The changing role of the engineer and equipment supplier in the steel industry

Steel company in-house process-driven technology developments prior to 1970 have been superseded by equipment supplier-led innovations and increasing emphasis on product development. As roles continue to change, it is of paramount importance for a successful steel industry that the relationship between equipment suppliers and steelmakers becomes one of partners, each bringing their unique knowledge and contributions.

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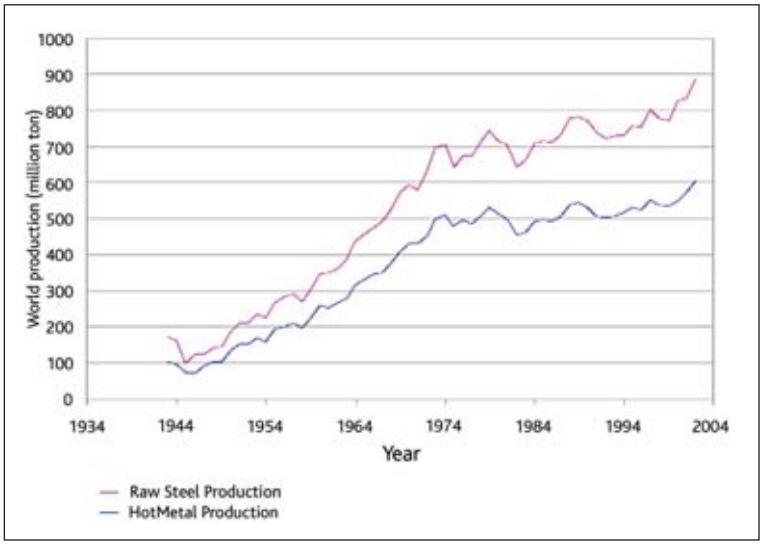


● **Figure 1** ***World steel production 1940-2000***

Although people have been using iron tools and artefacts for more then 3,500 years, only in the last 200 years has iron, and later steel, become the general-purpose construction material of choice. The main reasons are the abundance of iron ore and the massive changes in the production processes which made it possible for this versatile and strong material to easily compete with and rapidly replace the more traditional materials. Steel shaped the 20th Century and continues to do so (see *Figure 1*).

Early 20th Century: demand exceeds supply

The necessary innovation and the 'breakthrough' technological changes in the processes of manufacturing iron and steel that contributed largely to the low price availability of this material was initially possible because of in-house developments by the owners of the early steel mills, who in those days, could best be classified as 'engineers/entrepreneurs'.

In the short (about 100 years) history of large-scale steelmaking, companies used considerable resources and money in the optimisation of the process rather than on the finished product. This was logical in times when the market for the products was generally good and regulated, when demand was often higher than the supply, and therefore when the profit margins directly related to the increase in output.

Another contributing factor to this in-house development/innovation approach was the fact that the industry was run mainly by engineers who often spent their entire working life in the mills. As a result, the engineering departments of the traditional integrated steel companies had tremendous power, and worked with considerable pride, often deciding what was best for the plant operators.

Examples of innovations are the rapid increase in the size of blast furnaces and changes in the burdening practice in the beginning of last century made possible by US steelmakers, the Bessemer steelmaking process, developed by Henry Bessemer (see *Figure 2*), in around 1910, the development of continuous hot and cold rolling by the ARMCO Steel Company in the USA in the 1920s, the LD steelmaking process developed by Voest, based on German studies, in the early 1950s, and the continuous casting of slabs, originally developed by the Russian steel industry in the 1960s.

A number of breakthrough innovations came from the USA, mainly because of the unique circumstance of the lack of skilled workers, especially at the turn of the last century. This forced the companies to make their processes more efficient, especially when compared to Europe. When Hoogovens (now Corus IJmuiden works) developed their plans for a steel mill

● **Figure 2** *Henry Bessemer, steelmaker and entrepreneur*

● **Figure 3** *The ULSAB, ultra light steel car body*

close to the sea in the Netherlands at the beginning of last century, it was based on North American concepts.

