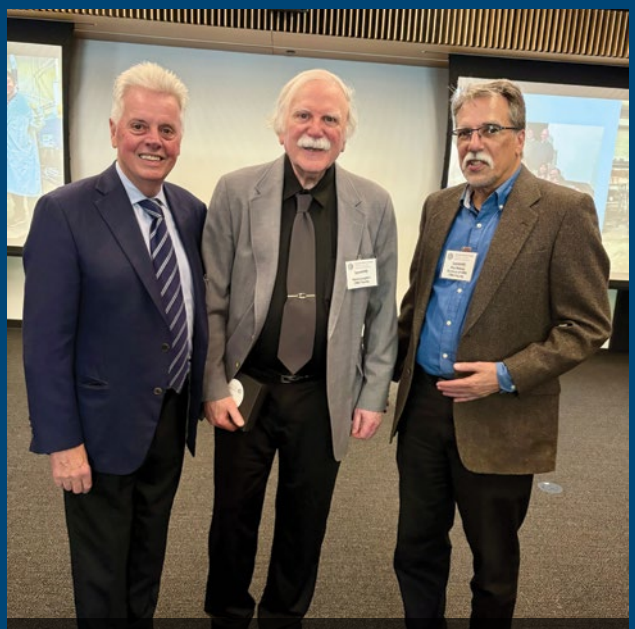
Graduates of the Colorado School of Mines and ASPPRC, along with faculty and staff.

Celebrating 40 Years of Steel Innovation, Research and Education

By Heather N. Smith



(L–R): Alan Cramb (former CISR director and co-founder), David Laughlin (CMU materials science and engineering (MSE) professor) and Roy Matway (CISR alumnus).

In the mid-1980s, as the global steel industry shifted due to the progression of new technologies and rising competition, two research centers took shape in the U.S., both developed using the Industry-University Cooperative Research Center structure.

In 1984, the Colorado School of Mines opened the Advanced Steel Processing and Products Research Center (ASPPRC), founded by George Krauss and David Matlock.

A year later, Carnegie Mellon University established the Center for Iron and Steelmaking Research (CISR), founded by Richard Fruehan and Alan Cramb.

Now, four decades later, both centers have celebrated their 40th anniversaries, reflecting a legacy of innovation, collaboration and student-focused education that continues to influence the global steel industry.

A Legacy of Research and Education

Founded within the Colorado School of Mines' Department of Metallurgical Engineering at a time when many programs were being rebranded as materials science and engineering, the ASPPRC began with six corporate sponsors and the mission to concentrate on building a bridge between steel producers and end users. Meanwhile, CISR had the support of 11 companies, the National Science Foundation (NSF) and Carnegie Mellon University as it launched its initial research.

The North American steel industry was under intense pressure from foreign competition and protectionist policies dominated the economic narrative. Despite this, they carved out a place for themselves focusing on applied research to support and strengthen the steel industry. From the beginning, both ASPPRC and CISR have balanced research with student development.

"CISR has stayed reasonably close to its mission of conducting basic research and educating students for the iron and steel industry," said Bryan Webler, professor of materials science and engineering, and co-director of CISR along with Chris Pistorius. "We've very much tried to keep the focus on people, particularly our students. I'm convinced the most important outputs of CISR are our graduates."

ASPPRC has maintained a similar focus. In a shared response from faculty members Emmanuel De Moor, John Speer, Kip Findley and David Matlock, they said, "Today, a half dozen faculty members actively contribute to center operations and the diversity in faculty seniority ensures sustained support for research and educational endeavors. Our focus remains on excellence in steel research and the education of the next generation of metallurgists."

"We actively involve approximately 30 graduate students in M.S. and Ph.D. projects, alongside postdoctoral researchers, undergraduates and visiting scholars, giving students hands-on experience that directly applies to industry challenges," they added.

ASPPRC's enduring emphasis on students is matched by their engagement with industrial partners. "Sponsor companies represent both steel producers and users, as well as ferroalloy producers," the faculty members said. "Through these partnerships, students gain insight into real-world industry challenges and develop the skills to contribute immediately upon graduation."

