METAL CASTING TECHNOLOGY FORUM 2007

Ensuring a Strong Manufacturing Capability - Final Report

Sponsors:

- General Motors Corporation
- The CERP Partnership, which includes the US Army, USCAR (Ford Motor Company, General Motors, Chrysler, LLC), Casting Industry Suppliers Association and the American Foundry Society
- American Foundry Society

Presented by

CERP
Casting Emission Reduction Program

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CERP

Casting Emission Reduction Program

CERP is a unique Government-Industry Partnership dedicated to improving, developing and validating new products, processes or technologies that help keep the domestic metal casting industry competitive in a global economy. CERP is operated by Technikon, LLC for the US Army ARDEC and industrial partners, which includes USCAR (Ford Motor Company, General Motors Corporation, Chrysler, LLC), Casting Industry Suppliers Association and the American Foundry Society, under a Cooperative Research and Development Agreement.

For more information about CERP, visit us online: www.cerp-us.org

Executive Summary

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- American Foundry Society

Richard McCormack, Editor and Contributing Writer

"Ensuring a Strong Domestic Capability"

The Casting Emission Reduction Program held its Metal Casting Technology Forum at Saginaw Valley State University in Saginaw, Michigan on May 1 and 2, 2007. By any measure, the event was a success, attracting more than 100 attendees for two days, and culminating in a plant tour of General Motors' Saginaw Metal Casting Operations.

ALL of the critical issues facing the United States metal casting industry were discussed and addressed by speakers and attendees at the Forum. The industry faces a growing set of challenges along a variety of fronts. Given the growing technological and market strength of international competitors, it will take an even more focused and concerted effort on behalf of all those involved in the industry to assure the continued viability of an innovative metal casting sector that can supply the U.S. military with the products it needs in the future.

If any one of the "three legs" that constitute the foundation of the metal casting industry – industry, government and academia – should disengage at this moment, then the United States could find itself in an untenable position: a depleted capability to produce the next generation of the country's most important military systems, industrial equipment, supplies and parts that go into virtually every manufactured product produced. Now is not the time to be complacent, said the speakers. Yet the industry is having to cope "with a void created by an evaporation of technical R&D support," said Jerry Call, Executive Vice President of the American Foundry Society. It was a theme repeated throughout the two-day event.

Imports of metal castings have grown from 7 percent of the U.S. market in 1998 to 22 percent of the market in 2007. The surge of cheap imports will not end any time soon, placing further pressure on the remaining producers in the United States. The number of foundries continues to decline to less than 2,200, down from 3,200 in 1991, though production is holding steady. Virtually all the growth in the U.S. market is being captured by imports.

Richard McCormack, News Editor and Publisher, Manufacturing & Technology Luncheon Speaker "U.S. Manufacturing: Is the Cup Half Full or Half Empty?"

To combat the import surge, there is an immediate need for a new commitment to researching, developing and implementing advanced technologies such as digital systems for designing, modeling, producing and testing metal castings. Achieving technological superiority through innovation might be the only way for the U.S. industry to combat the flood of cheap imports, especially since the U.S. federal government has not enforced trade laws against unfair foreign producers. Some speakers with experience in global markets said the United States is behind the technology curve, and all agreed that the lack of skilled engineers and technicians could lead to further erosion of the industry.

The majority of speakers at the event said that funding research and development is THE priority issue facing the industry. Sustainment of the industry will require the involvement of government research managers with long-term vision. Industry commitment to pursuing the next generation of digital metal casting capability and thus assuring the viability of the metal casting sector is imperative.

There was general agreement that those involved in the metal casting industry have had little impact on the U.S. political system, which has been reluctant to force a change of behavior among foreign competitors engaged in a variety of unfair trading practices. "I don't think they can level the playing field," said Raymond Monroe, Executive Vice President of the Steel Founder's Association. "Life is inherently unfair. R&D is competitive no matter how unlevel the playing field is."

But the metal casting industry should not give up pressuring the federal government and Congress to defend the interests of U.S. producers over those supported by foreign governments. The United States cannot depend solely on research and development to reinvigorate the metal casting industry because R&D conducted in the United States can be used in production facilities anywhere in the world. Multinational companies can take research conducted in the United States and transfer it to their growing number of factories overseas, said speakers from General Motors at the CERP meeting. Therefore, it is essential for the United States government to press aggressively for a level playing field, otherwise the benefits of U.S.-taxpayer funded research will not accrue to the citizens of the United States.

Speakers encouraged those in attendance to become more involved in communicating the importance of metal casting to all interested parties and the general public. Everyone involved

in the industry must become vocal advocates for a fresh infusion of federal R&D funding that is needed to transform the industry through the use of new energy efficient processes and technologies. Companies that have survived the shakeout must prepare themselves for another steep downturn. They must make their workplaces attractive for a new generation of highly skilled workers. If the metal casting industry is unable to sustain itself, then the United States will lose its status as a military superpower.

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Background

The metal casting industry is a vital part of our domestic industrial base. It is a foundation industry for providing parts to build and maintain our infrastructure and weapon systems. Wherever metal castings are produced, the machining, finishing and assembly operations are most often done at that location as well for economic reasons. American foundries have diminished in number from 6,150 in the 1955 to less than 2,200 today. The US metal casting industry has been eroding at a rate of 5 percent per year. The US steel industry no longer has the capacity to fulfill US requirements. A number of factors contribute to the rate of domestic capability loss and market loss to foreign competition including high domestic labor costs, safety costs, and environmental compliance costs.

The Chinese have publicly stated that they intend to become the casting and manufacturing center of the world. They have over 26,000 foundries and continue to grow. The U.S. has 2170 foundries and this number continues to drop.

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Weapon system metal castings can become unprocurable as a result of the plant closures. When parts cannot be procured, they become a Diminishing Manufacturing Sources and Material Shortage (DMSMS) issue for the Department of Defense (DOD). Often DOD buyers are unaware of DMSMS issues until a request for purchase gets no response from industry, and by then it is too late. Metal casting will soon become a DMSMS issue for the DOD given the current rate of plant closures in the industry

An increasing percentage of metal castings in the U.S. now come from China and other third world countries that have limited internal demand. The primary market for these foreign foundries is export; specifically export to the U.S. China has very aggressive plans to dominate the metal casting industry and the other industries that depend on it. The success of their plans could have significant impact on our future national security.

To help address these metal castings' issues, the CERP Partnership sponsored the Metal Casting Technology Forum 2004. The event built on the previous year's activities and introduced the national security and Department of Defense implications of the eroding metal casting industrial base. During the Forum, participants worked in teams to develop strategies to ensure a strong domestic metal casting capability, not just survival of this vital industry.

The 2003 Metal Casting Forum (http://www.technikonllc.com/forum2003.jsp) focused on identifying and defining technology needs and directions for metal castings. It resulted in a report that summarizes the top identified needs and challenges facing the U.S. Metal Casting Industry.

These challenges include:

- Foreign Competition
- Education
- Environment
- Image
- Production and Manufacturing
- Research and Development/Technology Transfer
- Lightweight Casting Efforts

The 2004 Forum built on the 2003 findings and explored selected issues in more detail. The participants were grouped into teams to develop recommendations that can be used by national metal casting program managers and funding decision makers to help guide their decisions.

Although trade restrictions and global labor and environmental requirements were discussed, the primary avenue for the domestic metal casting industrial sector to compete and win is through the application of advanced technology and highly engineered processes. Using advanced technology and highly engineered processes, the domestic metal casting sector can provide lighter, more complex castings that allow it to effectively compete in the global market and fulfill U.S. defense needs at a lower cost. Advanced technology also could eliminate the need for specialized tooling for low volume




DOD needs while speeding delivery. Instead of "tons shipped" models, the metal casting industry should focus on value added opportunities to ensure their customers are getting what they need, when they need it.

The Metal Casting Technology Forum 2004 was held at Rock Island Arsenal in recognition of the Arsenal's foundry being one of few remaining significant foundries within the Department of Defense. This foundry has very low utilization rates for Army armament manufacturing (25%) currently when compared to the private sector foundries (low 80% range), but could be used as a resource for helping to enhance future foundry technology deployment and other areas of the DOD, such as parts purchased by the Defense Logistics Agency (DLA).

Market Conditions

The U.S. metal casting industry has experienced a substantial downsizing over the past 50 years, according to the American Foundry Society. In 1955, there were 6,150 foundries in the United States. In 2005 there were 2,380. That number continues to shrink. In 2007, there were only 2,190 foundries in operation in the United States. In 2008, that number is projected to fall to 2,170. Yet, production capacity declined only by 4 percent between 1991 and 2007.

U.S. shipments are growing slowly, from 12.9 million tons in 2005 to 13.4 million tons in 2007. But 2007 wasn't as good as projected. The forecast was for production of 14.6 million tons shipped, with sales of $36.3 billion. But production was 1.4 million tons lower than expected, and sales were $4 billion less, due to unexpected increases in imports of light vehicles, a 25 percent reduction in the production of heavy trucks and trailers, and housing starts that fell by 8 percent (compared to forecast 3 percent growth).

Meanwhile, global production is soaring. In 2004, total world production of all metal castings stood at 81,854,000 metric tons. In 2006, that number had increased to 86,119,000 tons. By 2008, global production should exceed 90,000,000 tons. Production based in the United States will account for only 15.4 percent of total world production.

China's production was almost double that of the United States in 2005 – 24.4 million tons produced by 26,000 foundries, versus 12.9 million tons for the United States produced in 2,380 foundries. China exported 3.2 million tons of its output in 2005, 870,000 tons to the United States. In 2007, China is expected to account for 25 percent of all U.S. imports.

The United States was the world's second largest producer of castings in 2005 (with 12.9 million tons) behind China (24.4 million tons), followed by Russia (7.6 million tons); Japan (6.7 million tons); India (6.1 million tons); and Germany (5.1 million tons).

After a severe market decline that started in 1999 and bottomed out in 2001, the U.S. metal casting industry has stabilized and has entered a period of slow growth.

After a severe market decline that started in 1999 and bottomed out in 2001, the U.S. metal casting




industry has stabilized and has entered a period of slow growth. Capacity utilization for all metal casting operations – iron, steel, aluminum, copper, magnesium, zinc/lead, nonferrous and investment is 84 percent. Capacity in 2008 is projected to be about 16.7 million tons, up from 16.3 million tons in 2007. Shipments are projected to rise to 13.9 million tons in 2008 and sales should be $34 billion (far less than an earlier 2007 forecast of $37.7 billion in sales.)

After 2008, the U.S. industry is projected to enter a difficult period. Shipments are expected to tumble to $31.8 billion in 2011 (down from the previous forecast of $34.2 billion), due to the typical 10-year down cycle that last hit the industry in 2001. Prior to that, there were similar downturns in 1991, 1981 and 1971. In 2011, shipments are projected at 12.3 million tons.

Currently, the U.S. industry is poised for an infusion of capital equipment: plants are operating close to capacity and they need more staff and better tooling to meet demand, said Raymond Monroe, Executive Vice President of the Steel Founder's Association. "High prices for energy and materials are increasing costs, but are also stimulating demand for castings," he said. Global demand is outstripping supply. "Competitors face many of the same challenges limiting their ability to get market share," said Monroe. "You can't sell what you can't ship!"

But Monroe issued this caution: "One of the real painful things is that with the ramp down of R&D funding we've destroyed the infrastructure. Just at the moment we're about to make major capital reinvestments where we can use energy efficient technologies, the funding going away means that the university and engineering infrastructure is being pulled down. We will not be as energy efficient as we could be because we won't have the engineering infrastructure to make those investments."

Virtually every speaker touched upon globalization as a major force impacting the United States metals casting industry. The U.S. market is wide open to world trade, with cheap metal castings flooding into the country. These castings are eating share away from U.S. producers, who are either adopting new technologies and business strategies or are going out of business. End markets are undergoing dramatic changes, as the United States continues to hemorrhage manufacturing capability.

"The question isn't about just calculating risks across our supply chains around the world," said Dr. Sheila Ronis of Walsh College. "The question is: How do we assist the United States industrial base to reduce its vulnerabilities so we can remain a superpower?"

Looking Ahead: Where We Go from Here

Metal casting executives from industry and academia must continue to remain active politically by encouraging an increase in federal investment in a robust research and development program, said many of the speakers. Industry must work at improving its public image. Washington policy makers need to be pressured to enforce trade laws. Academia and industry must work together to attract new, talented students to fill an oncoming rush of vacancies in the industry with the pending retirement of Baby Boomers. Industry must recommit itself to self improvement; adopt best business practices; install a new generation of environmentally sustainable equipment; fund research and development; and become more engaged with universities, technical schools and even high schools to educate students on the exciting careers involved in manufacturing and metal casting. The Department of Defense must remain adamant about the need to sustain a strong supply base for metal castings in the United States, and help fund the development of new light-weight advanced castings and digital processes especially for low-volume parts and components. All partners must work together to assure the sustainment of the United States metal casting industry and to foster a greater appreciation of how important the industry is to the prosperity and security of the nation.