The optimisation of these new processes was also unique in the sense of the speed with which it happened. This was the result of the free flow of technical data and exchange of operational experiences between competing companies, which is another example of the engineering spirit that prevailed in those days. It was quite normal for steel company personnel to travel to competitors and access all data prior to making a decision about which process route to select.

Post-1970s: supply exceeds demand

Since the mid-1970s these in-house process developments declined considerably, initially as a result of changed economic circumstances (the growth for steel slowed dramatically in the developed countries), and because, for the first time, supply exceeded demand. Companies had to rationalise and the in-house engineering capacity which, until that date worked on expansion and growth, was downsized.

A second contributing factor is that during the 1990s the engineering mentality started to disappear from the board room. Companies became more financially driven, shareholder value was increasingly important, and the focus shifted to the 'core business'. This started the drive towards outsourcing activities that 10 years earlier would have been considered core competences.

Thus, in-house R&D, which for a large part used to be process-orientated, shifted focus towards the final products. This was an attempt to influence and enhance the application of steel and steel products and thereby the added value of the steel company towards its clients. The so-called ULSAB (ultra light steel car body) project is a classic example of the shift of R&D within the integrated iron and steel industry from process to product (see *Figure 3*).

There are examples of in-house process developments that are still ongoing, for instance the strip casting projects at Nucor/BHP and Thyssen Krupp, the CCF alternative ironmaking process at Corus IJmuiden, and the COMET process developed by Arcelor (Sidmar). These projects often do not outgrow the planning stage, simply because steelmakers do not have the capital required nor want to take the risk of building a prototype process. The 'white elephants', such as the BHP Port Hedland DRI project are a board member's worst nightmare and do not fit into the core business strategy of today.

The only true current example of the engineer/entrepreneur is Arvedi in Italy, who implemented his ideas on thin slab casting/rolling and turned it into a success (see *Figures 4 & 5*).

The changing role

Cost reduction Most capitally intensive projects in the integrated iron and steel industry have a relatively long lead time. Decision making can take years, the returns are often marginal, 10-12% at best, and the interest losses because of the long construction and start-up curves are relatively high. This leads sometimes to under-estimated internal budgets, to overly optimistic start-up curves and finally, to increased pressure on the equipment suppliers. This becomes apparent in, for example, reduced project duration. The additional time that is required for internal decision making, to change the original scope to fit the budget, and the commercial negotiations, are often at the expense of the time required to properly engineer, procure, build and commission the project.

Another interesting comparison is the change in costs over the years. We have compared the Corus IJmuiden (Hoogovens) second twin slab caster built in 1987 with the twin slab caster built by Arcelor Sidmar in Belgium, which was commissioned in 2001. Although the scope is comparable, the difference in costs is very significant (see *Table 1*).

As both companies are relatively close together, it can be assumed that the construction (site) costs are subject to the same actual inflation/increases

● **Figure 4** *Arvedi tunnel reheat furnace in Cremona Italy*

	Hoogovens 1987	Sidmar 2001
Production capacity, Mt	2.4	2.3
Ladle weight, t	315	300
Tundish weight, t	65	65
No. of strands	2	2
Slab width, mm	950–2,150	950–2,000
Slab thickness, mm	225–250	210–250
Casting speed, m/min	1.8	1.7
Supported length, m	35	36
Construction time (site), months	18	10
Costs, € million	150 (1987)	139 (2001)

● **Table 1** *Comparison between Hoogovens and Sidmar twin slab caster projects*

experienced over the last 15 years. It is clear, therefore, that the engineer/equipment supplier has made giant leaps in reducing the actual costs of project management, engineering and the equipment over that period. Because the level of automation and environmental control in the Sidmar project cannot be compared with the 1987 Hoogovens project, for simplicity this has been ignored.

Research and development On top of these cost reductions the engineer/equipment supplier has taken over the role of process innovator, often spending a considerable amount on R&D. In the case of Danieli, this was €128m over the past five years. Today, steelmakers rely increasingly on suppliers to ensure that the equipment gives them higher quality and/or output for less investment and production cost.