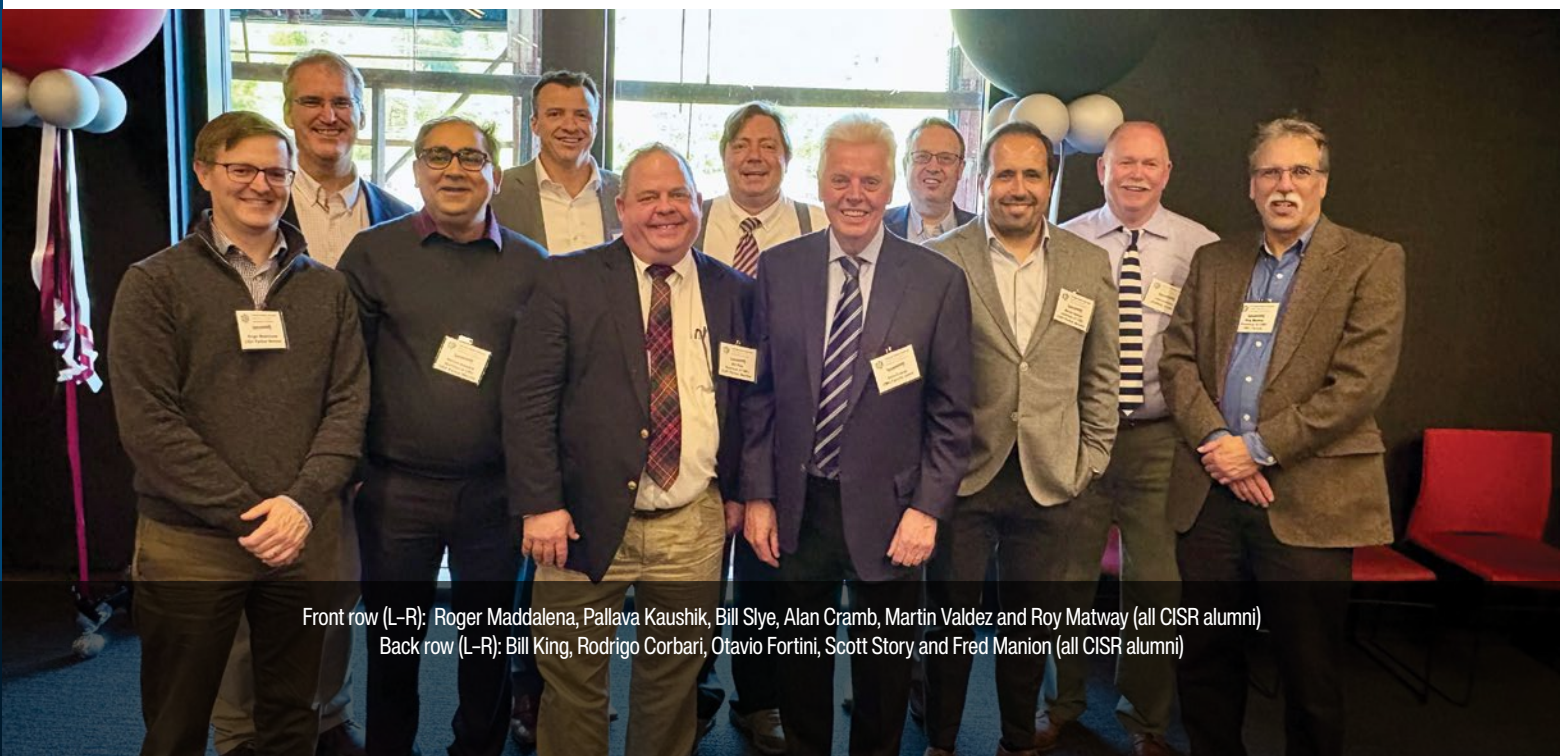
Impactful Research and Industry Innovation

The influence of both centers reaches far beyond the lab, helping to shape how steel is produced today and how it will be in the future.

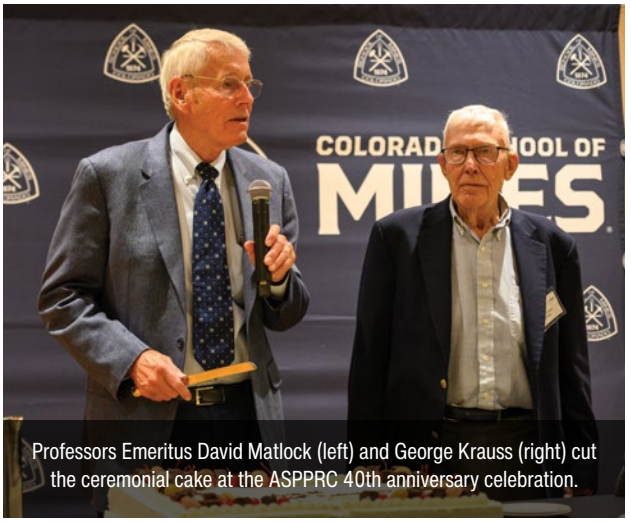
CISR has taken on some of the industry's biggest challenges, digging into the science behind low-emission ironmaking technologies. Its work has paved the way for hydrogen-based direct reduced iron (H-DRI) production and tested the promise of alternative fuels in traditional blast furnaces.

"Our work has also played a key role in process development for clean steel production," Webler said.

ASPPRC focuses on practical research for the steel industry, studying how different interrelationships between end user properties, alloying, thermomechanical processing, heat treating and microstructural evolution affect the structure of steel and, ultimately, how it performs in real-world applications.



