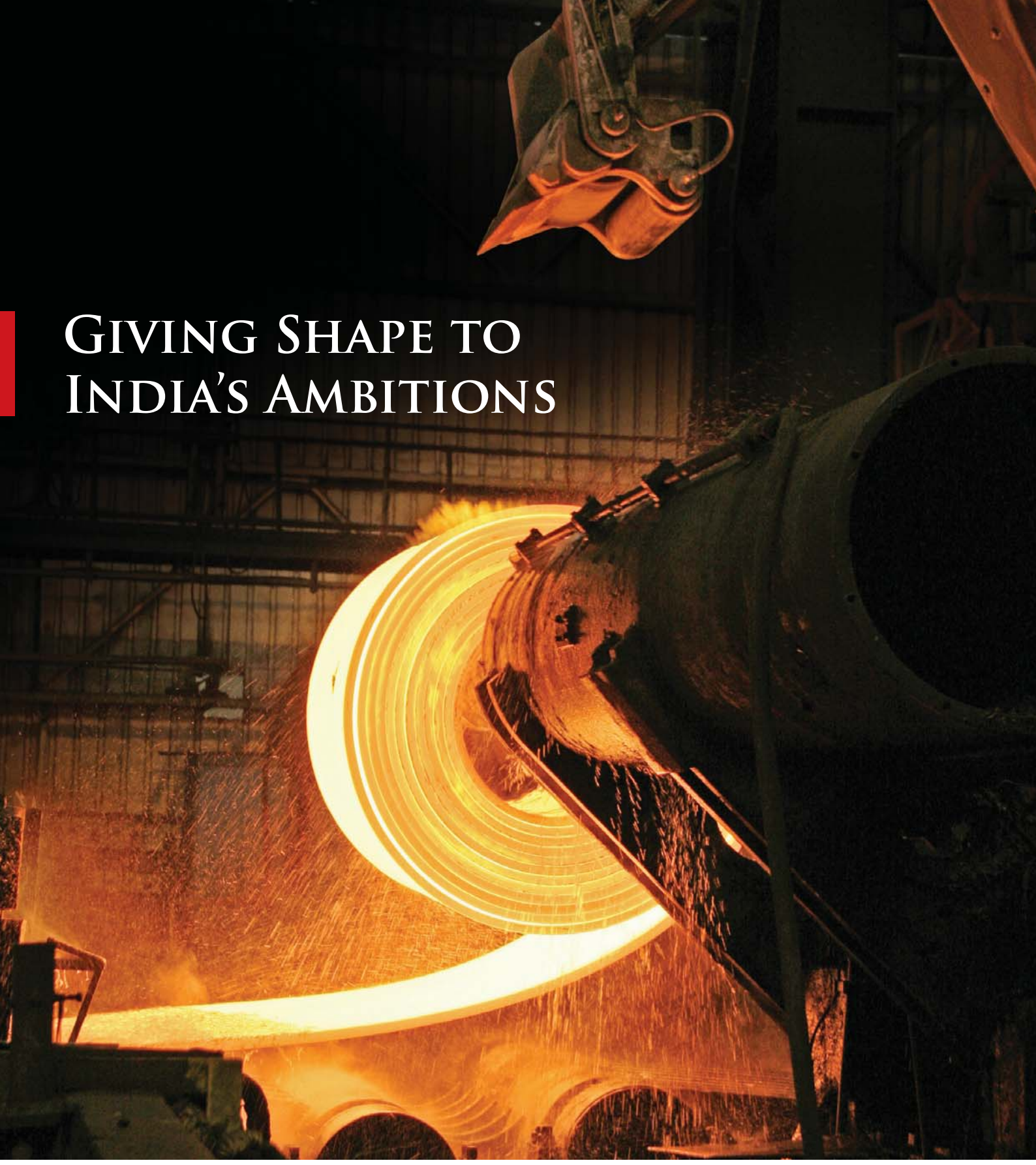
Land access issues may have accounted for the delays in India's greenfield projects, but they were not the sole constraint on the Indian steel industry's growth in 2011; a look at the production figures of India's largest steelmakers in 2011 reveals that constraints were felt even by long established plants (**Table 3**).

India has abundant thermal coal resources, yet deposits of coking coal are scarce. Most of the country's coke requirement, a vital input for the conventional blast furnace method of steelmaking, is met by imports of hard coals for coking.

Modern steel producers have always been somewhat vulnerable to raw material price fluctuations but in 2011, high coking coal prices, driven by factors such as the Queensland floods and augmented by the depreciation of the Indian rupee, exerted particular pressure on steel industry profit margins.

"The recent depreciation of the rupee has resulted in a spike in coking coal prices in Indian rupee terms at about INRs.23 000/t ($408.5) compared to about INRs19 000/t (US$337.4) in the corresponding period last year," the Stock Market Review reported in December 2011. "Higher raw material prices are expected to keep the cost of production high even in the weak demand scenario and may make it difficult for companies to pass on the higher cost to consumers. This is likely to put pressure on the margins and cash flows largely in the case of non-integrated companies."

Indian steel producers have moved to insulate themselves from the effects of coking coal price volatility in two distinct ways: through backward integration, acquiring coking coal assets domestically and overseas, and through investing in technology. As part of its modernisation programme, for example, India's largest steel producer state-owned Steel Authority of



JSW Steel, the flagship company of the JSW Group with installed capacity of 14.3 MTPA is one of India's largest steel producers. JSW Steel is building on its leadership position through continous innovation and is committed to support India's ambitious growth agenda.

