

# Engineering Leadership: Tech Innovation and SIGMA

## University of Saskatchewan

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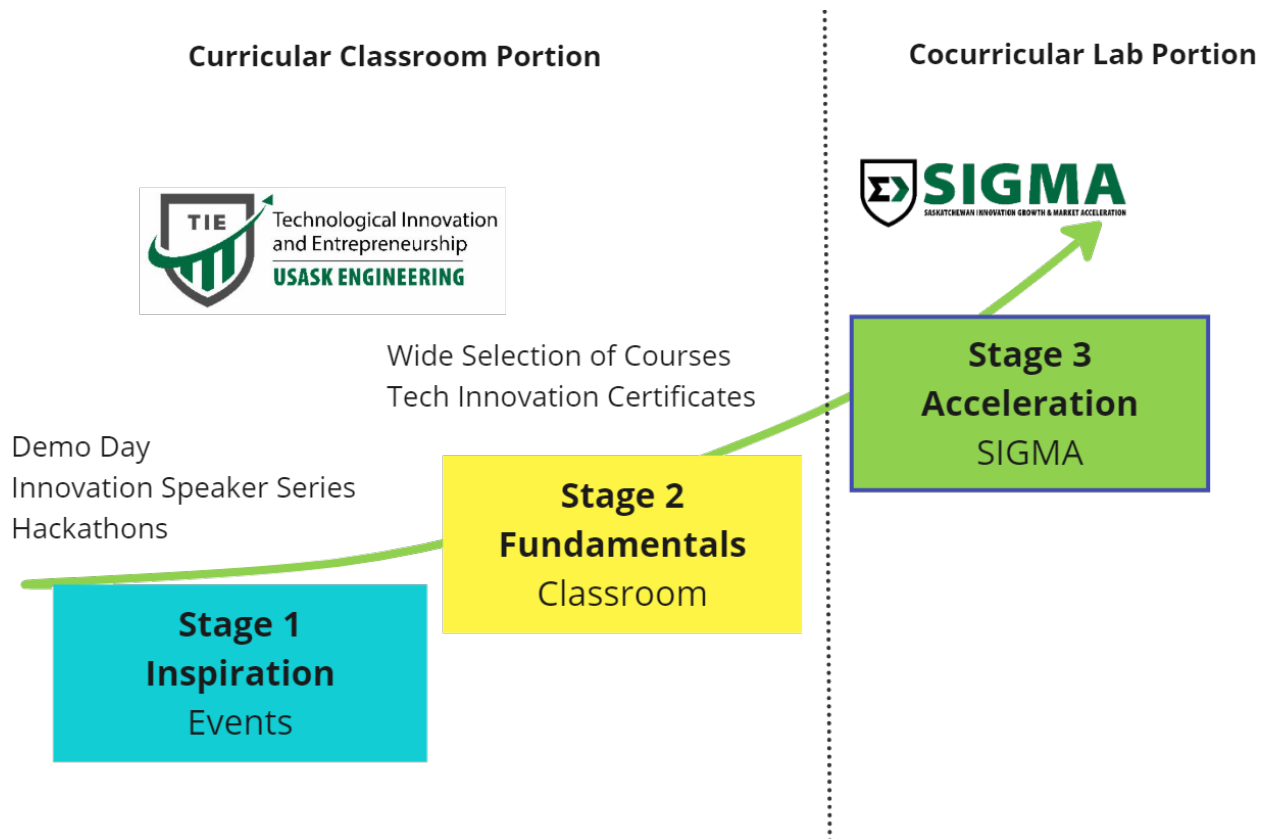
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### Abstract

At the Tech Innovation – SIGMA program, we use both curricular and extracurricular activities to accelerate the students' learning on leadership in bringing technologically innovative ideas to implementation through teamwork and entrepreneurship.

### Program Description

At the University of Saskatchewan, we use an integrated approach to develop entrepreneurial leadership skills. Entrepreneurial leadership is a mindset that focuses organizations on turning problems into opportunities that create economic and social value [1]. The process started as a program called Engineering Entrepreneurship Option (EEO) in 2010, focusing on business skills. By 2019, a new certificate program Technological Innovation Certificate (TIC) was established to replace EEO. The new program aims to provide academic credit courses such as Technological Innovation Design, Engineering Entrepreneurship, and Technological Innovation Management to develop entrepreneurial leadership skills to implement technical changes via entrepreneurship and corporate entrepreneurship. Students will learn skills such as teamwork, management, system and strategic thinking as they complete their degrees. In 2021, an extracurricular portion called SIGMA (Saskatchewan Innovation Growth and Market Acceleration) was created based on the former Summer Entrepreneur (SE) program as an extension of TIC. While SE was designed to use existing university intellectual properties to train a team of students on entrepreneurship principles, SIGMA is designed to provide experiential learning to TIC students, paired with students from across campus, to implement their learning from TIC through a four month Work-Integrated-Learning (WIL). These students will translate new technologies or designs into opportunities for creating a new organization, resulting in 6 companies at Co. Labs and 1 in Social Innovation Lab, 1 in CDL in the last 3 years. In this integrated design, a total of three steps are available to the students. In Step 1 and 2, the curricular program of TIC acts as the classroom to learn the concepts of entrepreneurial leadership, while in Step 3 the extra-curricular program of SIGMA acts as the lab portion to practice the learnings. Together, they create a continuous journey.