Front row (L–R): Roger Maddalena, Pallava Kaushik, Bill Slye, Alan Cramb, Martin Valdez and Roy Matway (all CISR alumni)
Back row (L–R): Bill King, Rodrigo Corbari, Otavio Fortini, Scott Story and Fred Manion (all CISR alumni)



Professors Emeritus David Matlock (left) and George Krauss (right) cut the ceremonial cake at the ASPPRC 40th anniversary celebration.

The research touches nearly every type of steel product, from sheet and plate to bar, wire, bearings and casings. "Industry applications have pertained to advanced high-strength sheet steel (AHSS) developments for automotive applications to increase vehicle safety, improve fuel economy or battery electric vehicle range extension through vehicle lightweighting, and maintain cost-effective products," the faculty members said.

Other projects have zeroed in on challenges like bake hardening behavior, shear fracture and friction properties, hole expansion/local formability, performance under high strain rates and even the risk of liquid metal embrittlement during welding. In plate steels, researchers have explored solutions for wear in earth-moving equipment, hydrogen and carbon dioxide transport, and how to design high-strength, high-toughness steels through microalloying and thermomechanical processing.

Bar steels have been a focus as well, with studies on fatigue resistance and surface treatments such as induction hardening, carburizing and deep rolling to boost product performance.

As steel producers and users have considered opportunities and challenges with decarbonization, ASPPRC has conducted related projects. Some of these projects include development of hydrogen-resistant steels, CO_2-resistant steels to support capture, sequestration and usage, effects of higher copper and other residuals in applications currently produced through oxygen steelmaking, and induction heating processes. Other topics such as machine learning and AI are also of interest in their research and student preparation.

ASPPRC's impact extends beyond research. Of its more than 280 alumni, roughly 200 have gone on to careers in the steel industry, with about half joining companies that sponsor the center itself.

Adapting to Industry Transformation

As the steel industry undergoes transformation, that shift is shaping the research agendas at both centers.

For faculty like Webler, the path forward is clear: decarbonization will touch every corner of steelmaking, from iron production to the reheating furnaces.

"Decarbonization affects everything," Webler said. "There are increasingly connected systems for process monitoring and control, as well as increasingly sophisticated methods for data analysis."

The rise of artificial intelligence is another factor in reshaping the field. While Webler doesn't believe AI will replace engineers and operators anytime soon, he sees it as a powerful tool — one that students must be prepared to use, and one that researchers are already incorporating into their work.

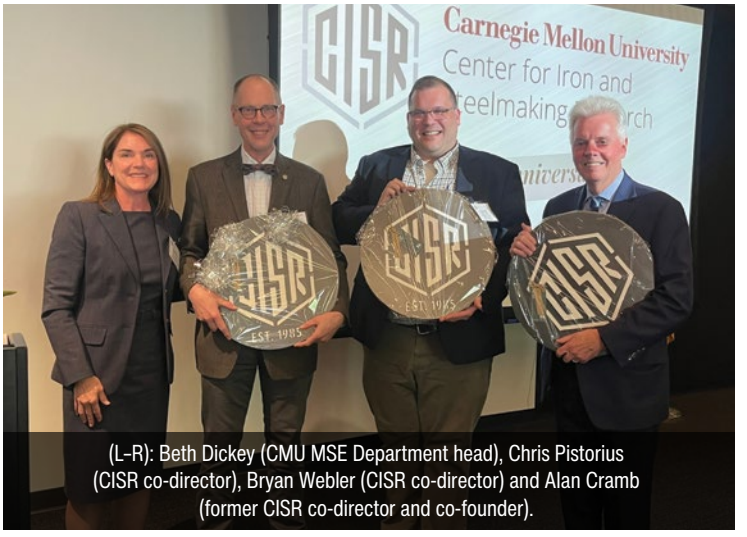
Just as the steel industry has shifted over the decades, the ASPPRC program has adapted alongside it. One turning point came during a wave of corporate consolidation, when many of its sponsor companies grew into global giants but continued their collaboration with the center across multiple sites.

"In 2000, the center transitioned from a U.S.-only based consortium model to a program that welcomes international industry sponsors, and the center has benefited from extensive global representation amongst its sponsor base," the faculty members explained.

Partnerships and Professional Networks

For CISR, industry connections have always been a cornerstone of the program — and AIST has played a central role.