JSW Steel
Bringing alive a billion dreams

Jindal Mansion, 5A, Dr. G. Deshmukh Marg, Mumbai - 400 026.

www.jsw.in

V R Sharma CEO & deputy MD, steel business, JSPL

Nearly a quarter of India's steel was produced in small scale induction furnaces in 2011 Pic courtesy Inductotherm India Ltd

	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	FY 10-11
Coal Based	7.278	11.012	14.142	16.050	16.821	17.065
Gas Based	4.542	5.264	5.845	5.280	6.172	6.190
Total	**11.821**	**16.277**	**19.987**	**21.330**	**22.993**	**23.255**

Table 4 DRI production in India (Mt)

India Ltd (SAIL) has taken steps towards reducing coking coal use in its existing plants. "We are targeting higher filtration (washing the coal to lower the ash content), reducing the need for coke and thus coking coal," said Anirban Dasgupta, SAIL's deputy general manager in the Chairman's secretariat. "Secondly, we are trying to develop technologies to use more of semi-soft and non-coking coal in the plant so our dependence on prime coking coal comes down."

Some of the most promising technologies will be discussed later, but most solutions mooted for India have the use of direct reduced iron (DRI) for steelmaking at their core.

India has championed the DRI route to steelmaking to a greater extent than any other steel-producing nation. There are now estimated to be 1275 induction furnaces spread across India which are used to melt a blend of coal based DRI and scrap. Although each operation is small scale, a total of 17Mt of coal based DRI was produced in FY 2010-11 contributing 24.4% of all production. Add to this 6.19Mt of gas based DRI production and the full contribution of DRI grows further to 33.4%. DRI-based production has increased dramatically; from essentially zero in 1980 to 23.2Mt in FY2010-11 (**Table 4**). India is now the world's largest producer of DRI. A conventional blast furnace is economically viable only for plants producing over 1Mt of steel per annum, whereas DRI-based production has allowed small producers to thrive in India. The Sponge Iron Manufactures Association, for example, which represents the Indian DRI industry, currently has 94 members.

For India's larger producers, the DRI route has provided something of a hedge against coking coal price volatility. Jindal Steel and Power (JSPL), for example, one of the four Jindal group entities, operate using both the conventional blast furnace and DRI route to steelmaking at its plant in Chattisgarh state. "Having compared costs, we believe that DRI is a cheaper route to manufacture steel than importing large quantities of coking coal, although like most Indian companies we will mix our methods," said VR Sharma, CEO and deputy managing director, steel business, at JSPL. In fact, the company is India's largest producer of coal based DRI by far making 13.19Mt last financial year representing 77.3% of India's coal based DRI production.

India is unusual in relying so heavily on coal to produce DRI. In calendar year 2011, a total of 73.3Mt of DRI was produced worldwide of which 17.3Mt was made from coal or 23.6%. Of this coal based DRI, India produced around 17Mt or 98%. More will be said regarding the technology of this process later.

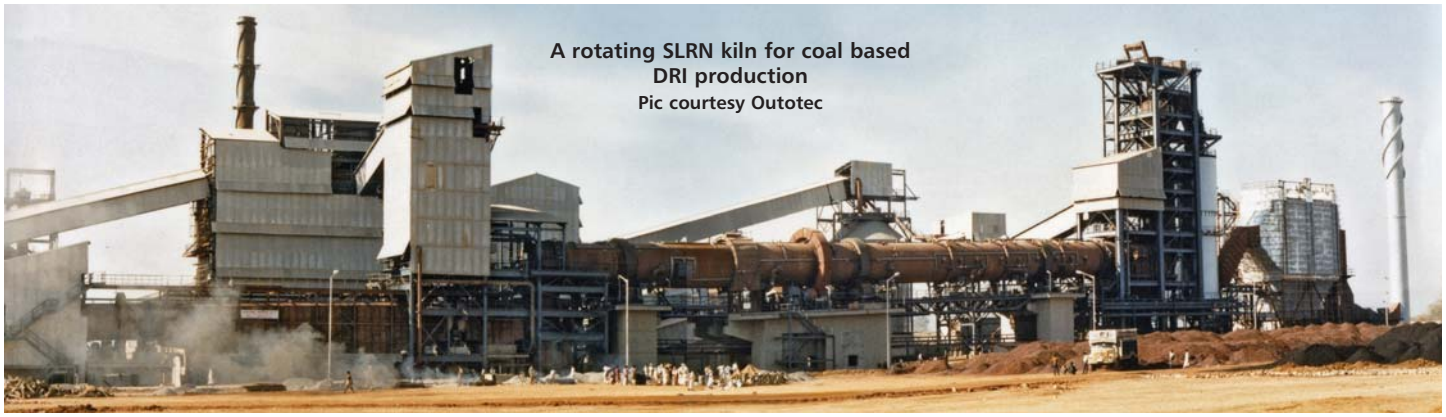
Even with DRI use becoming more prominent in the Indian steel scenario, producers will continue to depend to a large extent on imported coking coal. However, with Mozambique becoming an increasingly viable source, Australia taking steps to protect its mines from flood damage, and Indian players such as NMDC, NRE Gujarat, and GVK Power having already entered the Australian mining space, there are encouraging signs that the Indian steel industry will be less vulnerable to price volatility going forward. "With the arrival of American and Russian mining companies, the dominance of Australian firms is reduced, and in the past six months prices have gone down from more than $300 to $200/t. I think Indian prices should reach $160 to $180 and if they do, coking coal will no longer be a great concern," JSPL's VR Sharma told us. However, a caveat to this should be that rising resource nationalism in Indonesia, a key coking coal supplier to India, is causing increasing concern, as is the depreciation of the Rupee against the US dollar.