Rex Blackwell, Plant Manager
Saginaw Metal Castings Operations
General Motors Powertrain
Welcome and Introduction

Agenda

Day 1 - Tuesday, May 1, 2007	
Welcome and Introduction	**Rex Blackwell**, Plant Manager Saginaw Metal Castings Operations General Motors Powertrain
Keynote Presentation "General Motors… Products, Processes and Technologies"	**John R. Buttermore**, Vice President, Manufacturing Operations, General Motors Powertrain
"AFS and how it serves the North American Metal Casting Industry"	**Jerry Call**, Executive Vice President, American Foundry Society
"Outsourcing vs. Domestic Capability: A Practical Perspective"	**Dr. Sheila Ronis**, Director of the MBA and Master of Science in Strategic Leadership Programs at Walsh College and President of the University Group Inc.
Luncheon Speaker "U.S. Manufacturing: Is the Cup Half Full or Half Empty?"	**Richard McCormack**, News Editor and Publisher, Manufacturing & Technology
"Hypothetical (but true) Scenario for the Future: The All Digital Casting Process"	**Christof Heisser**, President, Magma Foundry Technologies, Inc. **Dan Maas**, The ExOne Company
"Defense Industrial Base and Critical Technology Assessment"	**Brad Botwin**, Director Industrial Base Studies, DOC, Bureau of Industry and Security
"How Globalization Killed US Metalcasting: a Fiction Novel"	**Alfred Spada**, Editor/Publisher, Modern Casting/Engineering Solutions and Director of Marketing, American Foundry Society
DAY 2 – Wednesday, May 2, 2007	
"Attracting and Training Tomorrow's Foundry Talent"	**Robert Tuttle**, Professor, Saginaw Valley State University
"FEF: Helping Today's Students Become Tomorrow's Metalcasting Leaders"	**Bill Sorensen**, Foundry Education Foundation
"CERP: History, Contributions and Evolution"	**George Crandell**, Vice President, Technikon, LLC (Operators of CERP)
"Steel Casting Outlook 2007"	**Ray Monroe**, Executive Vice President, Steel founder's Association
Roundtable Panel Discussion "What are the next steps to Ensuring a Strong Domestic Capability?"	Panel Chair: **Dr. Sheila Ronis**, *University Group Inc*. Panel Members: **Ray Monroe**, *Steel Founder's Association* **Jerry Call**, *American Foundry Society* **Brad Botwin**, *U.S. Department of Commerce* **George Crandell**, *CERP* **Kai Spande**, *General Motors Corporation* **Gene Tuohy**, *General Motors Corporation*

Summary of Presentations

Keynote Presentation: "General Motors… Products, Processes and Technologies"

John Buttermore: Vice President, Manufacturing Operations, General Motors Powertrain

GM is losing its position as the world's leading auto producer to Toyota, but that doesn't mean it's in a weak position globally, said Buttermore. GM is the leading producer in 12 of the world's 15 largest automobile markets and the differential in Japan (2.4 million more vehicles sold there by Toyota) is the primary reason for Toyota's advantage. Buttermore said GM is working on every conceivable Powertrain system for future automobiles and has advanced systems in place in virtually all of them, from hybrids, to electrics, to fuel cells, ethanol and advanced diesel.

John R. Buttermore, Vice President, Manufacturing Operations, General Motors Powertrain Keynote Presentation "General Motors… Products, Processes and Technologies"

"AFS and how it serves the North American Metal Casting Industry"

Jerry Call: Executive Vice President, American Foundry Society

The industry has done everything it can to convince the federal government to take action against countries that engage in unfair trade, but to no avail. Now it is imperative for the federal government to fund an aggressive research program that will enable the U.S. metal casting industry to compete with low-cost rivals subsidized by their governments. "With our costs and wages, we have to be at our very peak in every other area to offset" the advantages of low-cost countries, Call said.

"Outsourcing vs. Domestic Capability: A Practical Perspective"

Dr. Sheila Ronis: Director of MB/MSM Programs, Walsh College, President of the University Group, Inc.

The rapid growth of U.S. dependence on Chinese supply chains for parts and components used in every weapon system has become "an enormous national security issue" and represents a system that has become "extremely dysfunctional," said Ronis. The U.S. military industrial system is a subsystem of the overall U.S. industrial base, which in turn is part of the global economy. If the U.S. industrial base continues to erode then it will have a detrimental impact of the U.S. defense indus-

trial base. The U.S. government must acknowledge the seriousness of these trends and put together a comprehensive strategy to mitigate the damage.

Luncheon Speaker: "U.S. Manufacturing: Is the Cup Half Full or Half Empty?"

Richard McCormack: Editor and Publisher, Manufacturing & Technology News

In the 1990s, U.S. industry was rebounding from the competitive challenge posed by Japan by introducing lean, Six Sigma, ISO 9000, Best Practices, the Baldrige Criteria and by adopting digital systems throughout their entire enterprises. They cut costs, and reduced prices for their products, but it wasn't enough to counter a 75 percent reduction in prices for the exact same products made in the Eastern Bloc and China. Is it possible for U.S. companies to reduce the price of their product by 75 percent? The story today is the rise of China that has come about by its stealing digital designs of U.S. companies, some of whom don't even know they're being ripped off, and what China's rapid rise means for U.S. industry and U.S. society. Can the United States remain a superpower if it doesn't make anything?

Kevin O'Connor, Chemical Engineer, US Army, ARDEC-RDECOM Master of Ceremonies

"Hypothetical (but true) Scenario for the Future: The All Digital Casting Process"

Christof Heisser: President, Magma Foundry Technologies Inc., Dan Maas, The ExOne Company

The United States metal casting industry is way behind rivals in Europe and Asia. It is slow to invest in new equipment and technology and is 20 percent less productive than most foundries overseas. The claims that the United States is leading in metal casting technology are "laughed off" by the rest of the world, said Heisser, whose German company sells metal casting simulation software worldwide. The remaining metal casting firms in the United States could be in trouble when big customers that are buying low-volume cast parts figure out that they can get better and cheaper parts from offshore. Although the market in the United States has improved "there is not a movement of big foundries to invest in new technology and attract new people," said Heisser.

"Defense Industrial Base and Critical Technology Assessment"

Brad Botwin: Director of Industrial Studies, Bureau of Industry and Security, U.S. Department of Commerce

The last time the Commerce Department's Bureau of Industry and Security looked at the health of the U.S. metal casting industry was in 1987. It's probably time to have a new look at the industry, said Botwin. The Bureau of Industry and Security is currently engaged in industrial base assessments of the U.S. space industry, and electronics industry. It is undertaking a study on counterfeit electronic parts finding their way into military weapon systems.

Alfred Spada, Editor/Publisher, Modern Casting/Engineering Solutions and Director of Marketing, American Foundry Society "How Globalization Killed US Metalcasting: a Fiction Novel"

"How Globalization Killed US Metalcasting: a Fiction Novel"

Al Spada: Editor, Modern Casting and director of marketing, public relations and communications with the American Foundry Society

The United States metal casting industry is in better shape than news reports might indicate, although it faces some difficult challenges, said Spada in a talk entitled "How Globalization Killed U.S. Metalcasting: A Fiction Novel." The industry is in an up-cycle, but that will likely change starting in 2008. The industry is forecast to go through another deep retrenchment until it bottoms out in 2011.

"Attracting and Training Tomorrow's Foundry Talent"

Robert Tuttle, Assistant Professor of Mechanical Engineering at Saginaw Valley State University

The metal casting industry must step in and begin a public relations program aimed at attracting a new generation of production and technical workers into the industry, said Tuttle. The old model of industry relying on universities to recruit students into the engineering disciplines is no longer working. "The industry recognizes that it needs employees but getting the message out that there is an opportunity for them is where we are having trouble," said Tuttle.

"FEF: Helping Today's Students Become Tomorrow's Metalcasting Leaders"

Bill Sorenson: Executive Director, Foundry Education Foundation (FEF)

The FEF provides 200 university students with scholarships to study metal casting, but it needs to start providing more money to each student, given the rising costs of education. "It's probably more important today to have the FEF than it was in 1947 because trying to get engineering students to think about manufacturing and to get them to think about metal casting in particular is not an easy thing to do," Sorensen said.

"CERP: History, Contributions and Evolution"

George Crandell, Vice President of Operations, Technikon (Operators of CERP)

The Casting Emission Reduction Program is changing gears from a focus on emissions to the sustainability of the U.S. metal casting industry. CERP has developed the methodology to measure the source and content of emissions, a service that did not exist when the organization was created in 1994. Now it is imperative for the U.S. metal casting industry to begin investing in new technologies, processes and products in order for it to remain a viable force in the global industry and to provide the U.S. military with a new generation of products it needs to protect and arm the nation's warfighters.

"Steel Casting Outlook 2007"

Ray Monroe, Executive Vice President of Operations, Steel Founder's Association

After almost 25 years of having too much capacity, the metal casting industry is facing a new reality: more demand for products and the ability to charge higher prices. It should result in the addition of new capacity and a new round of modernization. But just as this is about to happen, the industry is coping with the evaporation of research into new digital technologies that would make it far more productive and environmentally sound. It is imperative for the United States to recommit itself to research in industrial technologies, and training of the next generation of scientists who will work in the industry.

Roundtable Discussion

A highlight of the Metal Casting Technology Forum involved a panel discussion chaired by Dr. Sheila Ronis. Audience members provided Dr. Ronis with questions written on index cards. She read them aloud and asked the panelists to respond.

"What are the next steps to Ensuring a Strong Domestic Capability?"

Panel Chair:	Dr. Sheila Ronis, *University Group Inc.*
Panel Members:	Ray Monroe, *Steel Founder's Association*
	Jerry Call, *American Foundry Society*
	Brad Botwin, *U.S. Department of Commerce*
	George Crandell, *CERP (Technikon, LLC)*
	Kai Spande, *General Motors Corporation*
	Gene Tuohy, *General Motors Corporation*
Question:	What will it take to reestablish a robust and growing metal casting industry in the United States?
Jerry Call:	The bottom line is we all have to be active. It will take everyone in this industry doing their part to get the word out about how important we are as an industry. It will take everyone in our industry to get active in the community to attract young people to our industry. It will take everyone in our industry to work on our image. There are news stories done on foundries across the nation and reporters have an idea in their mind as to what the industry is like. They use the same

Panel Members Left to right - Brad Botwin, U.S. Department of Commerce; Gene Tuohy, General Motors Corporation; George Crandell, CERP; Kai Spande, General Motors Corporation; Jerry Call, American Foundry Society; Ray Monroe, Steel Founder's Association
Roundtable Panel Discussion: "What are the next steps to Ensuring a Strong Domestic Capability?"

old pictures from the 1890s -- pictures of our industry from the EPA or OSHA with some guy grinning with the tattoo of “Rosie” on his bicep and a heart turned around backward. The pictures they run are of a smoky factory in which you can’t see the walls. We have to change that image.

We have to stay politically active. The most important place you can make an impact on your officials is in your district. Your facility represents voters and their tax base. Let them know how important you are to the economy.

Raymond Monroe: We need three or four things to happen. One is we need a dramatic improvement of high-performance casting applications. We have to get the engineering tools for manufacturability and service performance so that people will have confidence in castings. The most common concerns people have is that they are sure we buried a crack or there is porosity in their casting and it will fail prematurely. We need systems and the technology in place to assure people of the performance of high-performance parts, high-performance alloys and high-performance applications.

We can make steel with 180,000-yield-strength and we can have a better strength-to-weight ratio than titanium. That requires R&D funding that has always been provided by the federal government. But funding is in sad shape right now. There is little investment being made in the engineering infrastructure and real engineering research at universities that have an interest in engineering and that train engineers to actually make things.

The second area is changing tax policies that discourage capital investment. If you have a sunk capital investment in the United States, it’s very difficult to operate profitably. If we’re going to begin a major recapitalization of our industry, then there has to be a change in the depreciation in the tax code. If we don’t encourage people to make that capital investment in the United States, they’re going to make that capital investment in Mexico, Eastern Europe or in China.

The third thing is we need some rational approach to environmental regulations. There is a foundry in Berkeley, Calif., that takes all of the air from its plant and filters it through a baghouse and activated charcoal filters. They are next to the freeway. If they suck the VOCs off the freeway and they survive the baghouse and the charcoal filter, it is considered to be an emission from their plant.

Here we have a big vacuum cleaner doing nothing but cleaning up the air in California and yet they’re seen as an environmental negative rather than as an environmental positive. How many of our plants are actually taking particulate out of the air rather than contributing particulate to the air? We just don’t have the metrics to answer that question.

If you’re going to buy steel and Nucor is the most environmentally sound producer in the world, why don’t they get any economic benefit from that? They have to compete against Chinese steel makers that have no environmental controls.

I'm not optimistic that we'll deal with these three policy issues, but those are the critical ones in order to have a robust metal casting industry.

Sheila Ronis: The best advice for individual metal casters is that U.S. public policy only changes when voters want change. People ask, "What can I do?" The reality is you can do a lot. You can ask every one of your employees to write to your senator and congressman and get them involved in this discussion. Congressmen Don Manzullo of Illinois and Tim Ryan of Ohio have a bipartisan Manufacturing Caucus in the House of Representatives. You need to make sure that every one on that caucus knows your views. When I talk to a congressman, they tell me that if they get just seven e-mails from their constituents they know that people are concerned about an issue and that they have to get involved. So don't think you can't make a difference. You can make a difference, simply by having yourself and your employees sending e-mails to your local representative. The only way U.S. public policy will change is when people say we've had enough, it's time to change.

Jerry Call, Executive Vice President, American Foundry Society "AFS and how it serves the North American Metal Casting Industry"

Question: How does the United States compare to other countries regarding a cabinet-level organization focusing on manufacturing within the government, such as MITI in Japan?

Brad Botwin: We don't have anything like it. Our tradition -- our mantra -- is free trade. We try not to get involved in industrial policy. Occasionally on the defense side there might be a need for Buy American. But otherwise, it's what I call a free for all: it's us versus every other planned economy.

Take the case of offsets. If we sell a weapon overseas, a country dictates what portion of it will be built in their country. But if we buy a foreign system, you don't see the Defense Department dictating production here or technology transfer here. Even in civil aircraft, if Boeing sells an aircraft overseas, the country demands local content. If a U.S. airline buys a foreign aircraft, you don't see them demanding that a portion of it be built here. There is a free-market approach on our side versus dictated economies on the other side.

On exports, in this environment, our companies should be taking advantage of the dollar versus the euro right now. It would be worth it for the industry to come to Washington and sit down with our export people at the Commerce Department and figure out a strategy to take advantage of the pound and the euro. We should use the currency situation to turn our exports around and create an export drive and try to get some market share back.

Question: R&D performed in North America can make our foundries productive and competitive, but it can also be picked up by developing countries like China. Should we be doing something about it?

Jerry Call: That is difficult to handle because we have so many large U.S.

corporations that are multinational. We have had the experience where we proposed research projects that were rejected by the funding agencies in the United States but were picked up across the water. It's also difficult because U.S. research dollars can be shipped outside of the United States for research purposes. That is a tough problem. We do our best with the research that is done with our partners at the American Foundry Society where we require a two-year lag time before it gets out.

Gene Tuohy: A good bit of the answer goes back to a question that bears repeating: Do we have a level playing field? GM has tech centers in India, Shanghai, Europe and the United States. We're going to develop R&D collaboratively around the globe. The question is not that we're not going to share R&D, but it goes back to the question of do we have a level playing field?

