Options for Improvement of the Ugandan Iron and Steel Industry

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ABSTRACT

This paper sets out to look at the state of the iron and steel industry in Uganda, comparing and contrasting the local position with that of other steel producers worldwide with the purpose of highlighting ways to improve the production processes and quality of the steel considering the existing resources and the possibility of their reinforcement using viable modern scientific methods of exploitation as justified by current market development trends. Data was collected through industrial visits and individual interviews at different steel mills, foundries and related metal products user industries and stakeholders. Extensive review of relevant literature has also been done. Overall, the Ugandan steel industry is dominated by local small-scale industrialists and a few medium to large -scale producers. Obsolete technology, lack of proper training and appropriate technology transfer initiative and absolute lack of research and development at enterprise level have held back productivity, capacity utilization, product diversification and enterprise advancement. The major raw material is scrap iron which is also getting scarce. Quality related issues have also not been effectively addressed to ensure that only standard and reliable products reach end users. The harnessing of existing raw materials and increased government significance in the exploitation of mineral resources deposits are aspects that the iron and steel industry needs address urgently.

KEY WORDS: Iron and Steel; iron ore, scrap; Steel industry; Uganda.

1.0 INTRODUCTION

The Ugandan iron and steel industry has been growing at unprecedented rates averaging from 20% and 30% per annum for imports and exports respectively between 2002 and 2006 due to the booming housing and construction sector in the region (URA, 2010). The industry is donned with a few companies which have been operating steel mills in the country over the years, first based on imported billets and later predominantly using scrap iron. From the 1960s to 1988, the Madhivani group ran East African Steel Corporation in Jinja carried out steel production. Steel Rolling Mills under the Alam Group of companies was also established at Jinja in 1987. BM Technical Services in Mbarara which is run by local entrepreneurship also began operations while more recently in 2002, Tembo Steel Mills was added to the list followed by several others.

These industries have enabled substantial import substitution, supporting the rapidly expanding building and construction sector and are the major reason why



ratio of the imported steel products to the exported ones has generally been reducing (Fig.1).

Fig. 1: Exports and Imports trends in Ugandan Steel Industry (UBOS, 2009)

Relying on basically scrap, these mills currently suffer from shortage of this raw material. Scrap which constitutes 70% of their raw material (Janke and Savov, 2000). This has negatively affected the quality of their products and led to fervent competition between them for scrap input, making their continued existence quite doubtful. None the less, a mini-mill type outlook backed by sponge iron technology has to be considered rather than the integrated mill option. Substantial state involvement seems to be inevitable, be it in policy environment design or in the facilitation of financial logistics.

1.1 World Steel Production

Global bulk steel production began in the late 1850's with the development of the Bessemer converter, until then; steel was expensive to produce and was only used because there was no other alternative. The innovation of scale of the Bessemer process facilitated cheap and efficient mass production of steel rails for railway lines and enabled the industrial steel production to increase sharply during the World War II when the US government issued large amounts of money in loans to fund new plants and expand existing ones so that by the end of war period in mid 1940's, the United States controlled 60% of the world's steelmaking potential. However, in due course, poor labor relations and deficient financial management added to lack of innovativeness led to the collapse of the US steel industry in the 1960's while in later years, competition from countries like Brazil and South Korea broke the industries' backbone as they dug deep into the American market.

Steel production in the USA in earlier times was almost exclusively from integrated mills; this situation has been quickly changing. Up to 1974, for example, there were 50 integrated steel mills in the United States; in 1994 however, there were only 23; most having disappeared from the scene by closing down or merging to form new major producers (Hogan, 1994). Mini-mills have since expanded as they had lower

start-up costs, greater freedom of location, and more flexible job organization. They also need less skilled workers and do not need to be located in particular areas since they are not dictated by iron ore deposits and yet require minimal investments.

The Brazilian steel industry on the other hand started with the commissioning of Sabará Works, an association between foreign and local investors with a 4.5 MTpa production. Similarly, in the 1950's, Usiminas, a joint venture between the Brazilian State and Japanese companies was led by the then Yawata Steel (now, Nippon Steel). During the 1960s, the steel industry in Brazil was given high priority by the government while the banks facilitated them with affordable credit. Today as the abundance of raw materials and availability of relatively cheap labor compared to the more developed countries complements this background, Brazil is quickly becoming a world steel producer; posting an increase in production of 5.6 million tons, a 22.4% rise between 1996 and 2006 alone. Brazil, for instance produced almost as much steel (2.7 MT) as the whole of Africa including the Middle East (2.75 MT), ISSB, 2010.

In China, most of the steel and iron making plants started in 1958. Their results were generally poor because of the extremely small scale production i.e. less than 0.6 MTpa. This was due to poor technology, lack of skills and poor management skills. China being a big importer of steel and steel products, import substitution with new home made steel would have required immense amounts of capital. New large steel works were out of the question. The immediate answer was in modern mini mills which required less capital, labor and energy with less pollution. The actual compromise between the quickly growing demand for steel and the vast financial requirements was actually to modernize and revamp the existing inefficient small and medium steel plants on the mini-mill concept. The Chinese small and medium steel industries currently account for more than 30% of the national steel production, forming an important link in the steel chain. The cumulative effect is actually that Chinese steel industry has been the world's fastest growing in the past two decades. The Chinese government remains intimately involved in its steel industry; providing significant subsidies in the form of favorable tax regimes, export credit support, research and development initiative and direct funding of new projects.