Iron ore

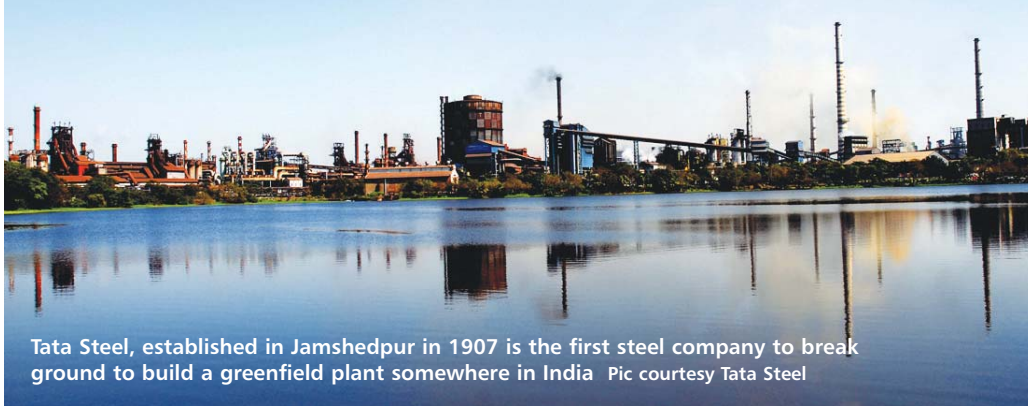
In part driven by strong Chinese demand for iron ore and the commodities resultant profitability, illegal mining has flourished in India. Even authorised miners have faced a litany of charges in India's ore-rich states, including unregulated encroachment on forest areas, underpayment of government royalties, and conflict with tribal groups regarding land rights.

In 2010 the Indian government launched investigations in the states of Karnataka, Orissa, and Goa in an attempt to stymie illegal mining. The investigations are ongoing in Goa, and have led the government to impose mining bans in Karnataka and export restrictions in Orissa. Such restrictions have translated into supply constraints for many of India's steelmakers. Karnataka, which accounts for around 30% of India's steel output and about 25% of the country's iron-ore exports, has been especially hard hit.

Around 80% of sponge iron units in Karnataka remained closed at the end of 2011, and sponge iron units in other states were affected by either a straightforward lack of availability, or scarcity induced high pricing of iron ore. The lack of iron ore was compounded by a short supply of thermal coal. "As things stand today, the future of the Indian sponge iron units, particularly the stand alone units, appears to be very bleak," said Dr Kashiva, executive director of the Sponge Iron Manufacturers Association. In addition, new Standards for construction rebar – the major market for induction furnaces melting sponge iron – are to be implemented in September which will be difficult to meet by these small scale producers.



A rotating SLRN kiln for coal based DRI production
Pic courtesy Outotec



Tata Steel, established in Jamshedpur in 1907 is the first steel company to break ground to build a greenfield plant somewhere in India Pic courtesy Tata Steel

In a move that some many consider reminiscent of pre-liberalized Indian economics, the government has become increasingly involved in India's mining scenario. In February 2012, the Supreme Court-appointed Central Empowered Committee (CEC) recommended that an artificial ceiling of 30Mt/y be applied in Karnataka's ore production based partly on fears – unwarranted according to commentators such as the Indian Bureau of Mines – that the state might run out of iron ore resources in 15 to 20 years time. At the time of writing, the mining industry, under the aegis of the Federation of Indian Mineral Industries, was preparing to appeal to the Supreme Court to permit 'A' category mines in Karnataka, those in which no illegality or marginal legality was found, to resume work immediately. At present, only the state owned NMDC is permitted to continue mining operations in Karnataka.

In parallel with the mining restrictions, the Indian government raised export duty from 20% to 30% in early 2012. The export duties are intended to advantage Indian steel producers by ensuring that they are able to compete for the country's now artificially limited resources.

Although the iron ore production limit of 30Mt from Karnataka meets the current domestic requirement for steelmaking and pig iron production, the ban on exports is costing Karnataka and Indian Railways, who move the ore, around $2.2bn per year, and the loss of export taxes alone accounts for nearly $1bn. India is the third largest exporter of iron ore in the world, with exports primarily feeding the Chinese market. India produced 260Mt of iron ore in 2009, but this fell to 190Mt in 2010, and exports from major ports were down 35% year on year in November 2011.

The bans may have served their immediate purpose of enabling Indian steel producers to compete with overseas buyers for iron ore supplies, but they have also impacted investment in new mines. New projects face difficultly in accessing funds if raw material supplies have not been secured. "Raw material availability is one of the most important aspects we consider when carrying out due diligence for a project," said Purshopam Agarwal, vice president, project advisory and structured finance, SBI Capital Markets at the State Bank of India. "In the past, the availability of raw materials, especially iron ore, was taken for granted. Of late, due to the environmental and other related issues, the situation has changed significantly. All government clearances on the supply side should be in place to ensure the viability of a project."

Further details on iron ore reserves and the political ramifications of their control are discussed in a separate article in this issue.

Steel giants

SAIL

Public sector Steel Authority of India Ltd (SAIL) is India's largest integrated steel producer, currently holding a market share of around 17% to 18% of the country's steel production. Throughout its history, SAIL has not only contributed significantly to India's production portfolio, but also to a large proportion of its steelmaking expertise. "Many of the people who have headed other major industrial companies came from SAIL. Many engineers and technicians groomed in SAIL have learned steelmaking and then gone on to work in other steel companies," said SAIL's deputy general manager in the Chairman's Secretariat, Anirban Dasgupta.