Question: It is okay for China to acquire U.S. production assets when all they do is bring all of the valuable tooling back to China and put the people out of work?

Jerry Call: No.

Question: Is there anything we can do about it?

Brad Botwin: There have been minimal formal takeovers by the Chinese of American companies to date. The Dutch, British, Japanese and Germans are the major buyers. But with the Chinese building up so much of a trade surplus at some point they are going to be buying assets because T-Bills may not be enough. This is going to be a big challenge for the administration.

Sheila Ronis: Most of the filings for foreign acquisitions made with the Committee on Foreign Investment in the United States are voluntary. The people being acquired do not have to say anything if it is not considered a national security concern. It's a complex process and many times it is not used. My DOD friends at CFIUS say that most of the time it's a political decision and not truly about national security.

Question: What types of strategies are needed to address the rising costs and increasing difficulty in sourcing primary metals and other raw materials?

Ray Monroe: Raise your price.

Question: Sometimes you need to get raw materials and you can't get them.

Ray Monroe: Prices are going up for castings and they are in short supply. You have to do the basic economics: castings aren't free; they're not out in the parking lot. Economics is always about the allocation of scarcity based on value. You see the price of all the raw materials going up not because the cartel is smart enough to control the price but because there is not enough production capacity. Whether its nickel,

molybdenum or titanium it's going to be an ongoing problem that is not going to be solved in the short term. If you need those supplies, you need to develop relationships with producers that give you preferential treatment, which means you will pay more than your competitors.

Question: How do we keep young engineering talent in our industry when we continue to place young engineers in production supervisory and maintenance supervisory positions? I see many of these people quit.

Gene Tuohy: Frankly, I don't see as much of that. I see more engineers that are more satisfied being in production and maintenance roles because there is excitement there. One of the things you have to do is run your business in a collaborative fashion, where there is a lot of overlap and exposure so that no one engineer sits on a laptop and plays with software all day long. I know a lot of people who think that's boring.

Many young engineers don't want to be on the floor. After having spent time with them and convinced them that they would be a better engineer after laying their hands on something and experiencing the floor, I see dramatic changes in their attitudes. The classic example is with Double-Es (Electrical Engineers). They don't want to go into maintenance. But I know with 100 percent assurance having sent Double-Es to the floor for maintenance they come back to me and say, "Gene, please don't put me back into engineering."

There is a lot of talk about engineers not wanting to be in manufacturing but that has not been an overwhelming experience on my part.

Ray Monroe, Executive Vice President, Steel founder's Association "Steel Casting Outlook 2007"

Question: What impact is the Iraq war having on the U.S. metal casting industry?

Ray Monroe: Military applications of castings are right around 5 percent of the total market. They threw the war in at the right time because in the 2000- to 2003-time period we had plenty of capacity. But if they try to significantly increase the amount of military hardware they're going to have significant problems doing that because of the shortfall of supply.

George Crandell: In the titanium world, there isn't enough. When the Boeing 787 Dreamliner is in full production that will use 90 percent of the total titanium that the U.S. uses and so DOD will have a problem. They're trying to figure out how to get titanium castings for military systems. That is a situation that is not going to go away.

Question: Is there a desire or need to pull large foreign metal casters into CERP?

George Crandell: We have had interchanges and visits from the Europeans. The trouble is they do not have an organized program. They have projects

funded by the EU. Part of the issue is who are we competing against? Mostly the problems are not with the Europeans. They have environmental standards. If you look at the basic reduction goals of CERP with castings emissions. Third World countries don't have environmental standards, so what is their incentive to participate in CERP?

Question: How much money do foreign governments invest in metal casting research and development and how does that compare to the United States.

Jerry Call: We had a visit from the Chinese Foundry Association last fall and they said the government does fund many of the projects that are vital to their industry. They mandate that certain facilities participate in research.

Question: Who leads in metal casting technology applications? Where does the U.S. stand right now and what are the trends?

Jerry Call: As far as application of research, the U.S. is still right there on the leading edge. But due to the level of investment in research, our greatest challenge in keeping that advantage lies in continued funding for metal casting research. The challenge is that so many of the programs from the government's standpoint today have to be sexy in order to attract research dollars. We need to improve our processes but these types of application and process research projects are difficult to package. They are not sexy enough to go with the current trends in government funding.

Question: What is the level of R&D investment that should be made by the federal government?

Ray Monroe: More.

Question: Has anyone done an honest assessment of the metal casting defense industry?

Brad Botwin: I'm not aware of any major assessments.

Question: Does the U.S. risk losing the metal casting industry?

Jerry Call: That question is why it is so incumbent upon us to make people aware of our capabilities and how integral we are to everything we do. There is no silver bullet out there to perpetuate this industry. It is so important that we keep working on all fronts including currency and intellectual property violations.

One of our members came to us and said he needed our help. His entire company was being knocked off by the Chinese. They changed his company name by one letter. They used his company's colors. They knocked off their designs along with everything else. But China has realized that to keep investment coming they have to take actions on these cases and so he needed a letter from us verifying that his




company was the real deal, that it was the original firm. He said, "We are going to take that letter into their court system and with it we think we can prevail." And they did. The point is we have to maintain pressure, vigilance and activity in all these areas.

Ray Monroe: There are wonderful people who work in the Commerce Department's Trade Compliance Center that will directly work with you on these intellectual property violations.

Question: How far advanced is India in modern metal casting?

Gene Tuohy: From what we've been looking at recently it's very clear that they're not as far advanced manufacturing-wise as China. Politically, they are much more disorganized than China, which has a national policy. From a technical side in the casting business, they don't have the infrastructure yet that other areas of the world have. I don't think India is going to be a threat to us in the next five years. After that it's hard to predict, but they're nowhere near China and Mexico today.

Question: How do you see your industry in 30 to 50 years?

Jerry Call: We're going to continue to see a shakeout in terms of numbers of establishments and continued diminishing to a point as we did in agriculture, but what remains is going to be much stronger than what is here today. What will remain will be very strong.

Ray Monroe: The foundries will become very boring. There won't be big ladles with lots of metal in them splashing stuff around. There won't be smoke. We'll have ladle-less production. We'll exclude air so we don't have any pollution. Everything will be digital. We'll have tool-less foundries so we won't make permanent tooling except for high levels of production. All the limited production will be directly print-to-mold. We'll see the highest performance metals parts being cast. The single crystal turbine blades are the highest performance metal part and they're cast. We'll continue to see high-performance casting as the absolute best opportunity for metal products for high-performance applications.

Question: Would you rather have R&D assistance from the federal government or a level playing field?

Ray Monroe: I'm a technical guy. I don't think they can level the playing field. Life is inherently unfair. R&D might be competitive no matter how unlevel the playing is. So I'd rather have the R&D and stay ahead that way.

Jerry Call: I agree with that because we're going to get R&D support much quicker than we're going to get a level playing field.

Ray Monroe: What we've seen when we had the matching funds program with [the Department of Energy's] Office of Industrial Technolgy and DOD is we could find the matching funds with industry. The government was

playing a convener and infrastructure-support role, which is critical to us. With the ramp-down in funding, it's more difficult to attract private capital to do the R&D as well. Part of it is the long-term capital contraction where there just is not enough money in the system. We still don't have money in the system. We're not hiring young engineers not because we don't need them, but because we can't bring ourselves to pay a kid $55,000 with a $5,000 signing bonus. That's really painful for us.

Prices have to get high enough where it's really profitable and we're an attractive investment. We're not there yet.

So while the price of commodities trends down over time, once every 20 or 30 years, you have to build a new factory and to build a new factory you have to hire a lot of engineers. And to hire those engineers to make that investment, the price has to go up.

Over the long term you erode your capacity because you can't make the capital reinvestment and at some point in the future global growth combined with the capacity that you lose creates a shortfall.

If we didn't have this volatility it would never hurt because we improve our productivity by 4 percent or 5 percent a year, so we're gaining capacity every year in an existing facility with improved throughput. But because of volatility we eventually get rid of the obsolete facilities that can't stay financially viable.

At some point you run into a situation where there is not enough capacity and that is when reinvestment is made. But in the early stage, people don't buy equipment, they buy out companies.

I think we're in that early stage. I don't think we'll see a significant increase in private R&D funding until after the projected 2010, 2011 slowdown, and then I think people will make that investment. As commodity prices remain high, they'll decide that they don't really need a factory that will last forever; they'll need one that they can pay off in three years. Once that happens you'll see people pull the trigger and start to make those capital investments.

Kai Spande, Engineering Manager, General Motors, SMOCO, Panel Member

Kai Spade: Isn't it really a Catch 22 though? If you do the R&D and spend the money, you need a capital investment to realize what you've done, and if you don't have the capital investment to go after the project, you can't apply the technology. You need to do both.

Ray Monroe: One of the real painful things is that with the ramp-down of R&D funding we've destroyed the infrastructure. Just at the moment we're about to make major capital reinvestment where we can use the energy efficient technology, the funding goes away. With the university and engineering infrastructure being pulled down, we will not be as energy efficient as we could be because we won't have the engineering infrastructure to make those investments.




Gene Tuohy: With regards to fair trade versus R&D, it's hypothetical to separate them because in today's digital world, Moore's Law means that every 18 months China will double its capacity to copy everything we have. So it's hypothetical to separate R&D and fair trade. We need both.

Speaker Presentations in Depth

John Buttermore, Vice President of Manufacturing Operations for General Motors Powertrain Division

"General Motors… Products, Processes and Technologies"

General Motors is positioning itself for a major increase in sales volume over the next seven years, John Buttermore, Vice President of Manufacturing Operations for General Motors Powertrain division, told the opening session of the conference. By 2014, global vehicle sales will increase by 20 million units. "People are surprised that it will be a high-growth industry," he said. China's market alone is projected to increase by almost three-fold, from 6 million to 15 million vehicles.

GM is in better health than news reports might indicate. In 2006, the company produced 9.2 million vehicles, up 14 percent from the previous year, and the company's second best year for volume, its best coming in 1978. Fifty-five percent of its production is outside the United States. In Europe, GM achieved record volume last year of 2 million vehicles. It achieved record volume in Latin America.

For the first time in history, Toyota is close to surpassing GM, but that's mainly because Toyota sells 2.4 million more units in Japan than does GM, said Buttermore. Toyota's dominance in its home market "is a headwind we're up against. We win in 12 of the world's 15 largest markets."

In the future, the competitiveness of GM depends on "product, product, product" because every region has different market characteristics. Eighty-four percent of the global market is for three- and four-cylinder engines. There is growing demand for high-performance fuel-efficient vehicles. "There is no silver bullet with regards alternative fuel vehicles," Buttermore said.

GM is investing significant resources in developing vehicles across the entire spectrum of drive trains including hybrids, electric, hydrogen fuel cells, clean diesel, advanced gasoline, natural gas, CNG and ethanol. It has developed 17 different engine variants for diesel fuels and sells 1 million diesel-engine vehicles each year. It has also developed a variety of models that run on flex ethanol fuels.




GM has 47 factories in 14 countries. It produces more than 36,000 engines per day. “The sun never sets on our operations,” Buttermore said. The company has achieved 44 percent improvement in costs over the past 10 years. It has invested $1.4 billion in its U.S. plants over the past 18 months. “This is our best effort,” said Buttermore. “We are going to be successful.”

Jerry Call, Executive Vice President, American Foundry Society

“ÁFS: Supporting the Metalcasting Industry”

Unfair trade remains an important issue for the metal casting industry. But the industry’s efforts to persuade the federal government to act on its behalf “has fallen on deaf ears,” said Jerry Call, Executive Vice President of the American Foundry Society. So what can the industry do to be more competitive?

The answer: create a more robust environment in the United States for innovation, the funding of research and development and the adoption of cutting-edge technology. It this doesn’t happen, then the U.S. foundry industry will continue to struggle. “We are somehow going to have to beat the Chinese on or own, even though they have rebates from their government and have an undervalued Yuan,” said Call.

The realization that the U.S. federal government won’t go to bat for the industry has sunk in. The International Trade Commission conducted its so-called Section 332 investigation of the industry and presented its findings in 2005. It found that China’s currency, undervalued by 40 percent, constitutes an unfair subsidy to Chinese manufacturers. It found that the Chinese government provides its manufacturers a 17 percent subsidy whenever they ship products offshore.

The ITC investigation “confirmed what we already knew,” said Call. The industry used the results in its lobbying trips to Capitol Hill, the Commerce Department and other agencies that deal with trade. The response: nothing.

Then there was the Section 421 ruling by the Federal Trade Commission, which voted six to zero in favor of the U.S. water equipment fittings industry against illegally dumped imports. But the

Government overturned the decision, claiming that the U.S. economy would be harmed if the federal government imposed duties on imports from China. In order to stay competitive, the company that brought the case to the FTC, McWane Inc., of Birmingham, Ala., opened a plant in China and has laid off about 500 American workers. “It was a stab in the back of that company” and the industry, said Call. “It has been a real disappointment to our members that they haven’t gotten more response from their own government.”

Now there is a sense that the industry has a five- to seven-year window of opportunity during which “we really have to do a lot of soul searching to make sure we are serving the proper customers and that we are investing in technology and state-of-the-art capital equipment,” Call said. “With our costs and wages, we have to be at our very peak in every other area to offset” the advantages of the low-cost countries. “The feeling is that we’re going to continue to have some shakeout in our industry, but we’re getting down to a core, and the core that remains is very dedicated to waging that war. If we can hold on until China gets enough of a middle class to start driving demand for cars and refrigerators then that will be a country we can export into. We have to maintain our base so that we can take advantage of that when it comes.”

The U.S. foundry industry is the backbone of every other industry that exists, “and yet there is still a great lack of knowledge about our industry, period,” Call added. “It might sound corny, but we are the key to every other manufacturing process. One of the important things for our industry to do is to make sure we get the recognition of how important our industry is.”

The industry is in need of a robust research effort. Yet much of the money being spent on R&D heads into sexy, cutting-edge technologies. “We’re considered an old industry and nobody wants to spend money there – but there are a lot of cutting-edge things we need to do to maintain a manufacturing base,” said Call.

The American Metal Casting Consortium and the Cast Metals Coalition are engaged in research programs aimed at supporting the American warfighter, reducing energy in production facilities and coming up with new materials to make much lighter automotive components that can help companies comply with CAFÉ standards.

