WSD WORLD STEEL DYNAMICS®

is a leading steel information service in Englewood Cliffs, N.J.

WSD's steel experience, steel database and availability of steel statistics are the principles for performing steel forecasts, studies and analysis for international clients. WSD seeks to understand how the "pricing power" of steel companies the world over will be impacted by changes in the steel industry's structure.

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Key steel industry technological breakthroughs

Note: A version of these comments was made by Peter Marcus during the technology panel at the Steel Success Strategies conference held in Istanbul, Turkey, on 18–20 February 2014.

The adaption of breakthrough steel technologies, at least from the viewpoint of the outsider looking down at the world, is about the feelings of great accomplishment on the part of those who invent the machines, install them and operate them to the benefit of the firm — i.e., adding to the firm's economic rent." It's an endeavor that brings out a sense of pride and satisfaction in all of those involved in the process. These badges of honor instill in the individuals the desire to achieve further advancements as their accomplishments spread to other facilities like wildfire.

Looking back to the 1800s, WSD lists four key breakthroughs that have brought the steel industry to where it is today:

1. The invention of the Bessemer converter for steelmaking (1856) and the Siemens Martin (1865) steelmaking processes. Subsequently, the cost to produce steel fell dramatically.
2. The creation of the hot strip mill. The American Rolling Mill Co. (ARMCO) — based on the ingenuity of John Butler Tytus — in 1921 started up the first hot strip mill at Ashland, Ky., USA. Output using the existing hand-mill process was about 520 tons per month. The 14-stand mill at first produced 9,000 tons per month and was boosted to 40,000 tons per month three years later. (Note: This mill was superseded by a rolling mill built in 1926 at Columbia Steel in Butler, Pa., USA, by United Engineer and Foundry Co. — owned today by Danieli.)

   Consider these facts:
   - The oldest highly productive HSM operating in the world today is probably located at the Zaporizhstal plant in Ukraine. It was designed in 1935 and started up in April 1938. Several years ago, it was producing more than 3 million metric tons per year with a typical coil size of about 9 metric tons.
   - In the early 1930s, so many wide hot strip mills were under construction in the U.S., at about US$30 million each, that they

accounted in one year for about one-12th of total private investment in the country. In comparison, in China today, the combined spending by the iron ore and steel industries is about US$110 billion, or about 2% of 2013's fixed asset investment of about US$7.2 billion.

3. Continuous casting of liquid steel into billet and slab.
   - Billet casting started in 1952 at Barrow Steel in England. Subsequently, especially in the U.S., continuous casting of billets to roll rebar took off in the 1960s due to the availability of cheap electricity for the EAF, low steel scrap prices and far lower operating costs than for an integrated mill because the ingot-breakdown billet mill was eliminated.
   - Thin-slab casting to feed the finishing train of a hot strip mill started up in late 1988 at Nucor's facility in Crawfordsville, Ind., USA. Interestingly, at that time, the price of steel scrap was about US$100 per gross ton versus about US$375–400 per gross ton today.
4. Computer controls that precisely control steelmaking-related and steel rolling processes. The start-up of Nucor's thin-slab/HRB plant in Indiana in late 1988 is symbolically the start of this era. As a consequence, the "cost above" to produce steel sheet products has been sharply reduced due to the decreased usage of energy, raw materials and manpower.

   WSD issued a report in 1992 titled *Nuking the Competition* that estimated Crawfordsville's cost to produce hot rolled band in 1991 at US$221 per net ton versus US$266 per net ton for a low-cost integrated steel plant — an advantage of 17% for Nucor. As of January 2014, based on WSD's monthly World Cost Curve data, a typical thin-slab/flat rolled plant in the U.S. had an operating cost of about US$557 per net ton versus only US$455 per net ton for the low-cost integrated steel plant with its own iron ore supply — a disadvantage of 18% (excluding depreciation and interest expense). The main cause of the violent swing in the cost comparison is the cost of steel scrap and other metallics: for the EAF-based mill, these amounted to US$105 per net ton in 1992 and about US$395 per net ton in January 2014 (although down sharply in price in February 2014).

   The steelmaking technology revolution tied to computer controls has included:
   - Amazingly precise controls for virtually all phases of the steelmaking and steel rolling process.
   - A lessened proportion of secondary and off-grade steel that's produced.
   - Significant cost reduction. Labor productivity is much improved. Energy and other materials are used far more efficiently (as noted above).
   - Less pollution.
   - More tons produced from the same unit.
   - Lessened capital intensity, i.e., investment per ton of capacity. Also, same smaller-sized units have achieved good economies of scale.
   - The breakdown of the last barriers of entry for mini-mills to produce hot rolled band.

Who Is Now Benefitting Most From the Information Revolution?

The Information Revolution, of course, is an amplifier of the Industrial Revolution. Let's consider how it is impacting the competitiveness of manufacturers in different parts of the world.

In the period from the 1960s to the 1980s, before the current Information Revolution was in effect, the Japanese were the biggest winners. Since then, they've become the biggest losers.

What happened? About 20 years ago, Japan was the undisputed winner when it came to global manufacturing prowess. In the period from the 1960s through the early 1990s, Japan had by far the world's best workers. And its product quality and product innovation were unrivaled.

The country was zapped by the Information Revolution. The application of the computer to manufacturing processes permitted Japan's workers, who were paid a high wage, to be replaced by more numerous workers that were paid far lower wages. The new factories in China often produced products that matched the Japanese when it came to quality. Computer controls were increasingly adapted in China to make ever-better products.

Who's the biggest winner now and, potentially, the biggest loser in the future? It's China. In the period from 2000 to 2013, fixed asset investment in China rose from one-third to 50% of GDP. Manufacturing costs fell and GDP on a current dollar basis grew more than 10% per year.

Today, the advancement in the use of computers to control the manufacturing process, along with a phenomenon called "global sourcing," is benefitting those who seek to build a new factory in the U.S. perhaps even more than those in China because the labor content of the product is sharply reduced (due to the lessened man-hours needed to manufacture the product).

The key question, therefore, is, "Are the greatest benefits from the Information Revolution now leapfrogging — i.e., bypassing — the developing world, including China, and benefitting new factories in the advanced countries the most?" ✦