SAIL's previous large-scale expansion occurred in 1995-96, when the company modernised its plants at Durgapur and Rourkela. Buoyed by India's demand scenario, SAIL is currently undergoing a round of expansion that will take its production capacity of finished steel into the region of 23.5Mt/y, and its crude steel capacity to around 20Mt/y.

Meeting projected demand and increasing market share is not the only driver in the current round of expansions. "The second precondition was the need to modernise our facilities," said Anirban Dasgupta. Over the past five years SAIL has increased production by roughly 11%, mainly through enhancing process efficiencies. However, some of SAIL's current facilities were installed in the late 1950s and many – such as IISCO – are reliant on now obsolete production processes. In addition to adding about 10Mt/y of capacity, SAIL plans to phase out 3Mt/y of its under-performing assets: 2.5Mt/y at its Bhilai steel plant and around half a million at its Burnapur plant.

As part of its modernisation programme, SAIL will be employing various technologies to reduce coking coal consumption at its plants and therefore insulate itself against volatile pricing. SAIL is collaborating with Japanese giant Kobe Steel for the installation of new technologies, and notably with Korea's Posco around the installation of Finex technology which can use fine ore and non-coking coal as the raw material feed (this technology will be discussed later).

Table 5 shows crude steel production by SAIL and privately owned plants

Tata steel

Established in 1907 in Jamshedpur NE India, Tata Steel was India's first industrial steel plant (Indian Iron had set up a blast furnace at Kulti – near Asansol, West Bengal – a little earlier but without steelmaking facilities). Today, its production places it in seventh place among global steel companies with an annual crude steel capacity of over 28Mt/y. In calendar year 2010 it produced 23.2Mt of crude steel across its Indian and international operations. Following its acquisition of the UK-Dutch Corus Group, it is now one of the world's most geographically-diversified steel producers, with operations in 26 countries and a commercial presence in over 50 countries.

The Tata Steel Group, had a turnover of US$ 22.8bn in FY'10, and has over 80 000 employees across five continents and is a Fortune 500 company.

Tata Steel's larger production facilities include

FY	Public sector								Private sector			
	BSP	DSP	RSP	Bok	ISP	ASP/ VISL	Total Sail	VSP RINL	Tata Steel	Others	Total Private	Grand total
06-07	4.789	1.869	1.990	4.067	0.472	0.309	**13.505**	3.497	5.174	28.640	33.814	50.816
07-08	5.055	1.914	2.093	4.127	0.458	0.315	**13.962**	3.129	5.014	31.753	36.767	53.858
08-09	5.184	1.888	2.082	3.578	0.417	0.264	**13.413**	2.963	5.646	36.419	42.065	58.441
09-10	5.109	1.966	2.128	3.599	0.400	0.308	**13.510**	3.205	6.564	42.562	49.126	65.841
10-11	5.329	1.961	2.160	3.593	0.411	0.308	**13.762**	3.235	6.855	45.723	52.578	69.575

Notes: BSP Bhilia Steel Plant; DSP Durgapur Steel Plant; RSP Rourkela Steel Plant;

Bok Bokaro; ISP Indian Iron & Steel Co; ASP/VISL Alloy Steel Plant & Visvesvaraya Iron & Steel Ltd; VSP Visakhapatnam Steel Plant (Rashtriya Ispat Nigam Ltd – spun off from public sector to privatise

Table 5 Crude steel production by major integrated plants (Mt)

Sail is close to commissioning a new 500kt/y wire rod mill and a 3.88Mt/y sinter plant at its IISCO Steel Plant (ISP) at Burnpur in the eastern state of West Bengal
Pic Courtesy Sail

Jindal South West is India's largest private sector steel company in terms of installed capacity and one of the lowest cost producers in the world Pic Courtesy JSW

Prashant Jain JSW Steel's head of corporate strategy

those in India, the UK, the Netherlands, Thailand, Singapore, China and Australia. Operating companies within the Group include Tata Steel Ltd (India), Tata Steel Europe Ltd (formerly Corus), NatSteel, and Tata Steel Thailand (formerly Millennium Steel).

Within India, Tata Steel started construction of a greenfield integrated site at Kalinganagar, Orissa state in January 2011. This is the first greenfield project to be started in India for many years. Phase 1 of production due to start in 2013-14 will have a capacity of 3.5Mt/y and the second phase, to be commissioned in 2015, will increase this to 5.5Mt/y. The plant will produce flat products.

At Tata's Jamshedpur works Jharkhand state, north east India, output reached 3.54Mt of crude steel and 3.46Mt of saleable steel in FY 2010-11, up 8.1% year-on-year. The company is investing in new plant at Jamshedpur including a second roller hearth furnace for its thin slab caster and rolling line.

Tata Steel has signed an agreement with Nippon Steel Corp to form a joint venture to build a continuous annealing and processing line (CAPL). The CAPL will have a production capacity of 600kt/y and should start operating in 2013. The two companies plan to discuss further collaboration in fields such as galvanizing lines for auto sheet or upstream operations.

JSW Steel

The Jindal Organization, set up in 1970 by the steel visionary O P Jindal and today incorporating Jindal Stainless Ltd, Jindal SAW Ltd, Jindal Steel and Power Ltd (JSPL) and Jindal South West (JSW) Steel Ltd, is regarded as one of India's most important steel powerhouses. The group has grown from an indigenous single-unit steel plant in Hisar, Haryana into a multi-billion dollar, multi-locational and multi-product steel conglomerate.

