Future iron- and steelmaking together with upstream marketable products
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The steelplant of the future

Future iron- and steelmaking together with upstream marketable products

Austin Matthews*

There will be a continued requirement for iron and steel products in the world market. However, the steel industry will be subject to intense commercial pressure from competing products, such as other metals, materials and composites, together with the continued economic growth of China, India and Russia. This competition will be felt particularly in the transport, packaging, construction, domestic appliance and heavy engineering industries. A detailed proposal to meet these challenges in the form of a 15 Mt capacity mega-plant with a business strategy to complete in future globalised markets is advanced.

The next decade will be a very trying time for iron- and steelmakers. Established global steelmakers must adapt to changing market needs or become victims of their own failure to recognise new market forces.

The largest change, giving a new dimension to iron- and steelmaking, will be geo-politics, which will bring about a new type of globalisation. The only answer will be to innovate to stay ahead, which means competing at all levels. One of the main weapons is added value, that is giving major importance to customer value and satisfaction.

Practical means to meet these challenges, which may include, for example, greater protectionism of core home markets by governments, some global automotive companies losing their competitive edge and global environmental protection, will be explored. For steelmakers, this is likely to involve:

- adopting new technological approaches to iron- and steelmaking, together with finishing operations
- coalescence of steel product manufacture and customer based product manufacture on one site, which will cross-fertilise both parties' needs and requirements
- adopting a fully integrated analytical approach to recurring problems within the steel plant and customer plants. Flexible through-process simulation models will be used to study a series of scenarios, identifying bottlenecks in production routes and supply, and tailoring costs to meet customer needs. Such an approach allows processes to be re-designed and fast tracked using different product strategies.

The objective will be to compete in terms of strategy, intrinsic value and design reality, thus getting under the radar of the competitors.

Determinants

Strategy

To meet the required needs of customer value and satisfaction, the aim must be to go beyond supply chain optimisation to a bold undertaking for globalisation. Most models are partial, dealing with, for example: demand management, supply, or finance. These aspects need to be part of an holistic enterprise optimisation model that integrates these three central areas of decision making in a highly focused global company. This company must be integrated with select customers with rich communications and collaboration to overcome the dangers that:

- plastic will continue to capture markets currently the preserve of metals
- spot market orchestraters will price metals out of control
- raw material suppliers will seek long term contracts with a limited number of very large capacity iron and steel consumers, e.g. in China and India, at the expense of others.

Therefore, the steelmaker of the future should concentrate manufacture in a single mega-plant (15 Mt capacity), or a network of a few large sites of 5 Mt capacity, based within stable political areas, with the requisites of raw materials, an intelligent workforce, energy supplies, an expanding economy and a single language, where products can easily be marketed globally. Ideally the main manufacturing recipient customers should be on site. Potential locations would be North America, Europe, India, China and Russia, or where the raw materials are mined.

Other requirements

Products must aspire to a solution for all markets at acceptable price and hence manufacturing costs, meeting environmental needs, compatibility with other materials and integral property requirements and take into account the needs of fabrication (i.e. functional design), while providing added value.

Transport *per se* is not difficult by land or sea for raw materials or energy; what could be difficult in the future is ensuring unconstrained passageways.

Increasing environmental constraints on industry are being imposed globally, for example by the Kyoto Protocol and European Union carbon trading scheme, which limit emissions of carbon dioxide.

Selection and motivation are key to attaining employees at all levels of the organisation capable of ensuring the strategy is followed correctly and competently.

The most important raw materials are ores and energy. Energy can be quantified in many forms, e.g. supply requirement, overall cost/price, function, environmental impact, reliability, availability within the manufacturing site. Rising ore prices, peaking prices for scrap, and the limited availability of sponge iron from direct reduction have recently highlighted the difficulty of meeting demand for metallic charge materials for both

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electric arc and converter production. This will be overcome in part by direct charging of liquid iron and intensified steel recycling programmes.

As demand for global energy grows, due to increasing demand from China and India in particular, there is the incentive to adopt technical routes using alternative energy sources such as hydrogen or coke oven gas (if available) for direct reduction, and to maximise energy efficiency.

Steel companies should be capable of far more than developing a good product, pricing it attractively and making it accessible to target customers. These companies must also communicate very well internally and with their present and future customers, together with powerful governments. Each company is inevitably cast into the role of communicator and promoter.

