



Rural

Economic/Workforce Development, STEM

Education Commission of the States

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Iron Range Engineering

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November 2013

— The third in a series of papers on rural education issues —

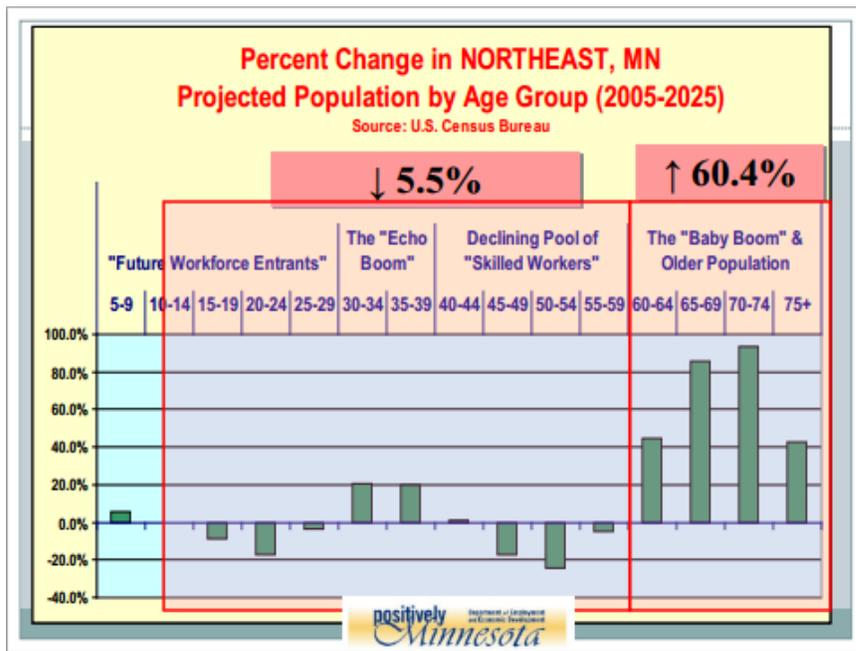
Imagine an engineering school with no classes. Students learn by working with their professors on projects assigned by local industry, which funds the school. These future engineers determine their specialties and pursue them in ways of their choosing. They graduate job-ready, saving the industries that hire them the cost of training.

You've imagined Iron Range Engineering (IRE) in northeast Minnesota, a school that is making news worldwide.

Accredited in August by ABET, the international Accreditation Board for Engineering and Technology, the school for third- and fourth-year engineering students was launched in January 2010. Its first students graduated in December 2012; accreditation is retroactive to those students. Most come from Itaska Community College, then graduate from nearby Mesabi Range Community & Technical College but with a degree from Minnesota State University, Mankato.



Minnesota's Iron Range (Wikipedia)



Trent Janezich, Director, University Partnerships, Northeast Higher Education District, Minnesota presentation at the 2nd National Summit on the Role of Education in Economic Development in Rural America, ECS, April 2012.

Keeping bright students in northeast Minnesota was the idea.

Having an engineering school in the beautiful Iron Range helps prevent brain drain—the concern that Range students would go to the University of Minnesota’s Twin Cities or Minnesota State’s Mankato and never come back. That wasn’t the only worry. The Range is home to mines that produce taconite for making iron, and it is home to paper mills. Those industries need engineers.

Those industries also need skilled workers, and they’ve got a disproportion of workers aged 45 and older, so the future was not bright. Taconite mining has a workforce that is 62.4% over the age of 45; paper manufacturing is 51% over. New hires can’t come directly out of high schools anymore—those jobs demand training. While Iron Range high school graduation rates exceed national averages, the percentage of students who go on to receive an associate or bachelor’s degree lags significantly, 28% versus 34%.

So a win-win-win situation was created: keep local students closer to home, provide college-level training in high school, more at local community colleges, and, on top of that, provide a steady stream of engineers to local industries who pay to support the school at the Mesabi Range Community & Technical College.

It was a long time coming.

Tom Rukavina, who now works for U.S. Representative Rick Nolan, was a Minnesota legislator for 26 years. “My district produced 60% of all the iron ore mined in Minnesota. Because of federal law, our land grant college, the University of Minnesota, received land and mineral rights. Just by chance, the land they received with the mineral rights contained iron ore. And over the last 100 years, the university has gotten millions of dollars from the mining companies that bought their ore,” Rukavina told ECS.

Those millions went into a permanent fund as required by federal law with the interest going to research. This all happens in the Minneapolis/St. Paul area, and Rukavina worked for years to try and shift some of the money back to the Iron Range for higher education.

