



IRON RANGE ENGINEERING BELL

A nation-wide cooperative engineering education for community college graduates

“The strongly positive effects of student work experience on labor market outcomes serve as a reminder that many relevant employability skills are probably best learned in workplaces rather than in classroom settings.”

(Mason, Williams, and Cranmer (2006), National Institute of Economic and Social Research, London)

In August 2019, Minnesota State University, Mankato’s Iron Range Engineering program began delivering a new upper-division engineering education that is centered on student experiences working directly in industry through co-op employment. Students work in industry for the last two years of their education while being supported in their technical and professional development by professors, learning coaches, and their own peers through the use of digital communication. Crafting a student learning experience that is centered on engineering practice from all of its perspectives, this program aims to better transition the student who entered, to the practice ready engineer who graduates. The Bell Program is designed to be relevant, interesting, supportive, inclusive, and financially sustainable..

Just as human-centered design is changing engineering practice to involve solutions that involve the human perspective at all steps, this work-based learning experience involves the student gaining engineering practice perspectives at all steps. The current, traditional, model of engineering education could be labeled as an “indirect” learning experience where the learning about the profession is done in the abstract in a classroom. In contrast, the new program delivers a “direct” learning experience where the profession is experienced in-situ. The learning experience opens doors for greater access to engineering education. Aimed at community college graduates, it serves a more ethnically and gender diverse student body. It is also creating opportunities for place bound individuals to earn the majority of their education near their homes. Further, the financial model (students earn while on co-op) increases access to higher education without crippling student loan debt.

Entering students have completed their lower division studies at community colleges and universities from across the United States. They enter a one semester development called the “Bell Academy” where they polish the skills necessary to succeed at high levels both professionally and technically as self-directed learners, working as unpaid engineering interns as they acquire and prepare to enter their first paid co-op. Satisfactory competency achievement is necessary to move from the Bell Academy to paid co-op placement.



The program has three distinct faculties. 1.) The “professors” (PhD level engineers) create, facilitate, and support the self-directed learning of technical competencies and give verbal exams to students while the students are in the Bell Academy, on co-op placement, and when they return for exams at the end of each year. 2.) The “facilitators” (engineers hired from engineering practice to this role) mentor students in their professional and engineering design development during the Bell Academy and in their co-ops through frequent encouraging feedback on the students’ reflection journals and development plans. Feedback is both in writing and face-to-face electronically. Learning coaches also liaise with company supervisors and facilitate peer-to-peer support teams. 3.) The on-ground academic team consisting of some professors, some facilitators, and a support staff deliver the Bell Academy.

The motivations for starting the new model included the emergence of the Charles Sturt University model in Australia, the success of the Iron Range Engineering (IRE) model, the opportunity to develop a fiscally sustainable model for both students and society, regional economic development within all respective areas of the country, graduating engineers with a more work ready skillset, and meeting the needs of the emerging digital generation of students.

Program Features

(Co-op features) Unique features distinguish the new program co-op experience from a traditional engineering co-op. These features result in a steep development trajectory enabling the students to earn full college credit towards their baccalaureate degree. Features include: the training experience before the co-op placement, technical credit learning from engaged professors during co-op placements, frequent support and feedback from facilitators, peer team support for professional and technical learning, a substantial development through reflection during all aspects of the program, and a one week on ground examination period after each year of co-op completion.

(Fiscal sustainability) The model is fiscally sustainable for both students and the institution. Differential tuition is charged to enable the program to operate on minimal external funding (~\$13,000 per semester for five semesters). Students earn a co-op salary for the last two years of their education (more than \$20/hour which translates to \$40,000+ per year).

(Student body) The student body of this program is made up of community college graduates from around the entire United States. These students transfer to the institution from community colleges everywhere to attend the Bell Academy in-person in northeastern Minnesota, or virtually from anywhere. For their next two-years, students work in co-op placements anywhere in the world. They are expected to return to the institution for a one-week exam period following each year of co-op placement. The enrollment is driven by a desired intake of 40-50 students every six months. At full capacity, this will result in ~200 students in the program at the different stages.

(IRE attributes) The learning model uses strategies for student development that emerged from the ten years of operation at Iron Range Engineering. These strategies include models for professional development, self-directed learning development, structured reflection, technical competence development, facilitation, culture management, leadership, innovation, design learning, and inclusivity.

Giving individuals the liberty to pursue their own path to engineering excellence