For a message to be effective the manufacturer's 'encoding' process must mesh with the customer's 'decoding' process, with effective feedback.[1]

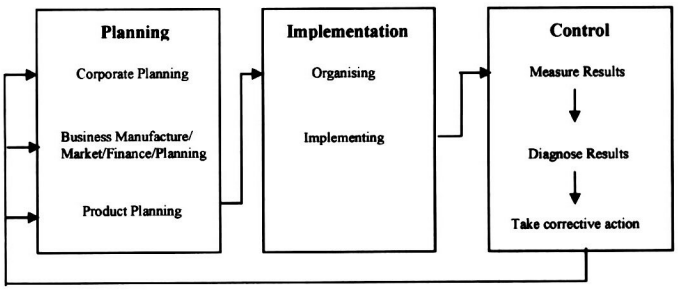
In the context of the present discussion, technology must be regarded as a holistic means of providing solutions relating to:

- technical know-how of throughput processes
- intrinsic properties of individual products
- new processes and products
- waste streams
- customer process evaluation and product requirements
- logistics
- a knowledge centre – research and development – academy
- training
- computer services and requirements.

Proposition for a future steel plant

Future systems of manufacturing iron and steel products will focus on low costs, to meet the requirements of very high productivity to provide substantial returns. It is the contention of the present proposal that this can be achieved only at mega-plants of 12–15 Mt capacity or through a tightly controlled network of plants of 3–5 Mt capacity. Based in politically stable areas, either manufacturing system must have clear scope for:

- products: strip, long, stainless, ...
- competencies
- markets
- resources.



1 Schematic representation of strategic planning, implementation and control process[3]

A mega-site should be designed such that clusters of major customers – transport, construction, packaging, tube, domestic appliances, chemical plant, etc. – can operate alongside their steel product requirement. This arrangement should give the steel company the ability to learn faster from its customers than the competition, and hence gain competitive advantage in supplying to global value supply chains.

The corporate strategy for a steel manufacturing company in the new millennium must be global, as reflected in its long term goals and objectives, courses of action and allocation of resources. Methodologies can be various, but the requirements have always been: intelligence gathering, planning and execution.

Anyone can plan a strategy (which may not be the right one), but implementation is difficult. Many strategies fail, not because they are poor, but through inadequate execution. Failure results largely from: poor communication, inadequate resources and/or failure to measure outcomes. The right knowledge and implementing it faster than your competitors is the real means to winning.

Intermittently linked with strategy is structure; however, structure must follow strategy. Analysis of corporate development[2] in the different steel markets and economies of the globe suggests that only by comparing the evolution of large scale multi-unit enterprises can organisational imperatives be identified and the impact of the cultural attitudes and values, ideologies, political systems and social structures that affect these imperatives be understood. Thus, the management hierarchy for a steel corporation of mega or network type should create multi-unit businesses and enable them to function through delegation of responsibility (Fig. 1).

Having acquired the necessary knowledge information, the structure of both product flow and control should be put in place. There is a requirement for a huge supply of electricity produced by a means designed to comply with the Kyoto Protocol and other restrictions on carbon dioxide emissions. The only practical means is nuclear power, i.e. a mini nuclear power station on a 15 Mt plant (excess electricity would be fed into the National Grid). A small tariff per kilowatt-hour will be levied on customers to pay for storage of nuclear waste.

Thin slab casting technology is now a must up to 2·5 m wide, and will be followed in a few years by strip casting for particular segments of unalloyed and stainless steels in similar widths. Therefore, effective plant layout and dispatch are pre-requisites to cross-match and utilise mill capacity to the full (Fig. 2).

All these components will contribute to corporate success derived from a competitive advantage based on distinctive capabilities. Direct relationships between customers and employees all on one site, which are precisely identified and applied to their relevant markets, will enable rapid learning. A multi-unit management hierarchy (Fig. 3), together with low productivity costs, will provide the profit margins to conquer global markets and the critical mass to be a Premier League player in global steel markets. Focus must be on what the corporation is best suited for and capable of doing, to attain maximum return on plant capability.

Intrinsic value and design reality of the corporation's products can be realised only from absolute knowledge of the requirements of the customer. This search will never stop as perceived benefits of 'added value' are sought throughout the supply chain all the way to the final customer. It is outside the scope of this paper to provide a full balanced account , but the aim is to gain a perspective of the competitive threat from alternative suppliers for component requirements. It is essential to be able identify customers'

