Steel Performance Initiative

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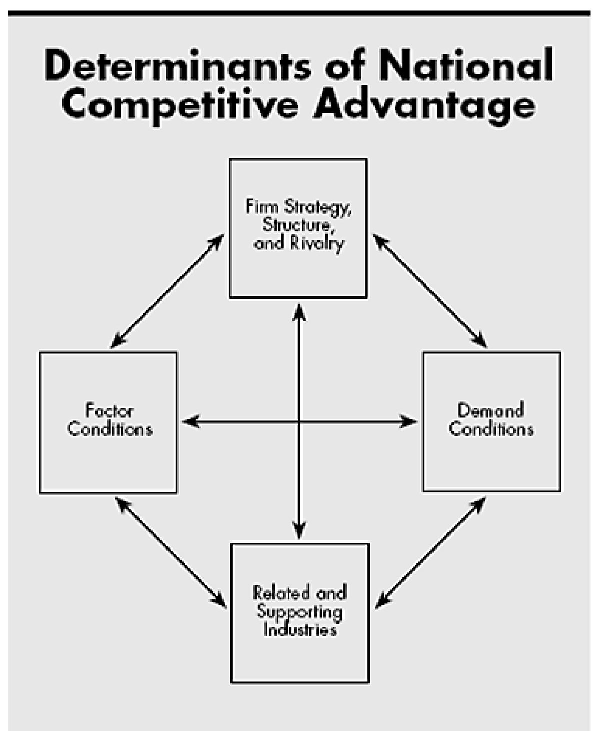
Steel Performance

Collaboration and competition are both essential values in our specialty steel world. Commercially, we compete for limited business. One fundamental way we compete is through developing technology that makes our products superior in value and performance. In steels made for defense, the competitive drive is not just commercial; it also intends to provide our defense equipment with superiority to our military foes. The goal of the Steel Performance Initiative (SPI) is to develop and maintain a superior competitive steel industry that provides a decisive performance advantage through technology development. Michael Porter is a primary source for commercial competitive advantage thought. (https://hbr.org/1990/03/the-competitive-advantage-of-nations)

He formulates this in the Diamond of the four factors of competitive advantage:



1. *Factor Conditions.* The nation's position in factors of production, such as skilled labor or infrastructure, necessary to compete in a given industry.

2. *Demand Conditions.* The nature of home-market demand for the industry's product or service.

3. *Related and Supporting Industries.* The presence or absence in the nation of supplier industries and other related industries that are internationally competitive.

4. *Firm Strategy, Structure, and Rivalry.* The conditions in the nation governing how companies are created, organized, and managed, as well as the nature of domestic rivalry.

We suffer from real challenges with Factor Conditions. Our cultural and public policies put the specialty steel industry at an international disadvantage. We have tax and regulatory burdens that disadvantage capital intensive industries. Low interest rates diminish the time value of money making long-lived capital investments unattractive. Demographically and culturally, our next generation workforce will remain a challenge. These issues are largely outside the scope of the Initiative. One opportunity is smart automation used to address the workforce challenge for limited customized production of critical components.

One of Porter's key insights is the need for both competition in Firm Strategy, and collaboration within the technical community in Related and Supporting Industries. Porter argues that the regional community of advanced particular technology and production expertise is often decisive. He uses the Swiss watch industry as an example. They have no inherent Factor advantage except the community of suppliers and parts producers and expertise that gives them the competitive edge. This has been tried as a strategy in many regions and public policies with limited success. The challenge is to develop a competitive community that also is collaborative.

This competitive/collaborative approach to innovation is illustrated in Silicon Valley. Our primary challenge in the SPI is the enculturation in our community of appropriate collaboration to develop and transition innovation while allowing individual firms to develop sustainable competitive advantages.

We face one aspect of this challenge directly now, in contracting the academic community to participate in this community. The universities want the unrestricted right of publication, arguing that their contribution is basic science and therefore not subject to approval. We want the universities to publish the technical insights so our producers, customers, and users can transition these into superior performance.

But, if the technology is addressed to the challenges of high-performance defense equipment and needs to transition into weapon systems to provide unrivaled performance, there will be competitive information for the steel producer, the equipment provider, and the defense user.

So, we face the challenges in the specialty steel industry of developing a collaborative approach to technology development and maintaining a competitive performance advantage. The universities already love collaboration but are questioning the need for competitive restrictions. The industry suffers from being overly protective of even basic technology that they believe is proprietary. Our success will be in direct proportion to our ability to create a culture that has a functional balance that allows our specialty steel industry to succeed.