Today, JSW Steel, headed by Sajjin Jindal, is India's largest private sector steel company in terms of installed capacity and one of the lowest cost steel producers in the world. However, the journey has not been easy for the group. Building on the Jindals' expertise in the steel sector, JSW's former incarnation Jindal Vijayanagar Steel Ltd set up its first plant in the Bellary-Hospetarea in the south-west state of Karnataka in 1995. Following the Asian financial crash of 1998, however, and the bursting of the dot-com bubble around 2000, the hot-rolled steel price dropped to $145 and the new player was in trouble.

"JSW made the mistake of investing during the peak of the economic cycle the first time round," said JSW Steel's head of corporate strategy Prashant Jain. "The management has (now) learnt to foresee market changes and adjusted our corporate strategy towards making investments during recession years when capital costs are cheaper."

JSW Steel's management did indeed learn from its first foray. In 2002, when the government and the national reserve bank came up with a corporate debt-restructuring scheme, JSW embarked upon a round of expansion, pioneering a green technology that did not require coking coal: the world's India's first Corex plant. "We set up a blast furnace in 2003, and since then have never looked back," said Jain. The works now operates two modestly sized blast furnaces each capable of producing 900kt/y and two C-2000 Corex units each with a capacity of 800kt/y.

Jain's analysis of market conditions has led JSW Steel to maintain its primary focus on the Indian market. "While demand rises, supply faces constraints: setting up new steel plants in India is not easy – there are serious land, social and infrastructure issues – which means that the country will continue to be a net steel importer," said Jain.

As part of its capacity increase programme, JSW is commissioning an extra 2Mt/y of capacity at its Vijayanagar plant in 2012-13, and the company aims to produce 34Mt/y by 2020, with greenfield integrated steel plants coming up in West Bengal and Jharkhand.

JSW steel has been one of the earliest movers in promoting steel use in India's rural areas. "When the industry opened up after economic liberalisation, steel only reached urban areas, and there was a further problem of poor knowledge of steel use in the countryside," said Jain. "The first thing JSW did was to improve steel availability: we placed stockyards in remote areas, with all of our products made available. Simultaneously, JSW has been promoting the use of steel, and our goal is to double our number of stockyards within 24 months."

Essar Steel

Essar Steel was one of the first companies in the private sector to move into steel production after the government liberalized India's economy in the 1990s. Although 80% of Essar Steel's business is local, Essar is present in over 30 countries, an attribute that Essar claims enables it to understand global business and how product portfolios change.

In India, Essar Steel is expanding its capacity from 4Mt/y to 10Mt/y, and is now in the stage of commissioning new plants and ramping up to production.

Like JSW, it is not forgetting the rural market. Through its pioneering distribution model, Essar Steel has taken the lead in addressing the discrepancy between rural and urban steel consumption. "We were the first to determine that the steel intensity of India was low compared to the rest of the world. This was not because there was no demand for steel, but because it was difficult for people to get hold of it," Essar Steel's former CEO and current board member Malay Mukherjee told us. "Our retail outlets are close to customers, with materials available in small packs, giving access to anyone within a five to 10km radius to quality products."

At the time of writing, Essar Steel had seven service centres located in India's industrial zones, and more than 375 retail centres. Larger retail outlets belong to the company, while smaller ones are franchised. "It is an ideal model that we believe works in creating steel intensity and availability to customers," said Mukerjee.

Bhushan Steel

While the mixed fortunes of large scale foreign investment into greenfield projects, such as that of ArcelorMittal and Posco, may have garnered much media attention, investment in the form of technical tie-ups between Indian steel-producers and foreign, particularly Japanese, companies, have enjoyed much greater success.

Bhushan, located in the state of Orissa, is unusual as a large scale producer in that it produces DRI using coal which is then melted in an electric arc furnace (EAF) which, unlike the induction furnace, permits refining to take place. Bhushan has eight DRI kilns each of 500t/day capacity.

The formation of the partnership between relative industry newcomer Bhushan Steel and Japanese giant Sumitomo in 1996 preceded the subsequent collaborations of Nippon Steel and Tata Steel, JSW Steel and JFE Steel, and SAIL and Kobe Steel. "Bhushan Steel was the first to realise the potential of this kind of arrangement," said Bhushan Steel's CFO Nithin Johari. "Our partnership with Sumitomo allowed us to enter into auto-grade steel in the first place."

The automotive market is considered to be one of the key growth destinations for Indian steel production, with the largest players now present in the country. Through its collaboration with Sumitomo, Bhushan Steel has penetrated more than most into the automotive sector's niche markets. "Steel is usually regarded as a commodity but we are not a commodity player," said Johari.

Expanding on the company's current range of flat products for the automotive industry, Bhushan Steel has signalled its intention to set up an advanced pickling line coupled with tandem cold mill and continuous annealing line (PLTCM & CAL) facility at Orissa, with a capacity of 2Mt/y. This line will cater to the requirements of the automobile industry: by increasing the strength of steel, thinner sections can be used thus reducing the weight enabling reduced fuel consumption. "We have already finalised the technology side, and are now working on the engineering, and we will start physical construction sometime in January

JSPL - Going Global

Jindal Shadeed Iron & Steel plant at Oman, Asia

Jindal Steel & Power Limited (JSPL), a part of the about US$ 15 billion diversified O.P. Jindal Group, is consistently tapping new opportunities by increasing production capacity, diversifying investments, and leveraging its core capabilities to venture into new businesses. JSPL has a state-of-the-art plant at Raigarh, Chhattisgarh which can produce up to 3 MTPA of steel with plans to scale it up to 7 MTPA. The company is also setting up 6 MTPA steel plants each at Patratu in Jharkhand and Angul in Odisha.