1.2 Problems Affecting the Ugandan Iron and Steel Industry

The major problems facing the Ugandan steel industry are low product quality and quantity and shortage of raw materials. While the lack of product standardization cannot be overlooked, the main shortcomings are associated with inconsistent chemical composition which ultimately precludes good mechanical properties. Shortage of steel scrap has caused stiff competition between the steel mills and has ultimately meant that low quality scrap is unavoidable; perpetuating poor quality of steel and threatening the very existence of the steel industry in the country. The installation of continuous casting steel rolling mills at Steel Rolling Mills, Jinja and Tembo steel Mills, Iganga has improved on the level of production. Because of old equipment, however, there are frequent breakdowns leading to low capacity utilization; averaging below 50%. Besides, workers luck proper technical skills; there being no serious linkages with research institutions to complement on quality and work skills. Furthermore, is the problem of intermittent power supply that is detrimental to the continuous casting process.

1.3 Steel Product Demand and Supply

The Domestic demand in steel is dependent on the growth of the domestic construction industry and due to Uganda's strategic location in the region, the local demand for steel products is also influenced by the general aggregate demand in the region (URA, 2010).

Steel mill	Productio	Installed	Rolling	Actual	Product
	n facilities	Capacity	Capacity	Production	Range
		(MTpa)	(MTpa)	(MTpa)	
Steel	2 x 8MT IF	70,000	50,000	40,000	Rebars
Rolling	1 x 15 MT				
Mills Ltd,	EAF				
Jinja					
Tembo	1 x 1.5MT	9,000	9,000	7,200	Rebars
Steel Ltd,	IF				Angles
Lugazi	1 x 2.0				
	MT IF				
Tembo	1 x 5 MT	12,500	10,000	6,000	Rebars
Steel Ltd.,	EAF				Angles
Iganga					Hollows
BM Steel,	1 x 3 MT	Not	Not working	Not working	Not working
Mbarara	IF	working			
BM Steel	1 x 2 MT	4,000	5,000	4,000	Rebars
Kilembe	IF				
E. A. Steel	1 x 10 MT	24,000	Not working	Not working	Not working
Corp.	EAF				
UGMA	2 x 1MT IF	4,000	2,000	-	Rebars
Eng.					
Corp.					
Total	-	123,500	76,000	57,200	-

Table 1: Iron and Steel Mills in Uganda (MISI, 2006)

Even with the very low annual per capita consumption (4.7 kg/year), the absolute steel demand in Ugandan estimated at a little over 140,000 MTpa remains well above the current actual steel production of 57,200 MTpa (MISSB, 2006). The existing steel industry would thus have to more than double both its liquid steel production and rolling capacity to cover just the local demand.

1.4 Raw Materials Sources

There is an outstanding shortage of steel scrap, the major raw material at present. By the year 2000, the national scrap deposits were estimated at 150,000 to 200,000 MT while the local steel production capacity stood at 72,000 MTpa (UIA, 2000). This shows the that the scrap steel input is currently mainly imported. However, substantial iron ore deposits exist in the country and have been shown to be of relatively good quality reaching over 90% yield in some places and on the average over 60% iron ore (Table 3). There is also hope in the use of gas as reductant since the confirmation of 400,000,000 m³ per day natural gas at Nzinzi in the Albertine basin in 2007.

Deposit location	Iron ore grade	Deposits
Butare, Kabale	90-98% Heametite	500 MT
Kashenyi, Kyanyamuzinda, Kamema	90% - 98% Hematite	NA
Mugabuzi, Nyaituma	Hematite	20 MT
Bakusu, Nakhupa, Nangawale,	Magnetite	41 MT
Surumbusa		
Sakulu, Tororo	62 %Magnetite	45 MT
Napak, Tororo Hills	Magnetite	Not known

Table 2: Iron ore deposits in Uganda (UIA, 2008)

2.0 FINDINGS AND DISCUSSION

The national steel industry is characterized by low production and dormancy with relatively low capacity utilization. Out of the total melting capacity of 56.6 MT, electric arc furnaces (EAF) represent 30 MT, constituting 53% of the total installed melting capacity although they are only 27% of the number of furnaces in the country. Given the fact that the EAF are either not regularly in operation or are actually dormant, the overall melting capacity utilization is damped to less than 50% (Table 1). Thus although the installed production capacity stands at 123,500 MTpa, the actual production trails at a mere 57,200 MTpa.

