

An Engineering Leadership Series Embedded into Core Civil Engineering Undergraduate Classes at UBC

Department of Civil Engineering, University of British Columbia, Vancouver Campus

T. R. Etmanski

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Abstract

This case study presents how an engineering leadership series came to exist within the required courses of the civil engineering undergraduate program at UBC, it shares the topics covered and scaffolded across the series as well as a general overview of the assessments used in each course.

Program Description

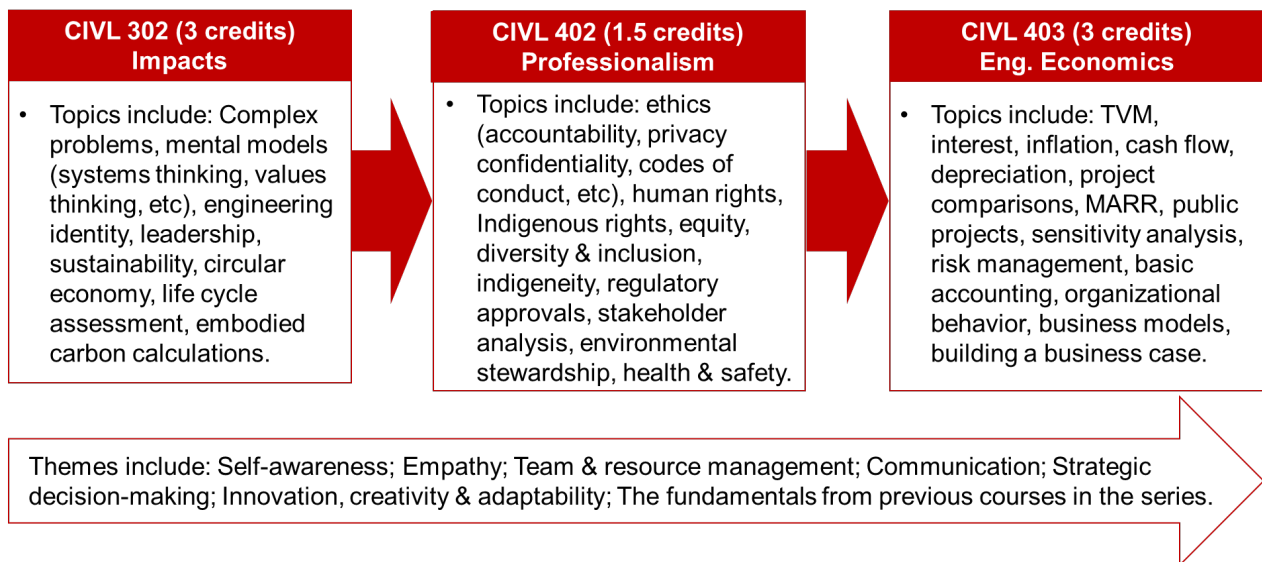
It is presumed that topics connected to engineering leadership are organically embedded within many required courses across the civil engineering undergraduate program at the University of British Columbia (UBC). However, there are a select number of courses that are a more obvious choice to strategically include engineering leadership concepts within. CIVL 302 (Impacts in Civil Engineering), CIVL 402 (Professionalism and Law in Civil Engineering), and CIVL 403 (Engineering Economics for Civil Engineers) are coincidentally scheduled in series, starting in the second semester of the program's third year, and in the first and second semesters of fourth. All three of these courses are mandatory (core) for civil engineering students. This case study describes the ways engineering leadership themes, concepts and tools have been embedded into and scaffolded across the series.

Redevelopment of these courses began in 2022 when one instructor was assigned to all three courses at one time. An initiative like this would not require one instructor to teach across all of the courses, as collaboration could be envisioned, however it made the implementation of reinventing them through an engineering leadership lens less complicated. Additionally, the instructor's flexibility and openness to slightly modify the topics traditionally covered in these courses (while maintaining the core competencies expected of them from an accreditation perspective) was necessary to allow for a true reimagining of the series.

Approximately 200 students make their way through the series across three semesters, and 400 students are taught simultaneously across third and fourth years on an annual basis.

This case study is unique in that all the courses in the series are required by students in the program, have many aspects tracked and measured for the national accreditation process, and utilises high-impact teaching approaches like experiential teaching, team-based learning and flipped classrooms.

Simply stated, the course series can be categorized in three broad themes of “self/environment” (CIVL 302), “teams/society/people” (CIVL 402) and “projects/business/economy” (CIVL 403). The series captures the four engineering leadership domains of self/teams/organization/society [1] as well as the three P’s of sustainability planet/people/profit [2]. An overview of the topics in each course in the series is presented in the figure below.



There are some notable changes to each course:

- **CIVL 302** previously focused entirely on sustainability and now is centered around the concepts of complex problems and frames-of-mind which allows for sustainability to still be covered, but also now includes content connected to personal values and self-identity (where the discussion of engineering leadership often begins).
- **CIVL 402** previously relied on the Engineers and Geoscientist British Columbia (EGBC) Code of Conduct to frame the discussion of professionalism whereas now the course uses the values of empathy, self-awareness, and good faith as the basis for the

discussion, while still including the EGBC content. This course now is also expanded to include Indigenous rights, Indigeneity and reconciliation.