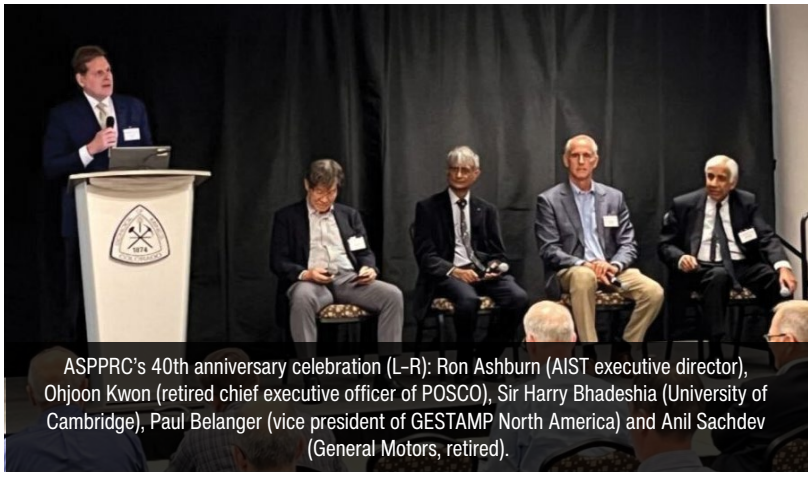
"AIST has been a great organization for us and our students to both interact with people in the industry and to present the work that we do," Webler said. It has also provided a platform to share research and build relationships with professionals across the field.



(L–R): Beth Dickey (CMU MSE Department head), Chris Pistorius (CISR co-director), Bryan Webler (CISR co-director) and Alan Cramb (former CISR co-director and co-founder).

Each year, many CISR students attend AISTech, the industry's flagship conference, and many also take part in specialized Technology Training courses. Both Webler and Chris Pistorius are active in AIST's Technology Committees as well, a commitment that has helped them cultivate a wide-reaching network throughout the steel community.

The partnership between ASPPRC and AIST also runs deep. Many of the center's industry partners are also active members of AIST committees, particularly the Metallurgy — Processing, Products & Applications Technology Committee, where ASPPRC faculty have held leadership roles.



ASPPRC's 40th anniversary celebration (L–R): Ron Ashburn (AIST executive director), Ohjoon Kwon (retired chief executive officer of POSCO), Sir Harry Bhadeshia (University of Cambridge), Paul Belanger (vice president of GESTAMP North America) and Anil Sachdev (General Motors, retired).

Presentations by faculty and students at AISTech, as well as at the MS&T technical conference, have provided valuable opportunities to connect directly with industry leaders. That connection is reinforced by the strong support of the AIST Foundation, which has funded scholarships, travel for students attending AIST conferences and programs designed to help early-career faculty.

Collaboration between ASPPRC and AIST has extended to co-hosted topical conferences, with staff working together on events dedicated to automotive AHSS, bar and forging steels, plate steels and most recently a microalloying symposium in June 2025. AIST's Steel Professor program has also fostered meaningful exchanges between students and industry professionals, including panel discussions timed with on-campus career fairs.

That partnership was highlighted again during ASPPRC's 40th anniversary celebration, where AIST's executive director Ron Ashburn moderated an international panel, underscoring the long-standing ties between the two organizations.

Looking Forward

Today, several forces are shaping the future of steel production. For Webler, decarbonization is at the forefront; at the same time, production systems are becoming increasingly connected, with sophisticated monitoring and data analysis tools transforming how plants operate. On the horizon are new structural metal concepts — but for these innovations to make a real impact, they must be scaled up for industrial production.

Researchers at CISR also have access to state-of-the-art tools to explore these possibilities.

"We will also need partners. CISR has, I would say, mastered the industrial research consortium model, and that has kept us and will keep us relevant into the future," said Webler. Partnerships have also expanded to include other Carnegie Mellon groups and universities, focusing on topics such as decarbonization, digital twins and AI in manufacturing.

"All our industry and academic partners bring critically important knowledge and perspectives that can help educate our students," Webler said.

At its core, the ASPPRC remains committed to advancing steel research and educating the next generation of leaders in ferrous metallurgy. The center continues to thrive under the guidance of a half-dozen active faculty members, whose mix of experience and seniority ensures long-term support for research and education.

Steel and ferrous metallurgy will remain central to the curriculum, with offerings at both the undergraduate and graduate levels. The center's approach emphasizes two-way collaboration with industry sponsors, now to about 30, a strategy that has proven successful and will continue well into the future.

Looking ahead, the center plans to explore new opportunities in steel research and development, responding to evolving industry needs and public research initiatives, while maintaining its mission to blend rigorous study with real-world impact.

Celebrating 40 Years

At the heart of CISR's work is a shared belief: the most important outputs are the students. "By giving them the knowledge, tools and perspectives they need, we're ensuring the steel industry will continue to innovate and thrive," Webler said.

In commemoration of the 40th anniversaries of these centers, their combined legacy of research, education and industry partnership stands as a model for how academic institutions can drive technological advancement while preparing future generations to lead the industry.

Four decades on, ASPPRC and CISR continue to forge not just steel; but the careers, innovation and knowledge that will help shape the future of metallurgy. ✦