Bolivia (South America)

Jindal Steel Bolivia has acquired development rights for the 20 billion tonne EL Mutun Iron Ore Reserves and plans to invest US$ 2.1 billion in the next few years. It will be setting up an integrated 1.7 MTPA Steel Plant, a 6 MTPA Sponge Iron Plant, a 10 MTPA Iron Ore Pellet Plant and a 450 MW Power Plant.

Oman (Middle East)

Jindal Shadeed Iron & Steel Co. LLC has installed a 1.5 MTPA gas based Hot Briquetted Iron (HBI) plant with an investment of US$ 500 million and has already started commercial production. The company will be setting up a steel plant and rolling steel mills in Oman in the next two years

Africa

Jindal Africa has established a significant footprint in the African continent through various exploration and mining activities in South Africa, Mozambique, Madagascar, Tanzania and Zambia. It is also exploring opportunities in the field of steel, power & cement production.

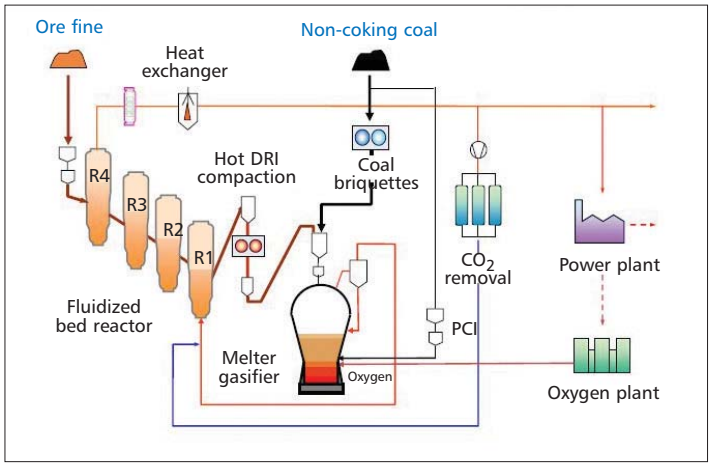
Driven by JSPL's vision and ideologies, Jindal Power Limited (JPL), a company promoted by JSPL, has earned the distinction of setting up India's first mega power project in the private sector at Tamnar in Raigarh district of Chhattisgarh. JPL has a project portfolio of 15,660 MW in various stages of operation, implementation and planning.

Jindal Steel Bolivia, Bolivia

JSPL Steel Plant, Raigarh (Chhattisgarh), India

Jindal Mining SA, South Africa

Corporate Office: Jindal Centre, 12, Bhikaiji Cama Place, New Delhi - 110 066 (India) | **www.jindalsteelpower.com**



Bushan Steel is operating eight coal based DRI kilns melting the product in an EAF

Process flow of Finex

2013," said Johari.

Bhushan Steel expects to be in the position to complete its project in Orissa in two and a half years from start of physical construction.

Engineering the future

Syngas

Of more than 350 DRI-based plants in India, all but seven make use of coal-fired rotary kilns. Rotary kilns are comparatively cheap and have allowed numerous SME's to enter into steel-making, however such kilns rarely exceed 200kt/y production capacity. Eventual steel quality is often compromised due to the use of ashy, sulphurous coal and low-grade iron ore lumps.

The DRI produced using coal has a lower carbon content of 0.2-0.3% than that produced by gas-based processes which makes it suitable for the production of rebar for the construction industry. However, the induction furnaces used to melt the DRI cannot refine the product in particular leaving it high in the detrimental elements sulphur and phosphorus by modern standards.

Gas-based DRI plants enable a much greater production capacity from a single site and on the surface appear to be an ideal solution. However, while India has abundant thermal coal, the country suffers from a shortage of natural gas required for the gas-fired process. This has forced steel makers to import LNG at high cost, negating the original benefit of avoiding the coking coal intensive blast furnace route, and has meant that just seven natural gas-fired shaft furnace plants, including six Midrex Direct Reduction Modules, have been installed in the country up to now. These are at Essar Steel, Gujarat, the former Ispat Industries (now JSW Ispat Steel following the taking of a 41.29% stake by JSW in December 2010), Maharashtra state, west India and Welspun Maxsteel also in Maharashtra.

In December 2009, Jindal Steel & Power Ltd (JSPL) announced its intention to construct a 1.8Mt/y Midrex DR plant with a Lurgi coal gasification plant to supply the reductant gas in Angul, Orissa. The Midrex module will pair commercially available gasification technology from Lurgi of Germany, with a 7.15m diameter Midrex shaft furnace to produce DRI as a feed to an electric arc furnace.

"In the long run, the Angul plant will have another gas based DRI. It will be based on the HYL/Tenova technology at a capacity of 2.50 Mt/y and one more Blast Furnace which will elevate the plant to 12Mt/y. We are expecting this quantity in Angul by 2017," said VR Sharma, JSPL's CEO and deputy managing director, steel business.

JSPL's project will be the first time a Lurgi gasifier is paired with a Midrex shaft furnace and will effectively enable the production of synthetic gas – or 'syngas' – from India's domestic thermal coal to be used in the steel-making process. "India is short of natural gas and it is impossible to produce DRI in the eastern part of the country based on natural gas. Therefore, for the first time in the world, JSPL has entered into a technological change for producing DRI by coal gas (syngas)," said Sharma.

Should JSPL's syngas project prove a success when it comes on stream in August 2012, it will represent another step change in reducing the industry's dependence on coking coal. JSPL also plans to install India's first HIsmelt plant by 2014. The product of a joint venture with Rio Tinto. HIsmelt could provide a more efficient means of consuming iron ore fines using local coals to produce hot metal. "I am sure this will prove to be the technology for tomorrow," said Sharma.