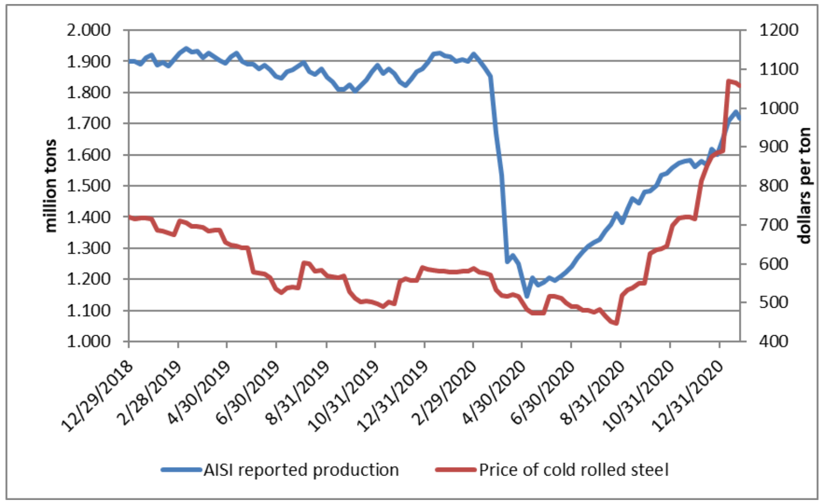
Projects & Partners: Texas A&M

One of the ways in which we can support the increased use and transition of Robust Advanced High Strength Steels (RAHSS)is by improving the ability to quantify hydrogen in the steel. Hydrogen embrittlement can limit the ultra-high properties needed from high performance steels. Being able to accurately characterize and quantify hydrogen defects in a test specimen is critical to knowing what factors should be controlled in producing the steel along with how hydrogen ultimately affects the performance. Texas A&M is developing an automated tool to distinguish hydrogen embrittlement from porosity-induced failure in structural steels, primarily focusing on high yield low alloy steels. This will enable high yield low alloy steel manufacturers to understand the root cause of low ductility in tensile tests and low Charpy impact properties for more-efficient resolution through manufacturing adjustments to correct hydrogen or porosity.

Texas A&M is also working on developing a statistically sound, Model-based Process & Product Design (MP^2D) engineering approach to the relationship between a test specimen and the actual part it represents. Section thickness and how a part is manufactured may affect secondary phase characteristics such as porosity, segregation, inclusions, etc. The size and distribution of these play a role in the properties of a test specimen due to a size of specimen vs. part effect or the local property variation through the section thickness. In addition to understanding the specimen vs. part relationship, it is also necessary to understand anisotropic through-section properties on part performance, which would be characteristic of heavy sections. Texas A&M will approach this problem computationally from two directions, determining both the statistically equivalent volume element for a given section with indications and by using the statistical theory of extreme values to logically explain extremes (large indication/low tensile property) present in a subscale test from a larger section. Tensile tests of various heats of steel with varying levels of indications will be performed to inform and improve these statistical models. These results can then be used to leverage manufacturing and design modeling in a MP^{2}D approach to improve reliable performance.

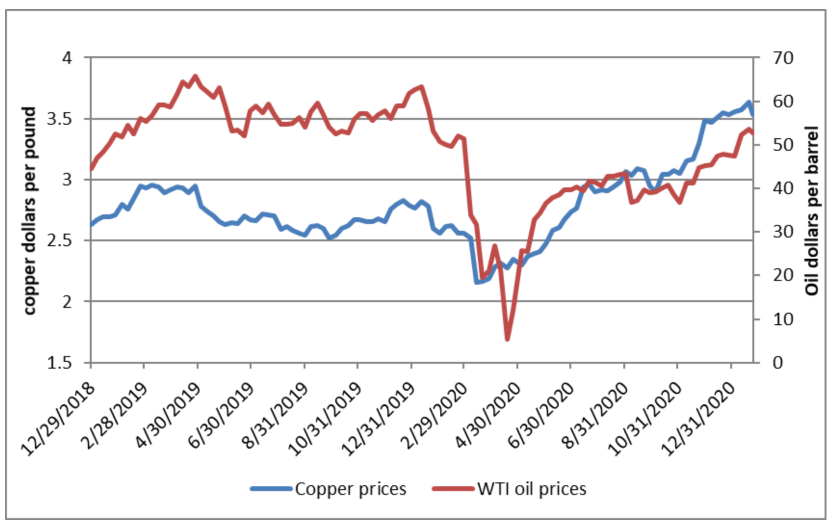
Successful completion of these two projects will provide both reduced scrap and a more performance-driven approach to qualification of thick section RAHSS.

Market Notes



The dramatic drop in business due to the pandemic has largely passed in the steel industry. The first graph shows the dramatic recovery of the steel mill industry that does not serve the same markets as the specialty steel industry but is often a good indication of business conditions.

Industrial demand for specialty steels is also likely tied to two indicators, the price of copper and oil. The revival of prices in these two commodities shown in the graph supports the idea that demand for specialty steels is in recovery.



The change in administration will affect the economic environment and the direction of government investment. It is unclear at this point how this will affect the demand for our steel.

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