So Rukavina took a different path. “You see our mines pay a production tax in lieu of property taxes.” The tax gets distributed to northeastern Minnesota schools, cities, and towns through a state economic development agency, the Iron Range Resources and Rehabilitation Board (IRRRB). “The production tax goes up each year ... usually around 5 cents a ton of taconite, unless the legislature decides to freeze it.”

Program Objectives

The program educational objectives for Iron Range Engineering are listed below and have been published on the official IRE website (<http://ire.mnscu.edu/about-ire/objectives.html>).

They are consistent with the Iron Range Engineering Program Mission to serve northern Minnesota. Graduates will achieve at least two of the following objectives but will be capable of achieving all within one to four years of graduation:

1. **Designing, implementing, and integrating** thermal, electrical, mechanical, and computer-controlled systems, components, and processes that will serve the region, the nation, and the world.
2. **Continuing their education through technical or professional graduate programs,** professional licensure, or certifications, and the wide variety of other types of life-long learning.
3. **Creating, developing, and managing** in a wide-range of enterprises that result in sustainable and enhanced economic regional development through their disciplinary expertise.
4. **Demonstrating actions** such as community service, professional ethics, professional responsibility, and mentoring future engineers.

In 2008, as House chair of higher education, he took that escalator and directed it to the IRRRB for higher education. At the time, with 40 million tons of taconite produced annually, that amounted to \$2 million a year.

Also at the time, Rukavina met Ron Ulseth, a professor of engineering at Itaska Community College in the Range, who had an idea for new kind of engineering school, a purely hands-on program that would be based at a local community college. It was the kind of program that had been recommended in *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*, published by the National Academy of Engineering, part of the National Academies, in 2005.

Similar calls came from the National Science Board, industry leaders and engineering education leaders who declared the current model for engineering education would not meet challenges of the future or keep the United States competitive. “The calls center on adopting pedagogies that better promote learning than does traditional lecture as well as better development of the professional skills needed for success as engineers after graduation,” Ulseth said.

Still, that new model never caught on.

Ulseth has pointed out that “in engineering education, we are responsible for creating the next generation of innovators,” but engineering education hasn’t changed in 60 years.

The teaching method itself is unusual. What does the engineering professoriate think of project-based learning? “Not much,” replied Ulseth. “If there were (a) general belief by academicians about this type of learning, it would be used much more widely.

“I would not say that teaching this way is more difficult. It is certainly more challenging than using the same lecture notes year after year. However, it is no more challenging than the challenge of being a good teacher. The biggest challenge comes with giving up the idea of being an expert on everything and being willing to join students side by side in the learning process rather than being the deliverer of knowledge. This model of teaching is much more intrinsically rewarding.”

Industry Partners

- Iron Range Resources and Rehabilitation Board
- United Taconite
- Medtronic
- Hibbing Taconite
- PolyMet
- Mesaba Nugget
- UPM-Blandin
- Minnesota Power
- TriTec of Minnesota Inc.
- Minnesota DNR
- Barr Engineering
- Jasper Engineering
- Boise Paper
- North Shore Mining



Manual Mill for training in machining, <http://irengineering.blogspot.com/>

Former IRE student Matt Hudson told ECS he'd done his first two years of mechanical engineering at Century College in White Bear Lake, Minnesota. "I realized that what I was paying for my education did not correlate to what I was learning and began looking into alternative options. Ron Ulseth came and presented to the Century College Engineering Club. After talking with Ron and visiting IRE, I decided to make the switch."

Hudson and Eric Schaupp made news when they won the student division of the Minnesota Cup for entrepreneurs. The two IRE students developed a light-weight generator that could take a variety of fuels and could power a phone or a building. In an example of the kind of innovation celebrated at Iron Range, Hudson said at the time they'd taken two technologies that were undeveloped and combined them in a way no one had done before. Schaupp added that both were interested in clean tech and clean energy and wanted to develop a generator that can efficiently produce electricity.

Educational Partners

- Minnesota State University, Mankato
- Itasca Community College
- Arrowhead University
- Mesabi Range Community and Technical College
- University of Minnesota-Duluth

Hudson said that during their senior year, additional prototyping of the generator was completed to determine feasibility, but results didn't match the theoretical results predicted.

By then he'd already accepted a position. "Before my senior year at IRE, I was fortunate to advance through a recruiting program at Procter & Gamble. The last stage was a week-long visit to the headquarters in Cincinnati, Ohio. During this time, I was offered a full-time position which I later accepted."