Furthermore, the equipment supplier nowadays has to be aware of global economic trends and of the differences in production and operating costs of the various processes in different parts of the world,

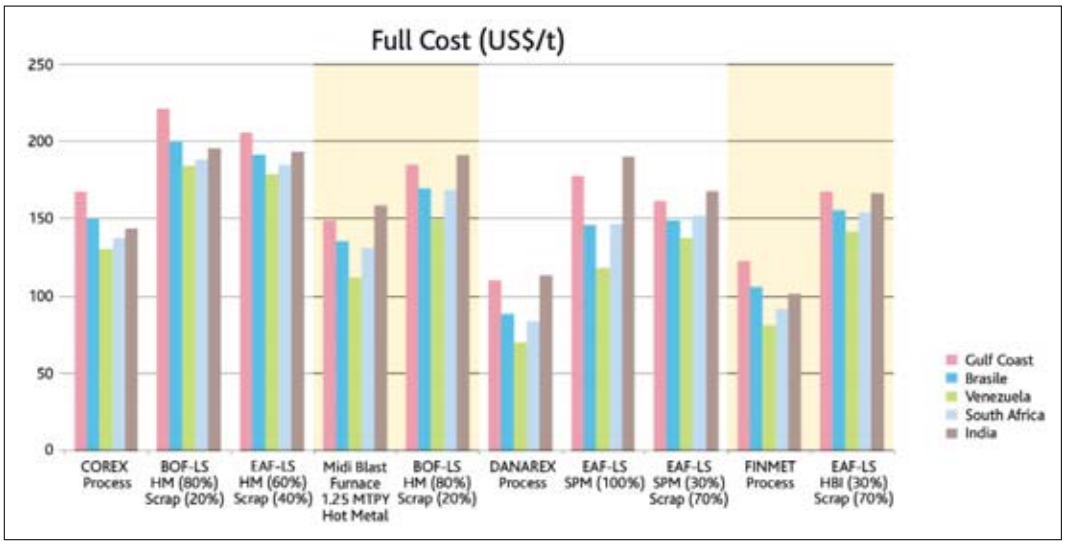
● **Figure 5** *Arvedi galvanising line-zinc pot area*

so that it can match its medium- and long-term research and development strategy with these developments.

An example is the development of gas-based iron making, which proves to be extremely economical in certain parts of the world. Danieli capitalised on these developments through it's new Danarex process combined with 100% DRI-fed electric arc furnaces, and a number of potential projects, suited to these new processes have already gone through the feasibility stage. *Figure 6* compares the cost for various gas-based steelmaking routes in different areas of the world.

Managing risk The equipment supplier now has to start taking some of the risks that the steelmaker took in the past to prove its innovations in the field. As steelmakers increasingly focus on their core business, they may no longer be interested in, or be capable of, taking process risks, and so are looking for turnkey packages with a fixed cost, fixed schedule, and guaranteed output and production costs. As a result, in order to be able to prove his innovative concepts the equipment supplier either has to have his own facility capable of full-scale tests under actual production circumstances, or has to take an equity participation in new projects and become a steelmaker himself.

Danieli has taken both routes successfully in the past few years. Our own steel plant, ABS, is equipped with our latest generation of endless casting/rolling long products mills – the Luna project



● **Figure 6** *Costs of slabs for various gas-based steel making projects*

(see *Figure 7*), while our participation in EFS, Egypt, gave us the opportunity to build the most modern and innovative flat steel mini-mill in the world (see *Figures 8, 9* and *10*).

Future changes

The market and its players are global and the current developments in countries such as China, where the latest available technology is installed incredibly rapidly when compared to Europe and the USA, will inevitably lead to changes in the future supply and demand for steel. This will not only influence the traditional steelmakers but it will also have an impact on the equipment supplier.

In order to be able to cope with these future developments we feel that it is necessary to start exploring the possibility of shipping semi-finished products such as slabs and coils, from the places where they can be produced at the lowest cost with the most economic processes, to finishing plants close to the final client, thereby minimising transport costs and ensuring the most flexible supply conditions.