- **CIVL 403** still contains the fundamental core concepts of engineering economics but now frames them through the lens of triple-bottom-line decision-making. And the concepts connected to complexity, personal values and sustainability are embedded within the economics examples used.

Connecting Themes

The definition of engineering leadership underpinning this work is influenced by the work done by iLead at the University of Toronto, the work of Robyn Paul et al. [3] from the University of Calgary, and by the National Initiative on Capacity Building and Knowledge Creation for Engineering Leadership (NICKEL) community at large. In short, engineering leadership involves a blend of technical expertise and leadership skills to guide engineers toward achieving their goals and delivering valuable outcomes in a rapidly evolving landscape. It assumes engineering leaders are responsible for setting a clear vision, motivating and empowering their team, making critical decisions, managing resources, and ensuring that engineering efforts align with broader organizational and societal objectives and norms.

Instructional Strategies and Teamwork

Students in CIVL 302 lead a discussion in their tutorial sections with their group, allowing them to practice their presentation/communication skills. The final exam in CIVL 302 is essay-based, in CIVL 402 there are a small number of multiple-choice questions included on the final exam however the final exam is primarily used to test the law component of the course (which is not addressed in this case study but is taught by a law firm and is delivered very separately from the rest of their series). The professionalism aspects of the course are primarily assessed via team assignments, such as creating a consultation plan for stakeholders of a fictional infrastructure project or case study analysis of a human rights violation on an engineering project. There are two heavily quantitative midterms in CIVL 403 with the final business case replacing a final exam. CIVL 302 and CIVL 402 have asynchronous modules students are expected to work through prior to attending lectures. The in-person lectures are largely experiential in nature and include things like plenary discussion, debates, work through a case study live, etc. Both of these courses also contain in-class pop quizzes, to encourage completion of the modules as well as class attendance.

All three courses involve teamwork: CIVL 302 with three due throughout term (worth 5% each) and one large research project due at the end (worth 30%); CIVL 402 with five (worth 5% each); and CIVL 402 with one done in pairs (worth 30%). Groups in CIVL 402 have 5 students per team

with leadership within one team rotating for every assignment. The students provide feedback about their experience after every submission with specific feedback meant for their team leader, which they receive anonymously after-the-fact, to be used for personal reflection. In all courses, the team assessments constitute $\leq 50\%$ of one students' grade.

Equity, Diversity, and Inclusion (EDI)

All courses in this series contain an EDI statement in the syllabi which is read and discussed in detail on the first day of classes. This is done to encourage a safe environment for teaching and learning, and to remind students of the expectations around professional behaviours both in and out of the classroom. EDI-specific course content was also added into CIVL 402, and 25% of the lecture hours are now spent covering it, through discussion and case analyses. Some of this content includes topics on unconscious bias, intersectionality, power dynamics, and inclusive leadership.

Our Impact

Assessing impact of changes like these in core courses is difficult and a work-in-progress. Anecdotally, there is a noticeable increase in participation by female students in the classroom as soon as EDI topics are introduced and two students have sent very personal emails of gratitude after CIVL 402 ended (unsolicited) expressing sentiments connected to how they were positively impacted by the course material. Moving forward, it would be interesting to invite more detailed student feedback on their experience through the series.

Next Steps

The next steps in this project are to further refine the course content of all three courses, including sourcing and updating new and relevant case studies and activities to do during lecture time. Also, more work on assessing impact through the use of student surveys.

References

- [1] A. Simpson, D.W. Reeve, C. Rottmann, Q. Liu, V. Hue, and S. McCullouch, "Engineering Leadership Education: Catalyzing Long-Term Personal and Professional Growth," in CEEA (Ottawa, ON), 2019. Available: <https://doi.org/10.24908/pceea.vi0.13869>
- [2] V.C Gallagher, MW. Hrivnak, S. Valcea, C.B. Mahoney, and D. LaWong, "A comprehensive three-dimensional sustainability measure: The 'missing' of 'people' – a vital stakeholder in sustainable development," in Corporate Social Responsibility and Environmental Management, Wiley, vol. 25, no. 5, Sept/Oct 2018, pp. 772-787. Available: <https://doi.org/10.1002/csr.1493>
- [3] R. Paul, A. Sen, and E. Wyatt, "What is engineering leadership? A proposed definition," in ASEE (Salt Lake City, Utah) 2018. Available: <https://peer.asee.org/30137>

Recommended Reading

M. Klassen, D. Reeve, G.J. Evans, C. Rottmann, P.K. Sheridan, and A. Simpson, Engineering: Moving leadership from the periphery to the core of an intensely technical curriculum," in New Directions for Student Leadership, 2020, vol. 2020, no. 165, pp. 113-124. Available: <https://doi.org/10.1002/yd.20373>