Most of the government research programs aimed at improving the industry require matching funds

from participants. “This is not corporate welfare because as our members and our associations invest money they have to see the project through to completion,” Call stated. “If they leave it hanging in mid air, it’s wasted money.”

The Energy Department has a small metal casting research program, but it is being stressed because the agency has allowed other industries – hydrogen cells, wind energy and food processing – to compete for the same pool of funds.

Continued funding of metal casting research “is just so key because in China the government will go in and tell industry, ‘You are going to participate in this research and this is what we want done at your facility.’ We’re developing our own non-profit 501(c)(3) metal casting research foundation, but we won’t be able to come up with enough funds without those matching funds. That is critical to CERP, the Steel Founders and to us. The R&D has to be continued to be funded because that is the lifeblood of our industry.”

In the meantime, it is prudent for companies to start gaining a foothold in the fast-growing Chinese and Indian markets. “We have to be careful as an association because our mission is to maintain a vibrant U.S. metal casting industry, but at the same time, as part of that – where it fits – and it doesn’t fit for everyone – our industry members can really benefit from having links overseas.” German competitors are building capacity in China, “and they’re taking advantage and getting a foothold in setting themselves up over there,” said Call.

Sheila Ronis, Director of the MBA and Master of Science in Strategic Leadership Programs at Walsh College and President of the University Group Inc.

“Offshoring vs. Domestic Capability: A Practical Perspective”

The United States is becoming overly dependent on China for manufactured parts, a situation that must be reversed, Sheila Ronis told the Forum. When doing research on the extent of dependence on foreign-made parts, Ronis said that the more she looked into the supply chains of almost every weapon system “the more Chinese it became.” The situation has become “extremely dysfunc-

tional," she said. "To me, this is an enormous national security issue."

Unfortunately, it's not viewed as such because many policymakers and military officials do not believe that China is a military threat. They believe, in fact, that China is not a threat at all. "They only see the dollars and the opportunity for growth," said Ronis. "They don't understand the totalitarian regime. They think somehow because China is becoming more capitalist from an economic stand point that it will automatically by osmosis change them into a democracy."

Sheila Ronis, Director of the MBA and Master of Science in Strategic Leadership Programs at Walsh College and President of the University Group Inc. "Outsourcing vs. Domestic Capability: A Practical Perspective"

But the more money that has flowed into China, the more totalitarian the country has become. "They may have some deeper sets of issues in China, like the growing gap between rich and poor that can make them sometime in the future more unstable and lead to mass hysteria," she said. If such a situation occurred, it could seriously disrupt the supply chain structure of the entire industrial world "and we can't afford that economically or from a military standpoint," she said.

Companies are not seeing the effects of U.S. policy decisions toward China because of their cozy business relationships with China, she said. This includes defense contractors Lockheed Martin and Northrop Grumman and many others. "When you partner with a Chinese company, there is a very high chance that it is not a company in the way we think of companies. It's part of the People's Liberation Army."

Ronis, a systems scientist, argued that the U.S military industrial base is a subsystem of the overall U.S. industrial base. The U.S. industrial base, in turn, is a subsystem of the overall economy; and the U.S. economy is a subsystem of the global economy. "The military industrial base cannot be separated from the other systems of which it is part," she noted. "It can be influenced, but not managed or controlled, though many federal agencies and departments contribute to it sometimes with forces that are opposed to one another. States can impact this as well."

Few people understand that the industrial base is an essential component of the overall national military strategy, said Ronis. This military strategy is a component of the country's overall national strategy, which includes foreign policy, global security and such things as trade policy. "There is no U.S. overall grand strategy," she said. "Where do our global supply chains and other global relationships fit into these systems?" she asked.

"Other nations' actions and policies influence our industrial base especially trade policies which influence our ability to be globally competitive. Free trade is a misnomer in a world of globalization. Free-market forces aren't free, either, since all countries have various non-market forces on their markets, as do we. Free-market states are an ideal we may want to strive for, but at the present time, does not reflect reality."

The U.S. government and military must change their mindset, especially with regards to maintaining a strong industrial base. Ronis quoted Gen. George C. Marshall, who said: "We are now concerned with the peace of the entire world and the peace can only be maintained by the strong."

The U.S. military and especially the Army should be partnering with private entities that still have major casting operations located in the country, such as General Motors, to ensure that they do not choose to outsource it all to China, she said. There must be a re-commitment to basic research and development being conducted jointly with industry directed at paradigm-changing technologies that would make the United States more competitive and improve the country's security options. Military acquisition rules should be updated to encourage purchases from U.S. suppliers, instead of the current legislative preference that allows suppliers from dozens of countries to be treated as if they were from the United States, she said.

The metal castings industry is essential to the underpinnings of U.S. national security, yet every year it shrinks. Import penetration has skyrocketed from 7 percent of the U.S. market to 22 percent. "The message is that every year there are fewer metal casting operations and the Department of Defense has to wake up or we could easily become dependent on China for our Howitzers," Ronis said. Based on her research, Ronis estimates that, at a minimum, 15 percent of every weapon system is made from Chinese parts.

"The question isn't about just calculating risks across our supply chains around the world. The question is how do we assist the United States industrial base to reduce its vulnerabilities so we can remain strong, be concerned with 'the peace of the entire world,' and remain a superpower?"

Ronis said she and others are investigating these issues with the Project on National Security Reform (www.pnsr.org).

She finished with a quote from Abraham Lincoln: “A little neglect may breed mischief; for want of a nail, the horse was lost. For want of a horse, the rider was lost. For want of a rider, the message was lost. For want of a message, the battle was lost. For want of a battle, the war was lost. For want of a war, the kingdom was lost. And all was lost for want of a nail.”

Richard McCormack, News Editor and Publisher, Manufacturing & Technology

“U.S. Manufacturing: Is the Cup Half Full or Half Empty?”

In order to understand where the United States manufacturing sector is right now, it is important to know how we got here.

The 1990s saw the most radical improvement of technology than any other decade in the past 50 years. It is the decade during which digital technologies pervaded every aspect of industry and radically transformed the global industrial landscape.

In 1989, I attended a technical conference in Austin, Texas, sponsored by the Microelectronics and Computer Technology Corp. (MCC). MCC was founded by Bobby Inman, who was previously the head of the CIA. One of the speakers at the event was the director of AT&T Bell Labs. He told the group of about 250 people that the world was going to be stood on its head, due to the fact that the telecommunications industry was, for the first time in its history, moving into the digital realm. Fiberoptics, optical switches, routers, boosters, and converters would replace the copper-based analog system that had been in place since the start of the industry. The telecom industry, he said, would be on the same technology growth curve that the electronics industry had been on since the creation of the integrated circuit. For the first time, Moore’s Law – the doubling of capability every 18 months – was being applied to telecommunications equipment.

This doubling of bandwidth capability every 18 months was taking place all through the 1990s. By the year 2000, sending massive digital files anywhere in the world cost virtually nothing.

In the 1980s, I was editor of New Technology Week. Basically I wrote about the rise of Japan and its




impact on the United States automobile and electronics industries, and the U.S. response. We learned a great deal about Japan – its embrace of Edwards Deming's statistical process control for quality; its attention to detail; and its keiretsu system of supplier development and excellence.

In the late 1980s, the story was how the United States was going to respond to the Japanese challenge – and how Ronald Reagan did just that. He became a hero among "Reagan Democrats" due in large part to his embrace of economic nationalism; for standing up to the Japanese on machine tools and for the massive investments he made in science and in "dual-use" technology, in large part to defeat the Soviet Union, but also to reinvigorate U.S. industry.

Reagan understood that economic security was as important to the country as national security, and he allowed the people working for him to take risks, and not be beholden to economic ideologues. His willingness to delegate and not micromanage led to all kinds of scandals: Iran Contra, HUD, EPA, Dept. of Interior and others. But in the science and technology arena, his hands-off approach had its benefits: there was a tremendous investment in the technological backbone of the country – the creation of Sematech, the funding of Star Wars, the creation of DOD's Defense Manufacturing Council, the genesis of the Advanced Technology Program at NIST, large-scale DARPA (which dropped the "D" for a short time) programs aimed squarely at developing dual-use technologies, and huge investments in networking and digital technologies, particularly in computer sciences and computer architecture.

In the 1990s, the story was how U.S. industry was adopting best practices and doing benchmarking against the best performing companies. As editor of "Manufacturing & Technology News" I covered lean manufacturing, agility, total quality management, Eli Goldratt's Theory of Constraints, the adoption of the Baldrige Quality Award criteria, the ISO 9000 quality standard, the ISO 14000 environmental standard, Motorola's system of Six Sigma, the Shingo Prize, and reengineering. All of these were BIG, important subjects and received a tremendous amount of ink in all the business publications.

In the early 1990s, I created a publication called High Performance Computing and Communications Week or HPCC Week. High performance computing and communications was what the Internet was called prior to its being called the Internet. I covered the creation of the World Wide Web and the creation of Mosaic at the University of Illinois' National Center for

Supercomputing Applications. With an infusion of money from Jim Clark, founder of Silicon Graphics, Mosaic shortly became known as Netscape, the first commercial browser.

As editor of HPCC Week, I traveled to Minneapolis and interviewed John Rollwagen, president of Cray Research Inc. Seymour Cray had recently left to create another company in Colorado. I took a tour of all the Cray Research vector supercomputers in the basement of the headquarters. There I saw five generations of Cray supercomputers. They were huge, about as big as a Volkswagen bug, circular machines that were marvels in the engineering and design of a vast super-cooled plumbing system.

After the tour, I walked with Rollwagen up to his office. He produced from his lapel pocket a DEC Alpha chip about half the size of an iPod Nano. He looked at it and said there was as much computing power on that chip as there was in the Cray I Supercomputer.

The supercomputer was on the desktop.

And look what happened. In the 1990s, led by SUN Microsystems, HP, IBM and Silicon Graphics the workstation industry, based on RISC processors, also invented by Seymour Cray, was able to take huge masses of raw data and render it into a graphical display. As a result, there was the rapid rise of computer-aided design: Catia, Unigraphics and AutoCad. That industry basically did not exist at the beginning of the 90s, when companies like GM were still making clay models.

At the same time, relational database software was a burgeoning industry. This software made it possible for companies to truly operate on a global scale by integrating their financials from all the currencies from counties in which they were operating. It was a huge boon for companies with the names like SAP, Oracle, JD Edwards, Manugistics and many others.

After I started Manufacturing & Technology News in 1993, I was writing about the rise of enterprise resource planning (ERP), manufacturing resource planning (MRP), manufacturing execution systems (MES), product data management (PDM), and, toward the latter part of the 1990s, supply chain management (SCM) systems. There were many others besides these, and they were all important.

Then toward the latter part of the 1990s, the Internet started to hit, and hit hard. A bunch of 26-year-old yahoos were hyping the revolutionary nature of the Internet and how it was going to completely

re-organize the global industrial landscape. The hyperbole was right. The Internet has completely transformed every aspect of industry, but not in the way it was envisioned.

At first it was B2B EC – Business-to-Business Electronic Commerce – and the rapid rise of electronic trading exchanges and online auctions. But they fizzled out. Instead, the Internet opened the doors to low-cost countries to the multinational corporations of the world.

The 1990s was an incredible decade for the development and adoption of digital technology. It was like the 1960s for rock and roll music.

Then something profound and totally predicable occurred. On March 10, 2001, the NASDAQ reached a peak of 5,048, and then it crashed. By Within October 9, 2002, the NASDAQ dropped to 1,100, a fall of 80 percent, far greater than the market crash that occurred in 1929 leading to the Great Depression. The dot-com-bubble burst and, with it, the demand for all of the hardware that made it possible.

Another story I covered closely in the 1990s was the rise of the EMS industry – electronic manufacturing services, or the contract manufacturing industry. Most every U.S. electronics company – IBM, Apple, HP, SUN, Cisco – decided to outsource their manufacturing to this new breed of manufacturing company – Solectron, Flextronics, Jabil, SCI Systems, and Celestica. These behind-the-scenes workhorses became big names. Solectron won the Baldrige Award twice. It was growing at 50 percent per quarter. Its stock hit $53 a share – after two splits – and then dropped after the bubble burst to less than $2.11 a share in September 2002. Solectron is now in the process of being bought by Flextronics.

Since I was covering these companies on the way up, I covered them on the way down. I started phoning into their quarterly conference calls they held with financial analysts. The CFOs of these high-fliers gave it to the analysts straight: demand had fallen off a cliff, down by at least 60 percent. They were swimming in inventory and much of the capacity they had just acquired from the big OEMs was sitting idle.

They all used a phrase that I had not heard before – their “global footprint.” It sounded like Sasquatch. They talked about how they were in the process of closing their high-cost capacity and

shifting their production to low-cost regions of the world. Their high-cost capacity was in the United States and Western Europe. Their low-cost capacity was in Asia and Eastern Europe. Virtually overnight, the companies that specialized in electronics manufacturing closed their U.S. manufacturing plants.

Something else of great importance was happening throughout the 1990s. There was a guy whose name was Ignacio Lopez. He was in charge of purchasing at General Motors. He was despised. He would issue edicts to GM's thousands of suppliers: Cut the cost of your component this year by 5 percent. The next year, it was 7 percent; then 9 percent; 10 percent; 12 percent; 15 percent! Oh My God, are you kidding! 15 percent?!?

Manufacturing was in a deflationary cycle. The rest of the country had no idea why inflation was held in check. Manufacturers were getting creamed. They weren't making any money. Their margins were miniscule.

Things were about to get worse.

In early 2003, I attended a conference at the National Academies of Sciences sponsored by the National Institute of Standards and Technology's Manufacturing Engineering Laboratory. It was not well attended and I was slumping in my seat in the Academies' ornate auditorium across the street from the Lincoln Memorial listening to a speaker.

One of his slides went up above his head. It was titled "The Bevel Gear Example," with a picture of two identical bevel gears, with a line below it that said: "Can You Tell the Difference?"

There was no difference. They were the exact same bevel gears.

Another slide went up, describing the difference. It pictured the same two parts, but with a price tag affixed to each one. The bevel gear on the left had a price of "$921 US Made in North America." The one next to it: "$256 U.S. Made in Poland." The top of the slide said: "COST REDUCTION OF 75 percent!"