The Corex process also offers an alternative means of supplying gas to a DRI shaft furnace and such a coupling has been operating at Saldanha in South Africa for many years.

FINEX

Posco's beleaguered Orissa project is not only notable for the size of investment it entails. The Orissa facility is set to be the world's first steel plant to employ solely Finex technology.

Finex, developed by Posco in partnership with Siemens VAI, provides another means to bypass the need for coking coal and allows the direct use of iron ore fines and non-coking coal as feedstock. The process uses fine iron ore charged in a series of fluidised-bed reactors. The ore cascades down through each in turn meeting the hot reducing gases from a coal gasifier and melter below. The ore is reduced to DRI which is then hot-compacted and transferred to a charging bin positioned above the melter gasifier, from where it is charged by gravity into the melter gasifier where reduction is completed and it is melted. The tapped product, liquid hot metal, is equivalent in quality to the hot metal produced in a blast furnace or Corex plant.

Posco's technology promises a dramatic reduction of SOx and NOx emissions, and dust, as compared to the blast furnace route. This reflects the emphasis India is placing on environmentally friendlier production methods going forward. "In the past the focus was all on production rather than (preventing) pollution, but now new plants have to receive permission from environmental organisations," said Navinender Gupta, chief general manager at Korus Engineering Solutions. "Environmental considerations are an integral part of investment, without which you cannot get your plant to run."

While Finex has the potential to change the face of the Indian steel industry, it is still commercially being optimised. A 1.5Mt/y commercial plant started operations at Posco's Pohang Works in South Korea in April 2007 and the construction of a second 2Mt/y plant is under way at the same location. The industry's foremost engineers will be watching its application keenly. "From an environmental point of view it does make sense," said Dr Jens Kempken, SMS Siemag's executive vice president for strategic project development and an expert on methodological engineering. "Finex is a unique solution to the problem of what to do with this low quality, high ash coal... [but] the capital expenditure is enormous, especially for the coal specification. We shall see whether this pays off or not."

Pelletising ore fines

Of the few really large miners in India, many are steel producers with captive mines. However, more than 90% of India's mines are

owned by small merchant miners with mining capacities of around 1.5Mt/y. Kolkata based engineering company Hari Machines, in partnership with Siemens, has come up with a new pelletisation technology specifically targeted at small merchant miners with a pelletising need of 1Mt/y to 2.5Mt/y capacity. "Since we had already acquired technology in the field of beneficiation, grinding and pelletising, Siemens approached our group for a tie-up on smaller pelletising plants. This is the best venture we are involved in, particularly in light of the government's restrictions on ore exports," Hari Machines' managing director Sabyasachi Mishra told us.

Initially focused on contract manufacturing, Hari Machines backwardly integrated into engineering when it became obvious the domestic steel industry would require more technical solutions to advance. "Hari Machines was based in Orissa from 1971, so the natural inclination was to get into mineral processing based industries," said Sabyasachi Mishra. "The idea was not to manufacture based solely on customers' designs but to provide complete solutions. In order to do this we needed engineers and industry leading technologies, so Hari Machines approached the global experts and formed joint ventures with them."

Hari Machines is an example of an Indian company that, through a combination of technical tie-ups and internal research and development initiatives, has moved up the value chain and helped equip the industry to face the demands imposed upon it. Hari Machines will set up the largest beneficiation plant in India for JSPL and has also supplied to Essar for their proposed beneficiation plant in Orissa.

Foreign engineering

Foreign engineering specialists have played an integral role in the Indian steel industry's development. Germany's SMS Siemag, for example, has been in India for the last 30 years, and has around 80% market share in steelmaking technologies and maintains a large workforce in the country.

As the market leader in plant engineering, SMS Siemag has come up with a variety of methods for optimising India's resources mix "The raw materials situation here in India is such that there is low quality iron ore that leads to a poor quality of hot metal," said Dr Kempken. "Therefore for the steelmaking plants that SMS has established in India we use Conarc technology."

Developed 20 years ago, Conarc is particularly suitable for the Indian steel scenario: of four plants in the world using the technology, three are in India and SMS recently provided a 2.5Mt/y Conarc furnace for Essar's Hazira steel complex.

The Conarc technology effectively combines the merits of an EAF with an oxygen converter (BOF). Indeed, the name is derived from 'CONverter ARCing'. It is a very flexible process in terms of both charge mix and energy use. Varying proportions of scrap, pig iron or DRI can be charged depending on the steel grade to be produced as well as according to the availability and prices of materials. An electric arc is used to melt the charge and an oxygen lance to decarburise the melt. And there is further flexibility when it comes to the type of energy used which can be electricity, coal or gas.

Another technology particularly appropriate to newly industrialised nations is SMS Siemag's Compact Strip Production (CSP) technology

which combines thin slab casting with an in-line rolling mill to produce hot rolled coil (HRC). This has also been employed in India as plants look to optimise capacity. "The key advantage is less capital expenditure: you do not need a big furnace, so there is less energy consumption for heating the slab and for rolling, and production yields are higher," Kempken explained.

As India ramps up its production and continues to modernise its processes, foreign engineering companies such as SMS Siemag, Siemens VAI, Danieli, and Outotec will continue to play a key role. In addition, in recent years, local engineering players have increasingly contributed to step-change innovation. "Up until now, steel grades have been imported and processed in India, however it is only a matter of time before India will do that on their own," Kempken told us.

Brand India

Partha Majumder, the founder of Eastern Metec, is one entrepreneur that has benefited from the rising profile of Indian engineers overseas. From an initial investment of around $5000 in 2006, Kolkata based Eastern Metec has reached an annual turnover of between $20M and $25M in just five years and has an extensive portfolio of overseas projects.

