



# IRON RANGE ENGINEERING BELL PROGRAM

## A nation-wide cooperative engineering education for community college graduates

*“The strongly positive effects of student work experience on labor market outcomes serve as 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 will 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 new 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 cost efficient.

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, as designed, 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 will have completed their lower division studies at community colleges and universities from across the United States. They will enter a 5-month Engineer Development Phase called the “Bell Academy” in northeastern Minnesota where they will polish the skills necessary to succeed at high levels both professionally and technically as self-directed learners as they acquire and enter their first co-op. Minimum competency achievement will be necessary to move from EDP to 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 oral exams to students while the students are in the EDP, on co-op placement, and when they return for exams at the end of each placement. 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 Engineer Development Phase.

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, expansion of project based learning (PBL), 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 co-op completion.

(Fiscal sustainability) The model is fiscally sustainable for both students and institution. Differential tuition will be 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 (~\$20/hour which translates to \$40,000 per year).

(Student body) The intended student body of this program is community college graduates from around the entire United States. These students come to the institution for the 4.5-month on-site period and are then able to return to their home region (or any other part of the country) for their two years of co-op placement. 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 75 students every six months. At full capacity, this will result in 375 students in place between the EDP and the co-op placements.

(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. The co-op aspect of this new learning model has been piloted at IRE with over 30 students. The students have averaged more than \$22/hour. They also found these co-ops on their own after receiving the professional and technical training provided by the faculty at IRE.

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