The person who presented this slide was John Cassidy, senior vice president of Science and Technology at United Technologies Corp.

I sat up. I thought to myself: Good luck, America. It was the first time I had seen such a slide, and it got stuck in my head. Ignacio Lopez wasn't so bad.

How is U.S. industry going to be able to meet that new cost requirement? How are U.S. manufacturers – the tens of thousands of suppliers to industrial companies like United Technologies, maker of Otis elevators and Sikorsky helicopters – going to be able to reduce the price of their products by 75 percent? How can the United States as an industrial nation stay competitive with Poland? If you could achieve cost savings of 75 percent using Poland as your supplier, what kind of cost advantage could you achieve using a poor nation, like China? 90 percent?

It was a new world, made possible by the revolution in the digital technologies I described earlier.

The designer of a bevel gear at United Technologies could sit in his or her cubicle in Hartford, Conn., using a computer-aided design software program that included every aspect of the part's features – the materials, the tolerances, polish – and send that digital design with a click of the mouse to the person in the cubical next to him, to the factory down the street, or to a contractor in Poland. The design would arrive in each place at the same time, for the same cost of transmission, which was basically zero.

That digital drawing is the intellectual property of the company that designed the part. It is no different from shipping digital music or movies. How can that be protected?

In many cases, it can't.

If the story of the 1990s was the explosion of technology and the rebirth of U.S. industry, the story of the 2000s is the piracy of intellectual property and the rise of China. Entire companies and products are being ripped off.

You want to set up production in China? Okay, but you better be careful.

Most Americans don't know the story of the General Motors' Spark car. GM decided to design and build a car in China for the Chinese market. It partnered with a Chinese company, Chery Automobile, which had a 20 percent stake in the venture and is owned by the Wuhu government.

GM produced a cute new car that it named “Spark.”

Well, low and behold, a few months after GM’s car hit the market, its Chinese partner company Chery which is in a partnership now with Chrysler, introduced its “QQ” car.

The QQ car looked a lot like GM’s Spark car.

In fact, you could take the door off the “QQ” car and put it on the Spark car and the door would close perfectly – a perfect fit. The entire car was a counterfeit. Every single part had been ripped off by the Chinese and used to build an exact replica.

I interviewed Rep. James Sensenbrenner, a Republican from Wisconsin, who at the time was chairman of the House Judiciary Committee, shortly after his return from a trip to China. He said GM’s experience with its Spark car “should be the poster child of intellectual property theft in China.”

But GM didn’t do anything about it. Sensenbrenner asked GM why they didn’t take Chery to court, sue them for ripping off an entire automobile. GM said that the court system didn’t offer any redress. Sensenbrenner said GM didn’t want to upset the Chinese government because China is such an important market for automobiles. Sensenbrenner told me this: “The Chinese government can simply tell GM that if you squawk too much about this then we’ll simply reduce your market share of cars. We’ll just give your market share to your competitors, which would mean that Volkswagen, Toyota and Ford would end up going to town there.”

Imagine if such a thing happened in the United States: Toyota introducing a new “Tundra” pickup truck that was an exact duplicate of a Dodge Ram pickup. Imagine the outcry in the press.

Yet there probably aren’t more than 5,000 people in the United States who know this story. It’s happening every day in China.

How is it possible? It’s pretty simple. A U.S. company outsources its production to a Chinese firm that is owned in part by the Chinese government. China is a communist country – a totalitarian state. Private property is not part of the communist manifesto. That U.S. company sends the digital designs of its products to be made to its Chinese contractor, who then provides them to another Chinese com-




pany, which makes them on their own – exact duplicates that will be sold against the U.S. company that provided its contractor with its digital drawings.

Not only are U.S. manufacturers susceptible to counterfeits in China, but their own products sold only in the United States are being counterfeited by the Chinese. Here's what Steve Pinkos, director of the United States Patent and Trademark Office, told a House Small Business Committee hearing recently: "Companies in the United States that don't even conduct business in China are having their products ripped off and copied. American companies need to protect themselves from Chinese fakes by making sure they patent and trademark all of their products in the United States."

I'm the editor of Manufacturing & Technology News. I listen to manufacturers and macro economists. The measures that matter to me have to do with how companies compete: The bottom line of costs and prices charged. I like listening to the people in the field, those making products, those having to compete. The armchair economists control the terms of the debate, but they're not running businesses that have to compete with the Chinese government.

The University of North Carolina's Business School did a study recently on the North Carolina furniture industry and why it was being annihilated by cheap Chinese imports. With case goods, a manufacturer in China could produce the same exact product that was being produced in North Carolina. They could pack the Chinese-made product into a container; truck the container to a port on the east coast of China; load it onto a container vessel; ship it over the largest ocean on the planet; unload it in Long Beach onto a truck; drive it across an entire continent; unload it in a warehouse a mile from the plant that was making the same product in North Carolina; and have it cost 35 percent less.

How is that possible? Even with the advantage of cheap labor, given the global cost of energy, which is running at more than $90 per barrel? How is it possible, given the weight of the furniture being shipped? It makes no economic sense. And yet it does, because the furniture industry in the Carolinas is disappearing due entirely to cheap imports from China.

I spoke with John Wentworth, the president of Moosehead Furniture based in Monson, Maine. It is the largest family-owned furniture company in New England, and it is out of business. When speaking with Wentworth, he cried when he described how hard it was to lay off his workers – people

he had gone to grade school with, friends of his family for generations. He said: “You have to look at those people in the face. They’ve been here for 20, 30 years. It’s a portion of rural America that is slipping away and it won’t come back.”

He said there was no way he could compete with Chinese imports. One of his cane chairs cost $110 to make in Maine by master craftsmen. The same chair made in China cost $15 by a worker getting paid 20 cents an hour without healthcare costs or OSHA inspecting his work place. To ship a container full of the same chairs from China to the United States costs between $2,500 and $3,500. A fully loaded container of Moosehead chairs was worth $55,000. A fully loaded container of Chinese chairs arriving anywhere in the United States: $7,000. That’s 87 percent cheaper. “I don’t understand how you do that,” Wentworth said.

Look at the machine tool consumption figures. The consumption of machine tools is one of the best indicators of manufacturing output. Machine tools produce products. China’s economy is officially one-tenth the size of the U.S. economy, and yet in 2006, China consumed more than double the amount of machine tools as the United States. China’s machine tool consumption was $13 billion, up from only $4 billion 10 years earlier. The United States consumed $6 billion in machine tools in 2006, down from $7 billion 10 years earlier.

In machine tool production – another bell weather of a nation’s industrial capability – the United States produced a meager $3.6 billion in machine tools in 2006. China’s output of machine tools was almost doubled that: $7 billion. Japan’s output of machine tools was four times the amount of the United States’ at $13.5 billion. U.S. production of machine tools in 2006 was $1 billion lower than it had been 10 years earlier. The United States is the only major industrial nation whose machine tool production declined over the past 10 years. China’s production increased from $1.7 billion in 1996 to $7 billion in 2006.

I interviewed Brian O’Shaughnessy. He is the president and CEO of Revere Copper – the company that was founded by Paul Revere. It’s the oldest company in the United States. One of the oldest factories in the United States is owned by Revere Copper in New Bedford, Mass., home of the Pequod, Ishmael, Ahab, Quequig and Starbuck. Revere Copper’s plant in New Bedford has survived through centuries of economic ups and downs, but the factory closed this year. The factory had been fabricating copper continuously since 1862. O’Shaughnessy said if Paul Revere were alive today, he’d be warning Americans “The Chinese Are Coming! The Chinese Are Coming.”




These are the people who make products. These are the people who employ Americans. These are the people who add value and create wealth and pay taxes so that money can be used to fix bridges so they won't fall into the Mississippi River; whose tax revenues we will need to pay for the retirement and health care of 76 million Baby Boomers.

And what do the economists say: "Who cares? It doesn't matter that we're shifting our production to China and that the United States doesn't make anything." I hear it constantly – constantly! – from them. They say the United States will be better off. Consumers are better off. They'll be able to buy a lot more stuff for a lot less. Wal-Mart has wedded itself to the concept. Wal-Mart is using it as a marketing tool, claiming it saves the average American family $2,500 in 2006 due to its "Save Money, Live Better" advertising campaign.

Has Wal-Mart looked lately at the trade deficit? In manufactured goods, it stood at $916 Billion in 2006. That's almost $3 billion PER DAY leaving the United States. To put that into perspective, the total yearly budget for the National Science Foundation is $6 billion. The interest payment on $916 billion per year (at 5 percent) is $46 billion. The trade deficit equaled $3,053 per person last year; or more than $12,000 for a family of four. Interest on that is $153 a year per person or $612 per family. But that is only for one year's worth of deficit. Every year it goes up and every year, that interest burden increases.

There is little inflation in our system. Oil prices have skyrocketed from less than $25 a barrel in 2003 to now exceeding $70 a barrel. Health care costs have increased by more than 50 percent since 2002. Higher education costs at state universities are up by 35 percent in the past five years.

Yet the inflation rate is low – 2 percent. The reason is because we have shifted so much of our production of consumer goods to China, where there is no enforcement of environmental or workforce safety regulations – where there are countless subsidies and tax abatements and incentives.

National Association of Manufacturers president John Engler recently said there are 120 major chemical plants being built in the world today, one of which is in the United States.

The Washington, D.C., law firm of Dewey Ballentine did a study for the Semiconductor Industry Association and found that there are 28 major semiconductor fabrication plants either on the draw-

ing boards or being built in China today. The number of major fabs under consideration or being built in the United States is two. A fab costs between $3 billion and $4 billion to construct, about the cost of a nuclear-powered aircraft carrier. A fab generates billions of dollars of revenue and residual benefits, and yet there are only two such plants being built in the United States.

The story I cover today is about China, unfair trade and the rise of the multinational corporations that are benefiting from protectionism abroad. The story today is how the big companies that have shifted production offshore are more profitable than they've ever been, and yet the country is going deeper into debt and millions of Americans can't afford even basic health care.

Few people in our country have made the correlation between the lack of industry and the growing impoverished state of the American workforce.

The story today is China: In 2006, China consumed 274 million metric tons of steel. The United States consumed 100 million metric tons. China's environmental protection agency has 500 employees. The U.S. EPA has 18,000.

The biggest export from the United States is waste paper. The nation's largest exporting company – in terms of ocean containers – is American Chung Nam. In 2004, American Chung Nam exported 201,100 containers of waste paper. The second largest U.S. exporter via ocean container was Weyerhaeuser, which sold paper. Thirty of the country's 100 largest exporters via ocean container exported paper, wastepaper or forest products – logs. The next largest export categories via ocean container were bulk chemicals, followed by foodstuff, animal feed and minerals.

There are 450,000 workers in Los Angeles moving imported containers. The container and port industry in LA added 45,000 new jobs in 2005.

I attended the SouthCon show in Orlando, Florida, in 2006. It is the big IEEE exposition for the electronics industry in the Southeastern U.S. Ten years ago, 10,000 people attended the show. In 2006, that number was down to 500. One of the show's sponsors told me that if the event was being held in China, there would be tens of thousands of people in attendance, but the electronics industry in the Southeastern U.S. has disappeared.




At a competitiveness forum held by the U.S. Department of Commerce in 2006, National Semiconductor CEO Brian Halla told a packed auditorium: “There is a gold rush taking place in China. It’s a major opportunity and it’s a major threat if we blow it. And we are blowing it – big time. The Great American Dream appears to be moving to Shanghai.”

The National Academy of Sciences issued a report in 2006 describing the economic condition of the United States printed circuit board industry. In 2000, the industry employed 80,000 workers. By 2004, that number had dropped by half to 40,000. Revenues for the industry have shrunk from $10 billion to $4 billion. The U.S. printed circuit board industry now accounts for less than 10 percent of world output. Of the top 25 companies, only four are based in the United States and all of them do the majority of their manufacturing offshore.

People say manufacturing job loss will follow the same curve as agricultural jobs. But there is an important difference. Warren Buffet, worth $43 billion, does not eat any more food than you or me. But his demand for manufactured goods is a lot bigger than yours or mine.

Why isn’t much of this reported in the media, save for Lou Dobbs? The reason was explained repeatedly by former South Carolina Sen. Fritz Hollings. He observed that the majority of newspapers were supported by advertisers, most of which were the big retailers. Big retailers like cheap prices from China. The big retailers are the biggest importers. If you’re only paying 35 cents for a copy of the Washington Post, you realize it’s the big retailers that are paying the majority of the costs of gathering and disseminating the news, and they don’t want to see stories about China or unfair trade or anything I’ve been discussing in “their” paper’s pages.

Basic societal questions are being raised by the trends of globalization, the most important of which is perhaps this one:

Who does the United States government represent?

Does the United States Government represent the interests of multinational companies or does it represent the interests of American workers?

Ralph Gomory, president of the Alfred P. Sloan Foundation says, “People in our government still

are treating companies as if they represent the country, and they do not."

When I interviewed Rep. Tim Ryan (D-Ohio) and asked him why his China currency bill wasn't going anywhere, he said this: "China has a stranglehold on our country right now." I was incredulous. Is that really the reason? I asked him: He replied: "There are a lot of multinational corporations that are making a lot of money in China and they are sending their goods back here for Americans to buy. They don't want it this legislation to happen. They like it the way it is because they are making a lot of money. They also donate a lot of money to Congress. China is also a major funder of the deficits that we're running.

I asked Rep. Duncan Hunter (R-Calif.), who was running for president, the same question: He said: "For practical purposes, many of the multinational corporations have become Chinese corporations. They like the fact that they are subsidized by their new government, which is China."

Cisco CEO John Chambers said in late 2004: "What we're trying to do is outline an entire strategy of becoming a Chinese company."

The second big question the United States faces is this: Can the country remain a superpower if it does not have an industrial base to support it?

Back in 1972 English historian and philosopher Winwood Reade wrote that, "Industry is the only true source of wealth."

Another question that needs to be asked is this: Without industry, can the United States remain a wealthy, prosperous nation?