Eastern Metec focuses on the engineering of furnaces, and supplying coating, and casting equipment to the steel industry, as well as providing consultancy services. The company has prospered in both the domestic and international markets in part thanks to a series of successful collaborations with technology partners.

A commitment to research and development has been central to Majumder's business model. "We cannot follow Chinese companies who made European contacts, copied their technology and implement it in their own country," said Majumder. "In India we prefer to work together with international companies."

Eastern Metec has mainly collaborated with overseas companies on a project-by-project basis, but is now seeking longer-term partnerships as it expand its product offering into slab casting and rolling mill lines.

Indian specialist equipment suppliers are also gaining brand traction overseas. In January 2012, Indian company Jasch Industries, which specialises in gauging systems for flat products, augmented its growing global presence by acquiring one of its former competitors, Chicago-based Indev Gauging Systems. "Entering the market in the USA is challenging, so we acquired Indev to market our products in the States; thereby providing us with a local base for after sales service support for our gauges.," O P Garg, executive director at Jasch Industries told us.

Ramesh Iyer, Vice President business at NCDEX

In addition to the company's recent presence in the US, Jasch Industries has an almost 100% market share in India, Pakistan, Bangladesh and the Philippines for coating gauges for galvanizing lines, and an almost 90% market share in China, alongside a significant presence in Europe. The company is looking to ramp up its presence in the European market with another acquisition in the near future.

Jasch Industries' facilities include a research and development centre at its Sonepat factory with a staff of 78, incorporating 25 research and development specialists. "Jasch Industries products are not a onetime sale and so we need regular modernisation," explained Singh Chadha, "Everything, including the design of PCB's and even software, is done in-house."

In the past Indian specialist equipment was considered cost competitive but not necessarily of internationally competitive quality. This perception made it difficult even for Indian companies with quality products to gain brand traction. However, in part due to sustained investment in research and development and the success of products such as Jasch's gauges, 'Brand India' is gaining a much stronger reputation in global markets.

Steel futures

While volatile metal prices have had repercussions across the strata of the Indian steel industry, the country's steel traders are particularly vulnerable. The introduction of steel futures trading by financial institution NCDEX has offered traders a valuable hedge in the today's uncertain climate.

NCDEX, which is promoted by four leading Indian financial institutions: the Life Insurance Corporation of India; ICICI bank; the National Bank for Education and Rural Development; and Credit Rating and Information Services, has pioneered a price discovery and registration platform for steel.

Unlike base metals, there is little precedent for forward trading in ferrous metals: standardisation is difficult because steel is an alloy, and having a standard is a pre-requisite for any form of futures trading. Furthermore, steel has varied applications across many sectors, and it is challenging to bring so many disparate participants together. Steel producers worldwide have been, and continue to be, adverse to the idea of steel futures. "They are unwilling to surrender their prices to somebody else," Ramesh Iyer, vice president of business at NCDEX told us.

However, the Indian steel market is different. "Secondary steel companies comprise around 60% of the market. They are sandwiched between very volatile raw material prices and equally volatile finished product prices". Such small companies are vulnerable to changes in input costs but are generally too small to do anything about them. It is this segment that NCDEX took it upon itself to address. "While the primary industry followed the international example, the secondary producers embraced our contracts. These are small businessmen that know their limitations but wanted to be part of the steel industry so took to hedging in it," says Iyer.

NCDEX's futures contracts are compulsorily delivered, unlike some of the other exchanges, and see around 50 000t of goods exchanged per month. Steel futures give producers, intermediaries and end consumers a real-time indication

of price trends. One of the issues that make steel futures trading so challenging is the wide grades and possible applications. However, NCDEX has been able to overcome this by focussing on low carbon steel, which accounts for 70%-80% of steel consumption in India's largely construction-orientated market.

Black steel during chaos

Popular rhetoric has it thus: Old World Europe is locked in a debt crisis, and the former New World is absorbed in its own slow recovery. Economic power and influence have shifted east, and rests in the hands of the new New World: Asia, and in particular two formidable BRIC's: India and China.

However, this east/west dichotomy has its limitations. While European traders may have once rounded the Horn of Africa to acquire the bounties of India and China, their contemporary Chinese and Indian counterparts are unlikely to be guilty of such an oversight: Africa is not a continent to be circumnavigated.

African mines are an increasingly viable alternative to Australia for India's raw material constrained steelmakers. While Australia will continue to play a vital roll in supplying raw materials, and particularly coking coal, to India, never-the-less Indian steel producers have been aggressive in acquiring iron ore and coking coal assets in Africa. These include JSPL, JSW and Tata Steel in Mozambique, while Essar Steel has invested in Zimbabwe, and SAIL in South Africa.

'But the advance of Indian steelmakers' into Africa goes beyond basic acquisitions. Steelmaking sub-Sahara is practically limited to South Africa. There is a vast landscape in between, with a population of a billion people with very limited access to steel products. "We make a mistake by looking at Africa as just a resource base," Malay Mukherjee, former CEO of Essar Steel told us.

"Zimbabwe fits far more into our vision for Africa than it would be if we were just looking at a mine. In addition to getting a steel mill up and running, we will look at meeting demand by adopting our Indian model of service and retail centres," said Mukherhjee.

If India's producers and service companies are successful in navigating their own domestic challenges: complex land rights issues, infrastructure constraints, and extremely low steel consumption in rural markets, they will not only propel their economy forward and raise the material standard of living for millions, but also prove themselves uniquely equipped to service the highly prospective African market. It is precisely this struggle against challenging political, economic, and environmental conditions that has galvanized Indian steel players to take on the world. ■

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