To create this integrated program, we redesigned both portions of the program to create an opportunity for students to learn and practice the same skills. In the curricular portion, the courses in TIC, most notably Engineering Entrepreneurship and Technological Innovation Management had been modified to provide fundamental knowledge on the skill gaps identified in the SIGMA portion. In the extra-curricular portion, the SIGMA program had used the same framework, rubrics, and activities in the real-world setting. Four senior executives from different industry were recruited to mentor students on organizational leadership both in the academic courses and SIGMA. Additionally, funding was secured to provide financial support for the work integrated learning in SIGMA.

The curricular program has trained over 50 students over the last decade, forming more than 14 currently active companies to date. The new designed program had been providing training to 40 students per year in the classroom portion and 15 students per year in the lab portion (SIGMA). The program capacity had increased over the years. In the 2023-24 academic year, a total of 60 students are trained in the classroom.

TIC-SIGMA is a one of a kind program in Canada, where the focus of the program is the capacity of the founders rather than the performance of the founders. The core of the program is to

teach students “how to fish”, so that they learn the craft of entrepreneurship and leadership in technological innovation rather than creating a company. The uniqueness of this program is that it focuses on the founder's leadership development and its delivery through both curricular and extracurricular activities. The courses are designed to provide the program to both undergraduate and graduate students in an easy and accessible fashion, where the SIGMA program in the summer acts as the “living lab” where the students make decisions as a leader and entrepreneur.

The program features training through traditional pedagogy in the classroom, guest lectures, apprenticeship with senior executive members about leadership, and mock board meetings. Thanks to our partners, our program can provide small financial resources (about \$2,000/month/student) to support their learning and practicing.

### **Connecting Themes**

We define engineering leadership (EL) as “the ability to assess risk and take initiative, the willingness to make decisions in the face of uncertainty, a sense of urgency and the will to deliver on time in the face of constraints or obstacles, resourcefulness and flexibility, trust and loyalty in a team setting, and the ability to relate to others” [2]. In its core, we want to develop engineering leaders who can create and implement innovative technologies effectively. To better define the leadership traits and to define the outcomes for assessments, we follow a six competencies model based on a 2015 review from Paul and Falls: Communication, Innovation, Creativity, Execution, Personal Drive, and Teamwork [2].

### **Instructional Strategies and Teamwork**

Pedagogically, we follow a three-step model each relying on a different method. Our first stage is to inspire the students to think that they are capable of engineering leadership and entrepreneurship. To accomplish, we rely on exposures through guest lectures, networking events, and peer mentorship from alumni. In the second stage, we aim to provide the fundamental learning through experiential learning pedagogical approach in the traditional classroom courses such as Engineering Entrepreneurship and Technological Innovation Management [3]. However, in order to connect the theory to the practice, we leverage theory based practical exercises and in class case studies to foster the application of learning. Executives in Residence (EiR) with industry experience at a senior level (engineers with CEO or Vice President experience over at least 10 years) provide mentorship and act as role models. They provide instant feedback through the active learning portion of the class when the students digest the concepts and provide more in-depth mentorship through one-on-one mentorship via office hours.

The first two stages are both done through the curricular based program, the final stage is an extracurricular program called SIGMA. In this program, the pedagogical model is based on flipped classrooms and experiential learning. Each week the students are expected to work in a workshop session with the EiRs to set goals, come up with strategies, implement and troubleshoot along the way. The students are required to answer key questions related to their practice as they move their innovative technology through the commercialization path: for example, what I want to accomplish and who else do I need to bring as a part of my team. Students are asked to regularly reflect on their learning and experience in all three stages to define their career goals and develop Their leadership identities (i.e. are they the CEO, CTO, or employees who drive changes?).

In the second and final stages, the students are asked to form teams of two or more persons who may have similar passions/values. The purpose is to introduce accountability and become familiar with teamwork. Team dynamics workshops are provided to students at the beginning of the program to support this experience.

### **Equity, Diversity, and Inclusion (EDI)**

To make the program accessible to everyone on campus, we first created graduate courses and combined the graduate and undergraduate courses together. This filled the gap of lack of entrepreneurial leadership training to the graduate students. The courses are also offered through online medium, making it available to learners in rural Saskatchewan such as practicing engineers looking to upskill. Additional office hours were provided by both the EiR and faculty members, this allowed female and international students to get more tailored one on one mentorship to clarify concepts and develop strategies around their situations. Lastly, financial support is provided to the students as they go through the programs. As such the program has a much higher proportion of female and visible minorities compared to the industry benchmarks.

### **Our Impact**

To ensure fair and prompt feedback and evaluation, the program established a panel of industry experts from various domains to engage students and evaluate their work against the set rubrics. The students are assessed in both their competence areas and personal characteristics [4]. Their competences are measured by EiRs based on their performance in the following ways: the ability to gather information and make decisions, the effectiveness of their written and verbal communications, as well as their ability to work with fellow teammates, classmates and external supports. Their personal characters are measured through their own reflection on their personal drive to lead, their self-belief and feedback through mentorship on their self-awareness.

### Next Steps

The next goal for our program is to expand and expose more students to leadership training in technological innovation and entrepreneurship programs. Our goal is to expose 20% of engineering students to at least one course on engineering entrepreneurial leadership. To accomplish this goal, we will continue to develop low stakes workshops and hackathons to inspire the students to pursue the journey of leadership.

### References

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