Virtually every industrial sector in the country is under attack, and some have long gone: shoes, textiles, printed circuit board, photomasks, semiconductors, machine tools, ceramics, and consumer products. "All industry/commodity sectors registered trade deficits in 2006," said the ITC in its "2006 Shifts in U.S. Merchandise Trade 2006," (http://www.usitc.gov/tradeshifts/2007/tradeshifts_china.htm)

I hear Washington and university economists say that those are old industries, and it doesn't matter if they leave. That is the natural course of economics. To which I reply: the industry itself might be

producing an “old” product, but the means by which it is being produced is unbelievably high-tech. Have you gone into a factory lately? Have you seen the technology? You don’t see many people lugging containers of widgets around factories any more. Most every worker is at a computer monitor sharing floor space with multi-million-dollar robots.

The issue of the de-industrialization of America is already expressing itself politically. The democrats swept Congress in November 2006, not on anti-Iraq war rhetoric, but on the trade issue. Read “Truck Stop Politics” by Tom Mullikin. You can buy it on Amazon.com for about $10. It’s the best analysis of the last election I have seen. Mullikin is a lawyer representing Nucor, which is actively working to unseat “free trade” members of Congress in the districts in which it has steel plants. So far, it has been hugely successful.

So what needs to be done.

- The U.S. Department of Commerce should be tasked to investigate with subpoena power the reasons why U.S. companies are moving their production out of the country or companies that decide to open new factories in other countries with the intent of exporting that production to the United States. They should talk directly to the executives making those decisions, and to the countries and localities offshore that have enticed them there.
- Once the U.S. government understands why the United States is losing the battle for new production, then it should immediately propose and adopt the best policy practices of the countries that are enticing our manufacturers to their shores. The trend should be reversed by adopting direct subsidies, tax breaks, tax abatements, infrastructure development and creating tax-free export-zones. If the U.S. Department finds foreign countries cheating to attract U.S. investment, then it should direct the USTR to file cases with the World Trade Organization. We need our government working on behalf of our citizens.
- Put in place any incentive that increases the likelihood of investment in productive capacity in the United States. Eliminate the corporate income tax. Improve depreciation rates.
- The United States government should immediately pursue foreign governments' control of their exchange rates and require that they conform to the free-market principles that dictate the true value of currencies throughout the free world. Cite China, Korea and Japan for manipulating their currency.
- The United States government should do what a friend of mine in the Commerce Department recommends: hold up a mirror to every one of our trading partners. Whatever advantage they give their industry, we will give ours. That means if a foreign country applies a 15 percent tariff on our goods, then we would apply the

same tariff on their goods. If they want to access to our market, they have to guarantee access to their market. It also means that if a country applies a value-added-tax to any import from the United States, or rebates a VAT to their exporters, the United States government should apply an exact same VAT on imports from that country.

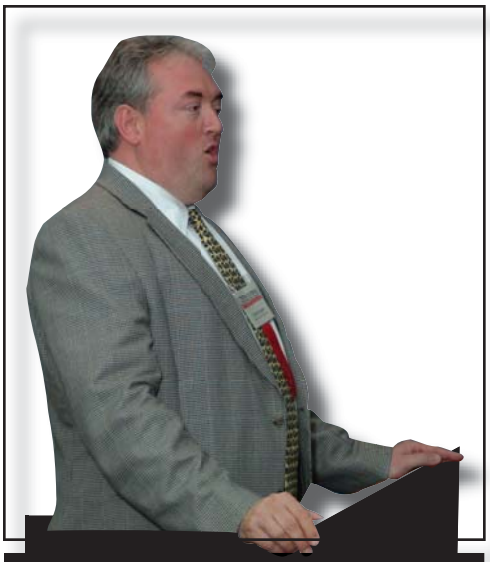
- Study all of the proposals that have been made to make the United States a magnet for industrial investment.
- Immediately boost federal investment in science and technology research and development and funding of engineering students in the physical sciences and the NIH. Create new programs throughout the federal government aimed at funding high-risk, high-payoff research throughout academia, the high tech community and industry.
- Fully fund the cost-shared industrial development programs run by the National Institute of Standards and Technology (ATP and MEP) and the Energy Departments Office of Industrial Technology.
- Fully fund research into sustainable development and create permanent tax incentives for energy industries that do not pollute.
- Re-empower government workers to do what is best for the country. Do not hold a political cudgel over their heads for taking risks, even risks that run counter to political appointees' ideological mandates. All government workers must do what they think is in the best long-term interests of the country, and not be beholden to corporations' short-term need to focus on quarterly profits, nor on politicians' short-term need to be re-elected.
- Get serious about costs that have been outlined by the NAM, especially health care costs.
- Modernize the U.S. government's data gathering and analysis, particularly as it relates to employment, production, imports, productivity and offshoring. All of the economic data being discussed now is suspect. It needs to be updated with important, global information and modernized.
- Require country of origin labeling on every product, especially agricultural imports.

Take responsibility for your own future, especially as it relates to the next generation of workers. Invite students into your factory every time there is an opportunity. Invite the press into your shop and show it off. Celebrate success by promoting it to the local newspapers and television stations. Establish an internship program within your enterprise. Become a champion for change and innovation. Embrace lean; exploit niches; stress services; go high-tech, completely; sell overseas; get help from the government to do so; study best practices; get involved politically; partner with the local university; reward risk takers; study the best companies and apply what you learn; empower your workers; empower your workers; reward them for taking risks; introduce new products aimed at new markets; innovate every aspect of your operation; travel; attend conferences; higher young go-getters who don't know the

importance of vacation or weekends, pay them well; reward them. Read business books and apply concepts; Read Andrew Grove's book "Only the Paranoid Survive."

Christof Heisser, President, Magma Foundry Technologies, Inc.

"Hypothetical Scenario for the Future: All Digital Casting"



Christof Heisser, President, Magma Foundry Technologies, Inc. "Hypothetical Scenario for the Future: All Digital Casting"

From the perspective of a German company selling high-tech simulation software to metal casting companies, the United States industry is not very advanced. Its supporters claim that the United States leads in technology, but that is not the case, said Christof Heisser of Magma Foundries Technologies Inc. The United States has some advanced foundries that meet world standards, but not many, and when Heisser visits the majority of small- and medium-sized family-owned foundries in the United States he finds they are at a technology level "where not even the emerging markets have those foundries any more."

With a profit margin of only 5 percent in the best of times and only 2.3 percent four years ago, the U.S. industry does not readily invest in new casting technologies. "The foundry industry is very complacent because a lot of the owners who run the companies grew up in an environment where America consumed 95 percent of the product it made," said Heisser. "What was consumed here was made here." But that situation has changed, with imports now accounting for 22 percent of the U.S. market and growing fast.

The claims that the United States is leading in metal casting technology are "laughed off" by the rest of the world, said Heisser. "If you want to see leading technology, go to Europe, Russia, the East Bloc; go to Germany, India and go to China where you see brand new foundries and research being done. Go to Japan, but not the United States. There is just no way."

The United States industry is still primarily serving the U.S. market and there remains a "safe-island scenario," said Heisser. "So long as companies like John Deere and Caterpillar keep buying from small- and medium-sized producers, those foundries are fine. But as soon as they find that it makes sense to get 250 castings from China, Mexico, Brazil or Germany because the quality and price are right and the transportation costs don't matter, those foundries will not be able to compete."

Many countries that lead in casting technology are exporting 65 percent of their output. The U.S. export figure is 8.5 percent. The productivity of German foundries is 20 percent higher than the American foundry industry. The German industry invests continuously in new equipment and new technology. Its executives and workforce are never happy with what they have. There is a sense that whatever new equipment is purchased can be improved upon. In the United States "you go into foundries and they're proud of the fact that they have lines running since 1949," said Heisser. "It's a maintenance nightmare and not productive and can't compete on the global market because nobody would go to China to buy 250 brake drums."

The U.S. mentality is to invest only when times are good. When U.S. companies do invest, they have a tendency to scrap an entire line and start over again because they haven't made any incremental investments over the past 40 years. "In other countries you have continuous improvement. As soon as equipment is written off they buy something new," said Heisser. That's not the case in the United States.

Many of the metal casting shops that still can't or won't invest in new process equipment and manpower will soon suffer the same fate as those that haven't survived the shakeout of the last 15 years. When Heisser first came to the United States 13 years ago there were 4,500 foundries. The most recent number was 2,291, "and that number won't increase," he said. "It will still go lower."

There might be some development of new alloys on the light non-ferrous side of the business, and there is still activity on the iron side, "but there is not a movement of big foundries that say we have to change the market and invest in new technologies and attract new people," he said.

In the next five to 10 years, 60 to 70 percent of the industry's knowledge workers will retire. Replacing them will be difficult given that there are so few engineers training for careers in metal casting. "There will be a huge challenge for the small- and medium-sized foundries to stay alive just for the reason of not having the personnel, and we're not even talking about the people who do the work in the foundries, like cleaning castings, molding, maintenance and machining. From that point of view, only highly automated and efficient foundries with a perfect cost structure will survive."

Right now, there is no reason for foundries in the United States to invest in new technology because they are running at capacity with utilization rates of 90 to 95 percent, said Heisser. The industry might bemoan the fact that China's market share is growing in the United States, but U.S. companies do not




have the capacity to serve their own market.

The wind energy turbine industry is desperate right now for castings, but the U.S. casting industry does not have the machining capacity to serve this fast-growing market. “If I was the government and looked at the entire manufacturing capacity of the United States, I would want to know how to encourage a company that has a backlog of 50 castings for wind turbines but doesn’t have the guts to open a new foundry– how can we help those people do that? How do we get it into the education system that foundries are an interesting and challenging place to work? Quite frankly, we can’t even get scientists interested in our industry any more. Then if you try to hire them from outside the United States, the whole visa situation is restricted. With the H-1B visa there are 140,000 applicants in two days for 56,000 open visas. That is why a company like Microsoft builds a research center in Canada: because it can’t get the people in this country.”

The U.S. government should be making the incentives to build wind turbines permanent, so that industry is willing to invest in the capacity. The wind turbine manufacturing industry in Europe is booming right now because the EU has guaranteed that the industry will receive tax credits and incentives for the next 15 years. But in the United States, legislation authorizing tax credits changes every two or three years. “The foundry industry sitting here in the United States says they would love to build a foundry for those wind mill castings, but at the end of 2007, the whole thing runs out and then what? They’ll be sitting with millions of dollars of investment. If they know it will go on for the next 15 years, they would build the foundry.”

One medium-sized U.S. foundry recently purchased Magma’s simulation software. The company founder told Heisser that his customer threatened to take its business elsewhere because the cost of his castings was too high. The foundry was producing a casting with five risers. After utilizing the Magma software it was able to reduce the number of risers to only one. The cost to the customer went down and the foundry’s profit went up.

“It was a great story, but I cannot believe that there are foundries out there that still make castings with those five risers,” said Heisser. “This is where America is lagging behind other countries. In other countries they could never survive with that kind of attitude.”

Magma is doing well given the upcycle. The company has 120 employees worldwide, with 14 in the

United States and 75 in Germany. In the simulation software arena for castings, it is the largest company in the world, with the next biggest company having only eight employees. Simulation technology has advanced enough to predict the mechanical properties and microstructure of iron castings, and can partially do that for steel, aluminum and nonferrous castings.

The goal is to create simulations to cover casting from design through manufacture – through heat treatment and machining – and to transfer data to finite element codes that even simulate car crashes "that are based not on the assumption that the part is perfect and has a homogenous microstructure and mechanical properties but actually has a distribution of defects," said Heisser. "We do this already in Europe, but we haven't done it that much again in the United States."

There is a goal throughout industry to simulate a product from before it is made until after it is put into the field. "If you talk to John Deere or Caterpillar or the automotive companies, they don't want to build prototypes," said Heisser. "The first part they make and the product they make should be the one that goes to the customer and doesn't get test driven."

Daniel Maas, Director of Technology Transfer, The ExOne Company

"Hypothetical Scenario for the Future: All Digital Casting"

Dan Maas, Director of Technology Transfer, The ExOne Company "The All Digital Casting Process"

Mr. Maas's presentation was on the transition of the traditional casting product development cycle to a digital process. The fact that castings are designed as a computer (CAD) file allows the foundry engineer the ability model the casting with solidification technology to cast a successful first article. The ExOne Company has developed the hardware and software to complete the process to allow for complete Digital Production of castings. ExOne has installed the ProMetal S15 machine at Technikon that uses a printing process for making molds and cores directly from 3D computer files.

The process starts with a 3D part drawing or model that is designed for digital manufacturing. The digital design process allows part structural analysis, mold and rigging design, fluid flow/solidification simulation, and microstructure prediction prior to committing the design to production. Once the design is optimized a 3D Print Mold and Core Package can be prepared for the S15 to print in sand. For

first articles the digital process eliminates the iterations of making hard tooling, casting, corrections and recasting. The cost and time wasted on tooling manufacturing and changes can be eliminated. Total time from design to finished part can be days.

Maas stated that the incoming generation of engineer's love affair with digital products positions them for a comfortable transition to, and enthusiastic attraction toward, digital work in manufacturing. This will supply the young engineers both the virtual simulations and exposure to exciting production tools such as the S-15 and other Computer Numerical Control machines. The Digital design environment enables improved cycle time and knowledge capture. When used properly, accurate simulations can provide physical insights that would have taken years of experience to acquire empirically. The digital environment facilitates the process of relearning "tricks of the trade" and "rules of thumb" that are being lost by the retirement of craftsmen and experienced engineers.

Brad Botwin, Director Industrial Base Studies, DOC, Bureau of Industry and Security

"Defense Industrial Base and Critical Technology Assessment"

Brad Botwin, Director Industrial Base Studies, DOC, Bureau of Industry and Security "Defense Industrial Base and Critical Technology Assessment"

The Department of Commerce's Bureau of Industry and Security (BIS) Office of Technology Evaluation is conducting studies on the health of various aspects of the U.S. defense industrial base, but none currently on the metal casting industry, Brad Botwin, director of BIS's Industrial Base Studies program, told the conference. The last time his office looked at the health of the U.S. metal casting industry was in 1987. It might be time to reassess the industry, given its importance to the military. "It needs to be updated," said Botwin, who suggested a possible joint industry -government effort on casting.

His office is currently conducting an industrial base assessment of the U.S. space industry. It has contacted about 350 space-related prime contractors and subcontractors and is in the process of putting together an assessment of the industrial, financial and economic performance of key firms comprising the entire space industry – including satellite, launch and services.