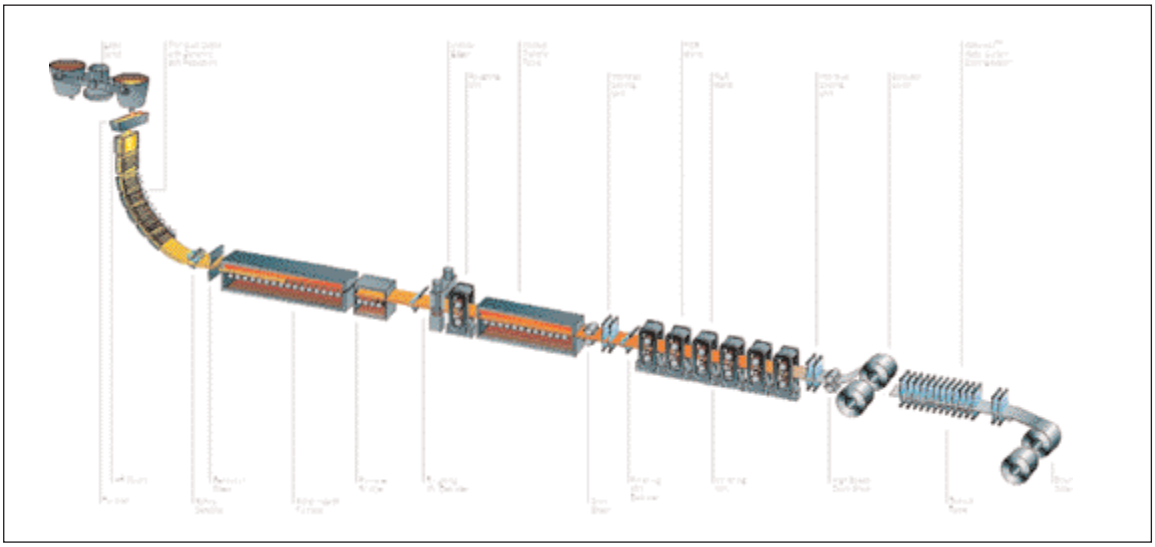
One of the projects based on this concept is Ceara in Brazil where eventually 2.5Mt of high-quality slabs will be produced through the Danarex EAF route for export only. This is another project where we take an active role in the ownership and operations of the plant.

Concluding remarks

By anticipating global steel production developments and tailoring in-house R&D towards the most suitable innovative processes and equipment for these developments, the modern equipment supplier will become part of the strategic decision-making process of its clients.

It is clear, however, that there is a limit to what we, as equipment suppliers, can do in the development of new breakthrough processes, for the simple reason that, like our clients, we are faced with continuous pressure on our costs. From the example given of Hoogovens 1987 versus Sidmar 2001, we can conclude that we have been actively playing an important part in the reduction of our client's cash costs, while at the same time taking over part of its historical role in the development of

● **Figure 7** *Luna project rolling mill*



● **Figure 8** *EFS flat steel mini-mill layout, Egypt*

● **Figure 9** *Danieli Danarc AC EAF at EFS*

new and more cost-efficient steelmaking processes.

In order to exploit fully this changing role in the relationship, it is of paramount importance that the interaction between equipment suppliers and steelmakers becomes one of partners, who each have their unique knowledge and contributions to make. It can be expected that with the further consolidation in the steel industry, the opportunities for cross-steel company information flow will reduce, and a lot of the operational results and advantages between various processes will be available only through the equipment supplier.

● **Figure 10** *EFS reheat furnace*

Some examples are already showing what these partnerships could bring. For instance, the way in which some companies handle their capital projects, namely, a first selection on technical advantages and production cash cost (which has a far greater impact on the bottom line price of the final product), than the initial investment, followed by single sourcing, whereby the best technical solution for the specific circumstances are chosen, followed by open and fair commercial negotiation, leads to successful projects for both parties.

It is this partnership and respect for each other's knowledge and efforts that will ensure the continued success of both steelmakers and equipment suppliers.

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