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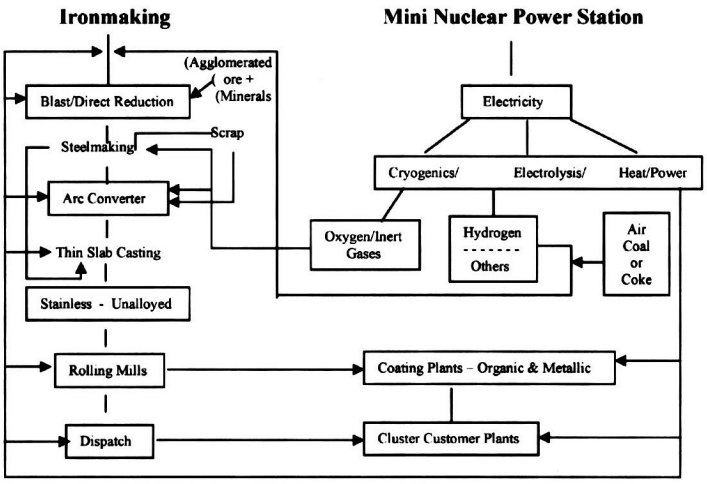


2 Proposed layout for 15 Mt steelplant

choice of products in current and future build. The objectives will be:

- to ensure the company can meet market needs better than other global suppliers
- to attain a high proportion of the global market.

The main goal is to establish how to benchmark the proposed company against competitors. Such an exercise will be based on the following procedures:

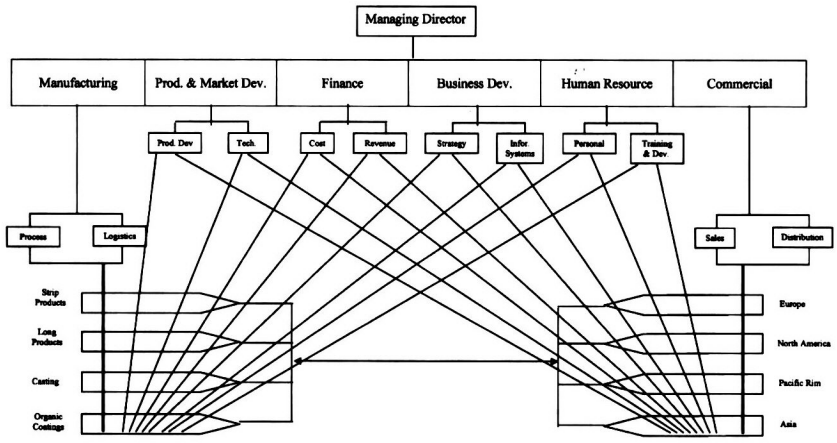
- definition – the target market is, say, the medium size, high volume global product segment
- evaluation versus competitors from a technical perspective
- measuring relative commercial exploitation in terms of cost, knowledge, plant capability, etc., to identify the true benchmark position
- preparing a template against which specific customers and their product listings can be compared.

The aim is to produce a highly profitable portfolio and maximise steel/material price through cost and added value techniques, a key being to suck out the anchor drag in the form of time and labour.[4] The findings should determine the position of the proposed company within the global market, and how the present product portfolio compares with the competition.

Is there a need to compete on all fronts? What is the best business product portfolio for the short, medium and long term? What are the opportunities for commonality of product? To satisfy the criteria defined, benchmarking will be undertaken by dividing customer products into specific sectors, e.g. automotive (passenger) car bonnet or tinplate can closure, which will be looked at individually in terms of the attributes and values expected by the customer, against the available products that best fit these requirements.

Structural organisation for radical global approach

To compete simultaneously at a national and global level, businesses must create superior value for consumers. This implies they must engage in two new activities: they must understand what gives customers value, and they must undertake the continuous re-engineering of their core business processes.



3 Management hierarchy structure for multi-unit business

A successful global company must create an environment that streamlines processes and creates as much commonality in product, service and processes as possible, while maintaining the ability to respond to customers with good, recognised brands. To create global customer satisfaction, companies must manage their value chain and the whole value-delivery system in a customer centred way.

The conceptual structure required to implement such a global business approach will now be outlined. The 'critical mass' will comprise a Leader, a Design Team and a Steering Committee. The Leader, who essentially chooses the Steering Committee, must be an original thinker having a finely tuned ego, team orientated qualities and process orientated qualities, who knows that one day when the transformation is complete he or she will return to a different role. The Design Team exists for a short period at the beginning of the undertaking. It literally designs the future. The Steering Committee is responsible for choosing the order in which core processes are to be re-designed. It sets goals, puts task teams together to perform the transformation, draws up plans for the re-design effort and monitors results against plan.

Task teams

Task teams are set up by the Steering Committee to fulfil very specific tasks. Each team focus on one core business process:

- commercial
- manufacturing
- technology
- finance
- distribution/information technology.

Potential activities for task teams will now be discussed.

Customer focus: after attaining market intelligence for the proposed global zones, ensure that there are not too many outlets chasing too few customers, low consumer spending and high human resource costs, which when combined will make a graveyard for new entrants.