A "major focus is on the effects of foreign competition and export controls on the industry's ability to

meet the demands of the defense and commercial markets," said Botwin. Given the circumstances, the industry might be experiencing "a perfect storm of foreign competition and export controls, especially in commercial markets," he said. The United States has the potential of "losing technological leadership and market share in portions of the space industry," he added. With it could go a great deal of the market for specialty castings, equipment and parts. Initial data from the study "highlight significant costs of export compliance," said Botwin. (The space industry report is now available online at www.bis.doc.gov under "Defense Industrial Base Programs").

His office is also conducting a study of defense "mission-critical" microchips. The study is the result of a Defense Science Board report from its Task Force on High Performance Microchip Supply, which said the rapid migration of semiconductor manufacturing plants to locations outside the United States is an "alarming" trend that must be addressed. "Urgent action is recommended, as the industry is likely to continue moving in a deleterious direction, resulting in significant exposure if not remedied," said the DSB report.

BIS has surveyed about 200 firms to provide a "snapshot of complete U.S. chip design and manufacturing capabilities," said Botwin. The findings will used by the Department of Defense to develop a "Trusted Integrated Circuit Policy" scheduled for release in late 2007.

The BIS is also looking into problems the military is experiencing with counterfeit electronics. It has initiated a new multi-year study sponsored by the Naval Air Systems Command. Botwin said there have been problems with circuit boards in aircraft that didn't work, forcing the grounding of systems. DOD didn't know the origin of the chips and components used in the defective systems. "There are concerns regarding the impact [counterfeits will have] on defense readiness, supply-chain integrity, critical infrastructure and industrial capabilities," said Botwin.

The Department of Homeland Security, the Semiconductor Industry Association, U.S. Chamber of Commerce and other organizations are being contacted by BIS. The survey will cover microchips, circuit boards and subsystems. BIS is contacting brokers, distributors, manufacturers, end-users, DOD commands and others to determine the scale of the problem, the sources of counterfeits, DOD's procurement process and their threat to industry, economic and national security. BIS will investigate methods to alleviate the problem, including the use of technology, regulatory tools and international agreements. BIS "welcomes additional input and participation defining this assessment," said Botwin.

There are “significant and continued challenges to the U.S. defense industrial base,” he concluded.

Al Spada, Editor, Modern Casting Magazine; Marketing, Public Relations and Communications, American Foundry Society.

“How Globalization Killed US Metalcasting: a Fiction Novel”

The idea that globalization is killing the United States metal casting industry is a “fiction novel,” said Al Spada, editor of Modern Casting and director of marketing, public relations and communications with the American Foundry Society. It is important for the industry to convey the message that it is alive and healthy. If it doesn’t, then companies and organizations that use metal castings will not know that there is plenty of capability within the United States and will source more of their castings from offshore.

Spada provided a detailed market snapshot of the U.S. metal casting industry and its standing in the world. There were 2,190 metal casting facilities in the United States in 2006 (down from 2,380 plants in 2005 and 6,150 in 1955). Metal casting foundries employed more than 200,000 workers in 2006. The industry is projected to generate $36.3 billion in sales in 2007, up from $34.9 billion in 2006. Production in 2006 was 14.6 million tons and is projected to decline slightly in 2007 to 14.57 million tons. Total global casting production in 2006 was 86 million tons.

The United States is the world’s second largest producer of metal castings, behind China, which, at 24.4 million tons in 2005, had almost double the U.S. production of 12.9 million tons. There are 26,000 metal casting foundries in China.

In the United States, industrial metal casting capacity is 16.9 million tons, and utilization is currently running at 87 percent. Shipments are about what they were in 1994 and remain off their peak of 1999.

AFS forecasts continued growth in the market. Next year, sales are projected to increase to $37.7 billion, and shipments are expected to increase slightly to 14.61 million tons. Tonnage is projected to be lower “due to increased aluminum use in the auto and heavy truck segments,” said Spada.

Between 2003 and 2008, the industry's shipments should increase by 9 percent, while sales should climb by 22 percent.

AFS predicts a substantial three-year decline in the market starting in 2008, following similar down-cycles that have been occurring every 10 years in the auto, heavy truck, railcar and construction industries, among others. Such downturns occurred in 1971, 1981, 1991 and 2001. Between 2008 and 2011, annual shipments are projected to fall by 2 million tons, and equal total shipments made in 2001. Sales are projected to drop to $34.2 billion.

Imports are satisfying most of the growth in the U.S. market, according to Spada's data. The United States is expected to import 3.53 million tons of castings in 2007 or 22 percent of total demand, up from 7 percent of total demand in 1998.

Gray iron imports (1.596 million tons) will constitute 28 percent of U.S. demand for those types of castings in 2007; ductile iron imports (580,000 tones) will constitute 12 percent of demand; carbon and low alloy steel imports (265,000 tons) will constitute 21 percent of U.S. demand; aluminum die casting imports (365,000 tons) will constitute 24 percent of demand; aluminum permanent mold/sand (487,000 tons) will constitute 38 percent of U.S. demand; and imports of copper base (69,000 tons) will represent 19 percent of U.S demand.

Imported metal castings represent 41 percent of those used by the U.S. motor vehicle industry (1.446 million tons), to a low of 2.9 percent used in the farm equipment sector (101,000 tons).

China is supplying the United States with 24.7 percent of its metal castings imports, followed by the rest of Asia (17.1 percent), Canada (9.9 percent), Mexico (9.6 percent), Brazil (9.4 percent), Europe (9.1 percent), and India (8.8 percent).

Spada outlined forecasts for gray and ductile iron, iron, steel, aluminum and die casting, copper base, magnesium, super alloys, zinc and lead-base die casting, and investment casting.

Strengths of the U.S. metal casting industry include engineering skills; the availability of raw materials; its close proximity to customers; communications skills; technology development; and productivity improvements. The industry's weaknesses include high labor rates; over regulation; poor perception of the indus-

try; the shrinking size of the industry both in terms of plants and people; the slow pace of adopting new technology; and a "complacent fixation on production, not profit," said Spada.

The industry has plenty of opportunities. There are many industrial applications that can convert to castings; export markets are booming; there are opportunities for strategic alliances and joint ventures; the industry offers machining and casting design services; it is in close proximity to customers; and it has the ability to provide rapid prototyping and quick turnover.

Threats include foreign competition, plastics, powdered metals, fabrications, and the "industry's reactive rather than proactive nature," said Spada.

Robert Tuttle, Professor, Saginaw Valley State University

"Attracting and Training Tomorrow's Foundry Talent"

Robert Tuttle, Professor, Saginaw Valley State University "Attracting and Training Tomorrow's Foundry Talent"

The metal casting industry has to address a major manpower challenge in order for it to survive and prosper, said Prof. Robert Tuttle of Saginaw Valley State University. Universities like his that have traditionally recruited young engineers into the industry can no longer be counted on to fulfill that role, said Tuttle. "We need help from the industry to go out and talk about the industry" – talking to potential engineering students about what the industry does, what types of jobs are available and where they can receive training.

The old model of relying on universities to recruit students into the engineering disciplines no longer works, said Tuttle. Kids coming out of high school – the "Millennials" born between 1980 and 2000 – are sophisticated about marketing. They see a person like Tuttle talking about the virtues of pursuing a career in metal casting and pay little attention. But that changes when there is an employer nearby able to make a real impact by stating: "I'm looking for people," said Tuttle.

"The industry recognizes that it needs employees but getting the message out that there is an opportunity for them is where we are having trouble."

The biggest challenge associated with attracting the next generation of engineers into the metal

casting industry is overcoming the perception that metal casting is a dead-end career. Most parents have no desire to see their child pursue a job manufacturing." If we do not do a good job and we can't find good employees to just replace what we have let alone talking about an expansion of the U.S. Metal castings sector, then we are going to shut doors because we are not going to get product out the door," said Tuttle.

Metal casting companies that have decided not to hire new talent are already being impacted. They are not able to provide customers with quotes on new jobs or produce tooling or castings on time.

There are a lot of engineering tasks in a metal casting operation that cannot be automated and require skilled and experienced engineers. There are attempts to automate engineering processes with software systems, but there will always be the need for knowledge workers throughout the process. Without knowledgeable and experienced metal casting design and process engineers many designs are being produced that are not easily castable.

Automakers are gradually losing their core of experienced product engineers who know about castings and young engineers replacing them don't know that much about them. They are designing parts with features that are difficult or impossible to cast "and they are beginning to really drive up the product's cost," said Tuttle.

The problem of adequately skilled engineers runs deeper than just replacing retiring Baby Boomers. Just at a time when the industry needs to be innovative, its entire process and product mix using new technology, new materials, automation, new software applications and energy efficient and non-polluting systems, there is not a new cadre of talented engineers and specialists being groomed for such an undertaking.

"You need the people working in the supplier industry to develop the technology for those specific needs," said Tuttle. "Where do you find people like that? Some will come out of schools like Saginaw State and the Foundry Education Foundation (FEF) schools, but getting them into the suppliers and not just foundries is going to be difficult."

Even design engineers going into the big OEMS and smaller makers of specialty components do not have experience with castings. "If all they're used to is machining and welding, guess what they are going to design: machined components and weldments," said Tuttle. "They will never do a casting




because they don't have the experience. That is a disadvantage that I'm not sure people grasp yet. The only time they grasp it is when a smaller OEM has to cast a component and they get a design that has to be completely reworked, and that produces bad blood on both sides. It doesn't help us move forward. I don't think casting shops realize they need more engineers themselves because they are used to the customer providing them with a good castable design," especially as those designs become more complex. Engineers working in casting operations must now work closely with their customers on designing a make-able part.

New tactics are needed to attract the "Millennials" into careers in the metal casting industry. This group of students is unlike previous generations, said Tuttle. They have no memory of Ronald Reagan or the Cold War. AIDS, VCRs, microwaves and the Internet always existed. They believe that change is constant and that they must be self-reliant. They are family oriented, brand conscious, mobile and addicted to the media.

They are fun seeking, hopeful and they prefer information to be delivered to them quickly. They select careers based on relations with family and friends, high-school teachers, television shows, the Internet, career fairs and scholarships.

So how does the industry fit into these mores?

Foundries are never seen on television and manufacturing in general remains a low-profile career among students. There is constant bad news about the American automobile industry, particularly in Michigan and Ohio. Many of the manufacturing industry's recruiting efforts are disconnected, and there is little information on the Internet, making it hard to find schools specializing in castings and career information.

"Kids have no clue as to where even basic metals come from, much less castings, yet those materials surround them," said Tuttle.

Tuttle proposed a national recruiting model aimed at attracting students to the 41 universities with a foundry education program. He said AFS chapters and foundry schools must coordinate their efforts by using "pre-built" and custom presentations that have a "shock and awe" value aimed at a media savvy group of kids who expect a lot of polish and like the unexpected. Holding plant and

college tours and involving more chapters in high-school recruiting are also essential. “Plant tours are great,” said Tuttle. The chapters should be provided with recruiting “how-tos.”

There also needs to be a central Internet resource for careers in the metal casting industry that describes the industry, the college majors who are employed by foundries, the schools specializing in metal casting and the summer programs that are available. The site should contain a repository of recruiting materials including off-the-shelf presentations and documentation on various recruiting programs. The industry needs a “www.metalcastingiscool.com” Web site, similar to SME’s “www.manufacturingiscool.com” Web site, said Tuttle. “Industry has traditionally relied on us professors for recruitment, and I hope they get the point and understand the repercussions” of that model no longer working.

He said Saginaw Valley State University, with an enrollment of 9,534 (319 of which are engineering students), requires that all of its mechanical engineering students take a manufacturing course that has a hands-on lab that includes students pouring castings. The school has a foundry recruitment program that includes tours of three plants a semester including one foundry. It is building a new 1,300-square-foot foundry that uses green sand with a capacity of 100 pounds of ferrous and 50 pounds of aluminum. Its winter 2008 metal casting course focuses on gating and risering, sand control, solidification modeling, designing grating systems and producing pattern and pour design. In the future it hopes to add a lost-foam and resin bonded process, and to pour castings for senior design projects.

Tuttle said there is another aspect of engineering training that must be considered: the creation of “renaissance” men and women. Engineers must now be articulate enough to communicate very complicated subjects to non-technically trained people. They need a keen sense of business – determining whether a product will sell and how the enterprise will make money. On the technical side, they have to be able to lead because often the first position they hold after receiving a degree requires managing a staff. “In no other degree program does that happen,” said Tuttle.

“Classically, the best people you wanted were those who could do integrals in their heads with their eyes closed and that made a good engineer. But there are huge differences needed now in skill sets. The real test is did the product work? Does it sell in the marketplace? If it sells in the marketplace, it must be good.”

Bill Sorensen, Executive Director, Foundry Education Foundation (FEF)

"FEF: Helping Today's Students Become Tomorrow's Metalcasting Leaders"

The Foundation for Metal Casting Education (Foundry Education Foundation-FEF), now 50 years old, is an essential component of an industry seeking qualified and skilled workers, said its Executive Director Bill Sorensen. The organization is also undergoing change to keep up with the growing needs of students, universities and industry.

Bill Sorensen, Foundry Education Foundation "FEF: Helping Today's Students Become Tomorrow's Metalcasting Leaders"

In the 1970s, companies like GM and Ford were hiring 50 or 60 students per year supported by the FEF. Now they're not hiring more than 10. "But there is still a strong need in the industry and we're adjusting to it by providing the best quality students," said Sorensen. "It's probably more important today to have the FEF than it was in 1947 because trying to get engineering students to think about manufacturing and to get them to think about metal casting in particular is not an easy thing to do."

FEF is healthy, despite the difficulties of the metal casting industry. Base funding from contributors is holding steady. "You would think that we'd be getting less money today, but it's gone the other way," said Sorensen. "Demand in the last couple of years is increasing."

FEF helps students "become tomorrow's metal casting leaders" and provides them with scholarship money of between $1,000 and $1,500 per year. Seventy-five percent of the students receiving scholarships through the program are being placed in a job in the metal casting industry.

In the 2005 - 2006 school year, FEF had more than 450 students registered and more than 200 receiving scholarships. It provided $728,000 in scholarships and program support. That money has come from individuals, corporations and associations. It has 68 endowed principal funds, including 18 from chapters associated with the American Foundry Society, 10 companies and six societies.