Hands On, Project-Based Learning

- **Company:** *Delta T Delta S Slider*
Description: Students will work on an entrepreneurial project to design and market a camera slider aimed at hobby level video enthusiasts.
- **Company:** *Design Wise Medical* (non-profit pediatric medical device company)
Description: Students are working to develop a noninvasive method to deliver oxygen to children as they sleep. What they will produce is a tracking system to say where oxygen needs to be delivered.
- **Company:** *Hibbing Taconite Company*
Description: Students are developing a high-flow fluids system, with structural and workplace design components, followed by a detailed economic analysis.
- **Company:** *MN Power*
Description: Students will be designing a heating system for the fuels storage and process buildings at Minnesota Power's Clay Boswell plant, evaluating using waste energy from the power plant.
- **Company:** *Terex*
Description: The goal of the Terex project group is to design and construct two sound dampening booths for the end of the Terex assembly line where quality testing is done.
- **Company:** *TesGen*
Description: As a continuation and further development of an entrepreneurial project, the team will refine the design and determine feasibility for a small, lightweight, portable power generator.
- **Company:** *Venari Trap Systems*
Description: Team members will be learning programming, electronics, and positioning technologies as well as business. Team members will be designing an autonomous triggering system for a clay pigeon trap based on relative position of a "hunter" to the trap.

Unlike Hudson, most IRE students stay in the Range. They graduate with degrees that tend to be in mechanical or electrical engineering and starting salaries may hit \$55,000. Tuition rates are around \$7,000 per year, but some get MAX scholarships from the National Science Foundation that cover up to \$5,000. Twenty to 25% of students are women, a higher percentage than at a conventional engineering school. The percentage of minorities is low, but matches the local demographic.

The core of what engineers do is manage projects, so that is what students do, spending only about two hours a week together in classrooms. The other 58-68 hours a week they are working on campus. “Half of (the time) they spend solving a problem for an industry client or starting their own businesses,” Ulseth said in a TEDx talk that is posted on the school’s site (<http://ire.mnscu.edu/about-ire/tedtalk.html>).

Before a new semester, project descriptions from local industries are posted and students select preferences with an eye to the 32 competencies they’re developing: eight mechanical, eight electrical core credits, and 16 of their choosing. Faculty have developed an assessment and evaluation program with a focus on cognitive development, technical knowledge acquisition, professional competency acquisition, student interest, and motivation.

So far, 40 students have graduated; two are in graduate school. The program is young, but getting attention.

In his State of the State speech, Governor Mark Dayton talked about how some state campuses already are preparing students for jobs of the future and referred to Iron Range Engineering, which is, he said, “so successful that the Engineering Department at Stanford University invited (Ulseth) there to teach their faculty about the benefits of this new (hands-on) model. When Iron Range Engineering meets Silicon Valley—well, Ron I just hope you have a share of the royalties.”

In addition to Stanford, Ulseth was invited to speak at Rose-Hulman Institute of Technology, voted the No. 1 undergraduate engineering school in the country for 15 years in a row (and counting) by *U.S. News & World Report*. “And we have presented at many national and international conferences,” Ulseth said.

Pakistani engineer Bilal Zafar at Qualcomm in San Diego wrote an article on Iron Range Engineering for a STEM-oriented Pakistani publication called *Next Step Forward*. One reader pointed out that teaching project-based engineering would be a tough sell in Pakistan because “we don’t have good/confident teachers even at colleges in ISB/RWP (Islamabad and Rawalpindi) who can interact fruitfully with the industry. (That) really kills this idea.”

Ulseth said the program can be scaled up because it was scaled down from a similar program at the University of Aalborg in Denmark. While it is the first like it in the United States, IRE soon will be joined by another Minnesota State institution, Normandale Community College in Metro, Minnesota. The program is Twin Cities Engineering (TCE), an effort led by Becky Bates, Ulseth’s co-director at IRE.

Legislation set up a higher education board at the IRRRB, and the board determines the amount of money for the engineering program on an annual basis, Rukavina said. That recommendation is then approved by the full board. All legislation was bipartisan, he said, “and everyone has been impressed that even at the height of the recession, these students have gotten great jobs in their field.

“I am now going to go full-circle here and tell you that in my last legislative session (I decided to retire in 2012), we passed legislation that mandates the University of Minnesota will establish a \$25 million endowment for the purpose of offering a mining/metallurgical-related engineering degree at Mesabi Community College similar to the mechanical engineering degree offered by Minnesota State.

“It took me 20-plus years to do it, but I finally brought some of that wealth back to the area it came from.”

Postscript: History of the Iron Range

For more than half a century, Minnesota's iron ranges supplied the iron ore that fed the nation's steel mills. First mined in the 1880s, the three ranges—the Vermilion, Mesabi, and Cuyuna— provided the economic underpinnings of northeastern Minnesota. They also drew waves of immigrant workers, creating the state's most diverse melting pot and a distinctive cultural legacy that still defines the region. Although mining has declined since the 1960s, the mines and the tight-knit communities they fostered have developed a new industry focused on cultural-heritage tourism.

— Iron Range Resources and Rehabilitation Board, <http://mn.gov/irrrb/DataCenter/history-iron-range.jsp>

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