Distribution: labour costs and productivity of that labour continue to present challenges, but material is the largest component of total costs. Material inventory can be an incredible consumer of cash. To compete and succeed in today's global market, material must be managed effectively and with a total system view. Global steel industry distribution costs[4] are:

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material 45%, labour 10%, overheads 35%. The steel industry must meet these and many other challenges through excellence in supply chain management: by maximising customer service and asset use, while minimising total delivered cost and inventory investment. After a decade of downsizing and re- engineering, most companies in North America, Europe and Japan are still stuck, searching for a formula for sustainable growth. Managers have lost sight of value for the customer and how to create it.

Information technology: operational excellence of the global cost supply chain requires integrated management because the people, processes and structure are fundamentally interconnected. Information technology is key for this integration.

Manufacture: global manufacturing cannot be achieved unless the business is totally integrated. Such integration relies heavily on global information networks. With such networks and a common way of working, assets can be managed on a worldwide basis. Manufacturing on a global scale cannot be measured by standard management accounting, which must take into account vagaries of transfer pricing and currency fluctuations. A more meaningful performance architecture must be constructed from key metrics that are sensitive to corporate objectives, product groups and regional requirements. These must be easily administered, have clear link to corporate strategy and facilitate continuous improvement. The principal metrics of core manufacturing are: cost, quality, lead time and service.

In such a global manufacturing environment with centrally managed processes and transferable products, external and internal concerns become easier to manage: each site recognises its part in achieving a common objective.

Technology: will have two distinct roles for the globalisation changes needed: quality and early vendor involvement. As indicated above, the thrust of globalisation will be through a limited portfolio of basic products which will be branded and marketed to known customers in zoned geographical areas.

Quality: for global branded products supplied through service chains, quality is a prime metric and world class methods to ensure quality of the product and its transport are paramount. To this end, quality standards must be continually benchmarked and means of obtaining them administered upstream to steelmaking and downstream to customers.

Early vendor involvement (EMI): EMI teams include personnel from each site and critical function, such as design and manufacturing engineering, quality assurance, service and maintenance, as well as key customer suppliers responsible for the introduction of core technologies. EMI teams are an important extension of the new product or new process development team. Their aim is to acquire best practice in process application and apply it to any relevant facility in the world.

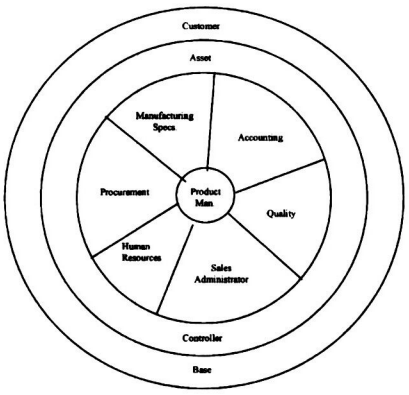
Finance: there are two main functions for finance in globalisation: estimating the probable rate of return on investment (market potential, future potential and risk, costs and profits) and risk assessment of globalisation (asset protection/investment recovery risk, operational profitability/cash-flow risk, potential for strikes, currency devaluation, political stability etc.).

Enablement: daily scheduling of capacity in a global business is too complex for even a centralised department. It is possible to create a fully integrated hardware and software system to enable capacity to be balanced around the world. This system, 'asset controller', functions by accepting worldwide orders, reviewing the condition of each manufacturing site and establishing the best final schedule for each plant. It then downloads the schedule to each manufacturing site. As conceived, the asset controller requires a set of key information databases. These databases include manufacturing and quality requirements, procedures and results (Fig. 4). The asset controller in its own right would provide data to the accounting and control functions.

Beyond supply chain optimisation

The growing interest in supply chain management is the result of two overlapping motivations:

- managers are seeking models and business processes to support fact-based decision making in designing and operating supply chains
- managers are seeking to integrate across supply chain functions, across geographically dispersed facilities and across time.



4 Schematic structure of asset controller

Roughly speaking, the essence of fact-based supply chain management is integrated planning, which has three important dimensions:

- strategic planning, concerned with resource acquisition
- tactical planning, concerned with resource refinement
- operational planning, concerned with business execution.

Reviewing the purpose and form of supply chain network optimisation models to support strategic planning is a necessity, followed by examination of extensions of such models that incorporate demand management. Extensions that incorporate corporate financial decisions are looked at separately. All need to be part of an holistic enterprise optimisation model (Fig. 5).