The low volume and resulting poor quality of scrap present the largest problem to the melting industry. Railway transportation of scrap from Mombasa at US\$ 85/t is hardly viable since rebars for example are produced internally at US\$ 570/t (UIA, 2008). Steel production, based on the mini mills variant rather than integrated mills, has been proved quite effective in many parts of the world, given their lower fixed to variable costs, making higher return on investment besides more effective human resource allocation than integrated mills as shown in the case of China and USA. They also require less start-up capital, enjoy greater freedom of location, and more flexible job organization (Hogan, 1994). Mini mills, however, have long been waiting for alternatives to scrap as raw material. The possibility of replacing scrap with direct reduced iron (DRI) is strongly supported by the availability of iron ore in Uganda (Table 2). Gas based DRI production looks attractive as there is little hope of obtaining coal in the country. Both Circored and Finmet processes were thus floated in 1997 (GSMD, 1997).

Considering the current steel demand of 140,000 MTpa (Table 2), the 60% grading of the ore at Muko deposits (Table 1) with an estimated 8% mining losses (DGSM, 1997), 252 MTpa of iron ore would be required to meet the current national demand, which can be amply met by any Ugandan ore deposit (Table 3). About half of the nearly 70 DRI plants operating globally produce at less than 0.5 MTpa (ACTED, 2000). This rate applied to the Ugandan steel industry, would leave up to 50% of the production for export. A DRI plant can produce viably in the range of US\$ 315 a tonne (based on electrical power at \$US 0.105/kwh) while the world price for DRI is in the range of US\$ 420/tonne (Metal Bulletin Ltd, 2010), leaving a 33% profit margin. A tonne of liquid steel made from the DRI in Uganda would be expected at US\$ 402 produced in an EAF while the billet steel price in August 2010 stood at US\$ 490 (Metal Bulletin Ltd, 2010). This leaves the sponge iron/mini mills option more attractive than integrated mills which are only viable above 3 mMT/y (Jung, *et al*,

2005); whether DRI is used alone in the EAF or at 20 to 30% level in combination with the locally available scrap. About half of the steel producers in Uganda still use billet casting (Table 1). The IISI estimated that by 2003, 88% of world liquid steel production was continuously cast. Continuous casting can reduce labor requirements in steel making by 10 to 15% and yet continuous casters can be obtained suitable for annual capacities of 0.5mMT (OTA, 1979); a likely production level to start with in Ugandan DRI based steel making.

Additionally, only two of the steel mills in Table 1, have fast, effective means of determining the composition of steel such as spectrometers; the rest use slow outdated quality control procedures. This can lead to poor and unreliable quality of the final steel product.

On the other hand, considering the low wage rates at an average US\$ 54 per month, (UIA, 2008) the labor cost in Uganda contributes less than 15% of the cost of liquid steel cost according to recent survey done by the researcher. Comparing this with around 30% labor cost in many developed countries like Japan and United States (P. K. De, 2000), one would expect the Ugandan steel making firms to be making very high profits. This, however, is not necessarily true, most likely due to the low productivity of poorly trained workers besides the high power tariffs, irregular power supply and high taxation and all put together.

Furthermore, empirical findings show that the loss of efficiency due to outdated equipment outweighs any efficiency gains from the learning-by-doing associated with aging (Jung, *et al*, 2005). Uganda government should stand strongly against the transfer of very old technology into the country; introducing incentives for example for investors with new technology as the Chinese government has ably done (AISI, SMA, 2007).

The technical efficiency of iron and steel firms is positively related to their production levels as measured by their shares of the total world production of crude steel (Jung, *et al*, 2005). The Ugandan steel industries' share of the world steel production is also so insignificant that the overall production levels do not allow them to influence the price of the steel in the region or globally. In Brazil, China, India and the USA, the production quantities of the steel industry have been influenced by policy and financial interventions of their Governments in order to uplift their economies of scale to decisive levels either directly by providing funding as in Brazil and USA or indirectly by involving foreign investors at national level as in India or providing incentives as in the case of China and Malaysia.

3.0 CONCLUSIONS

Mini mills are the most viable technology to support and uplift the Ugandan steel industry. They would save the steel industry from the need for big investments in the capital intensive integrated mills. There is also need to uplift the steel industry's efficiency through the use of modern melting, casting and rolling equipment.

The use of DRI in mini mills in developing countries with substantial ore deposits and low levels of industrial development has been largely experimented in countries like Brazil, India, Trinidad and Tobago and shown to give superior return on capital than integrated mills. In all cases, the availability of fuel and reductant was a decisive factor. The recent discovery of gas in the Albertine zone in Uganda and the fact that the national ores present a fragmented form directly suggest the use of gas based sponge iron extraction to be used in addition to scrap in the mini mills, beginning with small quantities (0.5 MTpa) to cover local consumption and limited export and later increasing as funds and experience allow.

The low production levels, and equally reduced capacity utilization should be addressed through research and development and training and retraining well as coordination with local research institutions in order to uplift the efficiency and productivity of the workforce as seen in the case of China.

Because of the large linkage effects and fierce competition in the global steel industry, the Ugandan steel industry needs substantial state involvement either to provide funds directly or facilitate the necessary logistics to link with financial institutions or foreign equity investment as has been the case in India, Brazil, USA and China. The high levels of initial capital investment related to the high fixed costs of steel industry need more than just the private sector although the industry would best remain private as the world trend has been since the 1990's. The resulting economies of scale would enable the steel industry to raise its share of the world crude steel production and to play a decisive role in the setting of the important production parameters including world product and input prices.

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