When FEF first started, it provided students with full tuition. Today, there is a growing need to increase its level of support to up to $3,000 per student. FEF is also finding that it is becoming more important to help universities with foundry education programs to improve equipment and supplies.

These demands are placing extra pressure on its budget. Funding for university research and training equipment is being cut by the states, and tuition is rising.

FEF is also broadening its scope to attract students while they are still in high school and even middle school. The industry has found that most younger students know little about manufacturing. FEF is providing instructors with funds to hold seminars for students in high-school and community colleges and it is funding the "Foundry In A Box," a hands-on metal casting demonstration that kids find riveting.

"There is more excitement and more desire to learn about our industry than there was 15 years ago," said Sorensen. "They've had so little exposure to manufacturing that when they see it, they say it's so cool. We realize that young people need to know more about this industry sooner so that when they get to college they know which college to go to," said Sorensen, who has been working with the FEF for 25 years.

FEF is in the process of assessing the number of universities under its umbrella so that it can do a better job of providing more help to fewer programs. It currently works with 25 universities and 12 affiliated schools, but the industry won't be able to support that many, said Sorensen. FEF is trying to consolidate that support to 15 schools through its accreditation process that universities go through every three to five years, making sure they are meeting industry needs and are on target. "We're an open allocation system, which means schools can request whatever funding they think they need and back it up with a grant and we're finding that not as many schools are needing as many different scholarships – they need more for each scholarship and to keep viable their 21st century labs."

FEF is also trying to attract the automobile transplants like Honda and Toyota into its program. "They're hiring students from someplace, but they are not part of our board or our contribution base," said Sorensen.

Sorensen said he listens closely to the debate about the health and prospects of the metal casting industry. Some people say the U.S. industry is washed up; others say the U.S. can exploit niches and can benefit by being close to customers and not having to pay shipping costs. "Having a source of good talented people coming into the industry may make a difference in the U.S. foundry industry," he said. "The kids today have a lot of ideas and are computer literate and will replace people who don't have that much computer experience. I think it's very positive and there is still demand for students

and there will be a bigger demand. If we don't have an FEF, then the industry will not have an organized way of attracting people at all."

The FEF's Web site is http://www.fefinc.com

Twenty-Five FEF Accredited Schools:		Thirteen FEF Affiliated Schools:
University of Alabama	University of Northern Iowa	University of Alabama - Birmingham
Bradley University	Ohio State	Cal Poly - San Luis Obispo
Cal State - Chico	Penn State	University of Cincinnati
Cal Poly - Pomona	Pittsburgh State	Clemson University
Case Western Reserve	Purdue - Indianapolis	Colorado School of Mines
Central Washington University	Purdue - West Lafayette	Eastern Michigan
Kent State University	Tennessee Tech	Instituto Tecnologico de Saltillo
Kettering University	Texas State	University of Michigan
Michigan Tech	Tri-State University	Milwaukee School of Engineering
Mississippi State	Western Michigan University	Penn State Erie,
Missouri - Rolla	University of Windsor	The Behrend College
Mohawk College	Wisconsin - Milwaukee	Ryerson University
	Wisconsin - Platteville	Virginia Tech
		Wisconsin - Madison

George Crandell, Vice President, Technikon, LLC (Operators of CERP)

George Crandell, Vice President, Technikon, LLC (Operators of CERP) "CERP: History, Contributions and Evolution"

"CERP: History, Contributions and Evolution"

The Casting Emissions Reduction Program (CERP) is the only formal castings research program in the United States focused on environmental issues, according to program manager George Crandell. The program, created in 1994, has almost completed work on its initial project of creating a system to measure emissions from the casting process. It has created a database that is now available to foundries on how to calculate total hazardous air pollutants (HAP) for their entire operation. The tool available on CERP's Web site, is used on a regular basis by foundries throughout the world. "It's something that would not have happened if the federal government had not financed it," said Crandell of Technikon LLC, which runs CERP.

CERP has helped the metal casting industry successfully deal with major issues associated with emissions including documenting the source of emissions, dealing with odor complaints from foundries working in urban areas, helping metal casting suppliers develop products that lower HAPs and odor, and dealing with the growing scrutiny of local citizens groups and regulators. "CERP data has 100 percent capture and has the EPA methods optimized to measure accurately each analyte that makes up the HAP emissions," said Crandell. "CERP data now contains accurate data on carbon monoxide, carbon dioxide, nitrogen oxide and sulfur dioxide."

CERP found that foundries generate more than 70 of their organic HAPs during pouring, cooling and shakeout. As a result "major HAP emissions reductions are being made in the casting industry," said Crandell. "The supplier base is developing alternative low-emissions products and processes, and foundries are successfully using these products."

The goal now of CERP is the sustainment of the United States casting industry, something that will be of growing importance to the military as the casting industry is transformed by globalization. Sustainment will come about by the development and introduction of new technologies, new materials and the creation of




energy efficient processes that can keep the United States metal casting industry viable and able to supply both civilian and military systems. “Our programs are migrating to materials engineering, more process development to lower costs and less energy usage,” said Crandell.

There is a growing need for this type of program. General Motors shut down its casting development and validation center last year. GM did a lot of the research work on castings that the U.S. government has utilized in military systems. But no more. By the end of this year, Ford will be completely out of the metal casting industry. It is shutting down its Canadian metal casting plant, its U.S. casting plants and its one foundry in England. By the end of this year Ford will contract all of its metal casting work to Mexico and a small amount in Europe.

As the manufacturing and sourcing of more basic components leave the United States, castings leave with them. Chinese engines and transmissions are currently being used on the GM Equinox SUV. The auto companies and their largest suppliers continue to import more engines and transmissions.

The result is a metal casting industry that is in transition, despite it being in a current period of robust sales. “There is not much of a commitment on behalf of our society to maintain a capability,” said Crandell. “The auto guys don’t have money for R&D any more. They are depending on the tier-two suppliers to do it, but those companies barely make 5 percent profit, so they don’t have money for R&D either. Even university professors conducting research and teaching casting technology don’t get support so they are moving their efforts to other materials.”

With its Cooperative Research and Development Agreement (CRADA) partners – the U.S. Army, American Foundry Society, Casting Industry Suppliers Association, USCAR, GM, Ford and Chrysler – CERP is approaching a new era by pursuing the development of a new generation of lightweight metals and fuel economy improvements for the auto industry. It is also pursuing efforts aimed at bringing the cost of titanium down through its Armament Titanium Casting Advancement Program (ATCAP). As the Defense Department’s need for titanium has increased, the price of the metal mineral has skyrocketed, up by a factor of five over the past decade. The aerospace industry is a heavy user of titanium, but it primarily buys billets and machines them down, yielding only 10 percent of the titanium. Castings would provide the industry with far better yields and combine structures that would otherwise have to be welded. But the aircraft industry needs assurances of a cast part’s dependability. The plan is to transition casting process innovations such as microwave

melting and the use of titanium powder "to meet the needs of lightweight armaments and munitions systems," said Crandell. The program is operated by Technikon and managed by the U.S. Army RDECOM/ARDEC.

An example of the potential success stories associated with the titanium program is the field testing of AM General's titanium brake rotor for the HMMWV. The new rotor improved braking distance by 25 percent at 40 miles per hour. The base of the new Howitzer is also cast titanium, reducing weight and improving strength. CERP has also conducted ablation process testing and development with aluminum and magnesium processes that use water for sand removal. It developed aluminum castings with "tensile properties of cast iron," said Crandell. "Plans are to integrate it with digital mold printing." There is also the potential for using the technology in steel castings.

CERP is experimenting with rapid manufacturing and the digital printing of molds, a technology that holds huge potential for the U.S. casting industry. It has installed an ExOne digital printing system that eliminates hard tooling and reduces lead time for low-volume production of castings. Parts can be built directly from CAD files, and printed sand molds and cores can be used for the casting of the most common metals including magnesium. The plan is to develop a low-emissions binder system and use graphite molds for titanium.

CERP has also been supporting the re-establishment of the Rock Island Arsenal's Joint Manufacturing & Technology Center as the supplier of choice for DOD organic metal castings. The goal is to produce complex, hard-to-obtain cast parts and reduce costs to DOD. Equally important is the need to "preserve and expand organic casting core competencies" and to integrate digital molds and cores into production, said Crandell. The creation of an organic titanium casting capability at Rock Island Arsenal is another goal of the project.

The next iteration of CERP will be the proposed Casting Advancement and Sustainment Technology (CAST) program, aimed at the development of lightweight metals, continuation of the environmental programs done by CERP, and manufacturing development for casting technologies. The current Washington environment "is focused on support for the warfighter and reduced dependence on foreign oil," said Crandell.

The United States Council for Automotive Research (USCAR) consortium has been active with

the U.S. Department of Energy in these areas and has been working jointly with CERP and the Department of Defense. “CERP has been the only successful USCAR program with the DOD,” said Crandell. “The goal is to start a new program tailored to the joint Army and industry’s needs – the CAST program would be part of this new overarching effort.”

Among the proposed joint DOD/USCAR initiatives are the development of lightweight metals, materials applications, manufacturing and sustainment, advanced electric motor and drive trains design, advanced powertrains, digital and “virtual” manufacturing, electronic architectures, and biofuels and fuel cell development. “The CAST program would continue the CERP legacy in supporting the foundry industry by supplying needed data and new process development,” said Crandell. “The casting industry is challenged. We need a sustainable industrial base for weapons systems.”

Ray Monroe, Executive Vice President, Steel Founder’s Association

“Steel Casting Outlook 2007”

The metal castings industry is emerging from a long period of stagnation characterized by excess capacity and declining prices for its products, said Ray Monroe, executive vice president of the Steel Founder’s Association. The industry had a 20-year period – from 1979 to 1999 – during which it had excess capacity. But then things got worse. From 1999 until 2003, as market conditions deteriorated, the industry liquidated the obsolete capital equipment that was installed before 1979, “so we no longer have the capacity” to deal with increased demand, said Monroe.

By 2003, a great deal of capacity for the manufacture of commodities like coal, copper, oil, nickel, and concrete was retired, making it difficult to serve a rapidly expanding global economy, especially with the economic surge of China and India. “Right now, the capital equipment industries are struggling to keep up with the ongoing consumption of capital equipment at the current production levels, which are inadequate to supply the world economy,” said Monroe.

The year 1979 was an important tipping point for the metal casting industry. At the time, the industry believed that double-digit price increases were inevitable; that it would always be busy; and that

it would never have enough capacity to make all of the material to serve the world economy. That all came to a crash in 1979.

It was the same year during which major changes were made in U.S. tax policy. Prior to 1979, the tax code provided wealthy investors with incentives to invest in capital equipment. “The use of capital equipment as a tax shelter was so bad that in 1979, we made 90,000 freight cars and more than half of that demand went for attorneys and doctors who bought them as a tax shelter,” said Monroe. “They didn’t care if they got filled with corn.”

There was also a monetary policy in place in which every time the economy started to soften, the Fed printed more money, leading to a period of stagflation. The retrenchment of the industry after 1979 “was a train wreck waiting to happen,” said Monroe. “If you continually invest in capital equipment to build capacity and you keep that equipment busy by printing money, it becomes clear that you want to own stuff rather than money.”

From 1979 to 1983 there was a dramatic drop in production of steel castings. It took until 1999 to reach prior levels of production. During that time, the industry stopped funding innovation because of tight budgets and the lack of growth in markets and new products.

In 2001, the industry experienced a capital bust and by 2003 the industry thought it was never going to get another price increase; it thought there was always going to be a glut of capacity in the global market; and that demand would never recover. The industry was cannibalizing its facilities to maintain limited levels of production. The industry was obsessed with cutting costs. It stopped hiring new employees with technical and engineering skills. It wasn’t buying spare parts so its suppliers were hurting. It was in a downward death spiral. “In 2003, you were sure you would never need additional capacity,” said Monroe.

That situation has changed dramatically. “Now we suffer because most of our working careers have been in the 25-year period of over capacity, depressed prices and no investment in equipment,” said Monroe. “We think that is normal business, so all of our intuition and management practices are completely tied into this model of excess capacity.”

The industry has entered a period of limited supply. “Customers are willing to pay you more so they




get preferential treatment so they get their supply," said Monroe. "We know in the steel casting industry things changed because in 2004, the customers for the first time in well over 20 years came in and demanded to pay more for their steel castings in order to assure supplies. In a limited supply market, the story is throughput: if you lose one day of production, you lose a day of profit. You can't sell what you can't ship!"

Now, the industry needs to start investing again. "It's really odd: you have all the time in the world to develop new processes and products, but no money, so nobody does," Monroe explained. "During the current period, when we're running flat out, that's when you get new processes because you can't get the old equipment running well at full capacity."

It's also time to start hiring again. When Monroe speaks with students, he tells them it's a great industry "because your boss is likely to develop Alzheimer's or have a stroke....The most exciting thing that has happened is the digital technology that makes castings attractive to young engineers and gives us the tools to make high reliability, high performance castings that behave robustly. If we can do that, we have a dramatic story to tell with tremendous growth potential."

Monroe will know the start of the next cycle when the industry begins to build new foundries and expand dramatically. "That means we're pretty close to the end of this capital expansion cycle," he said. "Two things indicate when we are at the end of the cycle: one is when the large OEMs wake up and also when the banks decide that it is profitable to provide money to people who have capital equipment."

Since 2003, prices of most commodities have increased dramatically. Existing operations are profitable. There are a lot of mergers and acquisitions. "We're not bringing on a lot of new capacity because investment in capital assets has performed so poorly in the past 25 years, nobody has the confidence or the equity to afford to invest in it," he said. "It will take 10 or 15 years before we begin to make the global worldwide capacity investments to expand the capacity into copper and oil and the capital equipment we need to manage and operate those production facilities so we can actually supply the world market."

Monroe said that it is imperative for industry and government to support a robust metal casting research program. In order for the United States to remain competitive against countries that cheat in the global trading system, the federal government must acknowledge that innovation is the primary

way the United States is going to survive as an industrial nation. Industry needs smart people, it needs a new generation of clean manufacturing systems, improved product performance and quality, and the development and deployment of digital systems throughout the entire design and production process.

2007 Forum Participants

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