The issues that arise when integrating supply chain and corporate financial decisions are different from those in integrating supply chain and demand management. Corporate financial management involves numerical data and is therefore an excellent basis for fact-based decision making, unlike supply chain management. However, corporate financial managers have yet to recognise the importance of integrated or holistic decision making based on optimisation models. An optimisation model for corporate financial management begins with the balance sheet equation

$$FA - CA - CL - D - E = 0$$

where the terms refer respectively to fixed assets, current assets, current liabilities, long term debt and equity. This equation holds at all times but, for planning purposes, consider it at the end of each year of a multiple year

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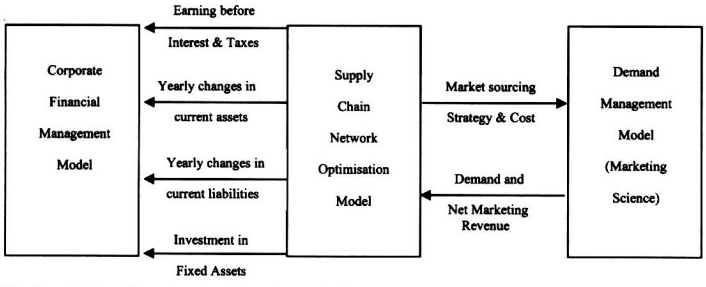

5 Holistic enterprise optimisation model

planning horizon. Thus, for each year

$$\Delta FA - \Delta CA - \Delta CL - \Delta D - \Delta E = 0$$

The Δ quantities for each year are the financial control variables. An important link to supply chain management is through ΔE for each, which can be expressed as a function of earnings before interest and taxes, cumulative values of ΔD from the beginning of the planning horizon to the end of the year and dividends paid during the year, i.e. Δ(net worth). The details of the functions are not relevant here, but it is possible to substitute for ΔE in the balance sheet change equation. The result is the funds flow equation, the cornerstone of optimising models for corporate financial planning.

Without an enterprise optimisation model it will be difficult to determine true value in the whole supply chain. 'Value' is a changing ratio that relates benefits to price. It can be expressed in terms of a brand value equation or a company value equation, either of which can be used to separate the three elements of value and assess their relative contributions. For example, for brand value

$$P \times FB \times PB = CV$$

where P is price, FB functional benefit (the objective performance of a product or service, shorn of its imagery, e.g. statistics show that the Lexus is an extremely reliable car), PB perceived benefit (based on the consumer's perception of branded products and services) and CV customer value. The difference between objective performance and perceived benefit is often described as the brand image. An analysis of resources must be undertaken in a way that establishes how such competitive differences are achieved throughout the value chain.[5]

The most powerful force subverting conventional value chains, partly because it acts as a catalyst and accelerator for all others, is a revolution in the economics of information. Information, always the glue that held together value chains, is now melting. Universal connectivity and common communication standards are enabling the open and virtually cost free exchange of information of all kinds. Companies can share product designs, CAD/CAM parameters, logistical information and financial data with equal ease.

This gives rise to two simultaneous effects. On the one hand, proprietary links give way to markets, witness the outsourcing trend: companies can now make use of key activities in the value chain without owning them. On the other hand, opportunities for rich communication and collaboration between customers and suppliers are greater. Both developments undermine vertical integration, replacing it with a highly flexible mix of coordination mechanisms, ranging from the ruthlessness of the spot market at one extreme, to the most strategic partnerships at the other.

For example, if a vertically integrated incumbent recognises the opportunity to outsource, integration gives way to orchestration. This is successful only if orchestrators possess powerful brands and use them to retain the lion's share of the industry's value-added while minimising their own assets.

However, maintaining control of the value chain is not easy. Those companies who focus on a specific added-value step or layer will drive for scale, and if successful will wrest control of the value chain from the leader. The business then deconstructs entirely.

The brand–company equation can be detailed in a value map that compares $(PB \times FB)/P$ for various scenarios. A value map for quality is illustrated in Table 1; this can be replicated for customer service, on time in full, etc.[6] This exercise will be done through a benchmarking system against competitors. Creating an environment that streamlines processes and creates commonality in product or service or process, is a requisite to be a global player through well managed supply chains.

Table 1 Value map based on quality–price comparison

	Price		
Quality	**Higher**	**Parity**	**Lower**
Superior	Good value	Very good	Excellent value
Parity	Poor value	Acceptable	Good
Worse	Terrible value	Poor	May be acceptable

Concluding remark

The iron and steel industry will be subjected to intense changes in the next decade, brought about by competing products and more rapidly by the market growth of China, India and Russia. This will create a new type of globalisation with a holistic supply chains. The question is: What will it take to compete with, produce and deliver such supply chains?

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