



FOR RECOMMENDATION

PUBLIC

OPEN SESSION

TO: Academic Board

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PRESENTER: Same as above
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DATE: March 27, 2018 for April 19, 2018

AGENDA ITEM: 7

ITEM IDENTIFICATION:

Proposal to establish the Institute for Studies in Transdisciplinary Engineering Education and Practice as an EDU: A, effective July 1, 2018, Faculty of Applied Science and Engineering

JURISDICTIONAL INFORMATION:

The Planning and Budget Committee is responsible for making recommendations to the Academic Board on plans and proposals to establish, disestablish, or significantly restructure academic units, here defined as "faculties, schools, colleges, departments, centres and institutes with teaching, or teaching and research functions, undergraduate degree programs, and graduate degree programs," regardless of the source of funds. (*P&B Terms of Reference, Section 4.4.1*)

GOVERNANCE PATH:

1. Planning and Budget Committee [for recommendation] (April 4, 2018)
2. **Academic Board [for recommendation] (April 19, 2018)**
3. Executive Committee [for endorsement and forwarding] (May 8, 2018)
4. Governing Council [for approval] (May 17, 2018)

PREVIOUS ACTION TAKEN:

The proposal to create the Institute for Studies in Transdisciplinary Engineering Education and Practice (ISTEP) as an EDU: A was approved by the Faculty of Applied Science and Engineering Faculty Council on February 27, 2018.

HIGHLIGHTS:

This is a proposal to create the Institute for Studies in Transdisciplinary Engineering Education and Practice (ISTEP) in the Faculty of Applied Science & Engineering as an Extra-Departmental Unit Type A (EDU:A), effective July 1, 2018.

Engineering graduates face a rapidly changing, ever more challenging world. Those who are creative, professional, ethical, effective communicators, team players, life-long learners and systems thinkers will amplify their technical knowledge and increase their contribution to society. Thought leaders, accreditation agencies and employers are calling for engineers to have greater knowledge in the realms of multidisciplinary design, leadership, communication, business, education, entrepreneurship, sustainability and globalization. These challenges are driving changes to both what and how the Faculty of Applied Science and Engineering (FASE) teaches its students, and the need to adopt leading edge engineering education so as to integrate broader competencies and enhance engineering student learning.

The Faculty of Applied Science and Engineering has been bolstering its capability to respond to these challenges for some time through key initiatives:

- The Engineering Communication Program(ECP): established in 1995
- The Institute for Leadership Education in Engineering (ILead): established in 2010
- The Engineering Business Minor: established in 2011
- The Collaborative Specialization in Engineering Education; established in 2014

Through related hires already in place, FASE now has a critical mass of faculty who actively collaborate and are strongly engaged in cutting-edge scholarship and exemplary pedagogy in engineering education. It is proposed that this core of existing faculty and initiatives be brought together, effective July 1, 2018, in an Extra-Departmental Unit Type A (EDU: A), called the *Institute for Studies in Transdisciplinary Engineering Education and Practice* (ISTEP). The new EDU:A will house 9 teaching-stream faculty 100% budgetary appointments, 1 teaching-stream budgetary cross appointment and 2 tenure-stream budgetary cross-appointments. These 10 teaching-stream faculty represent approximately a third of teaching-stream faculty members in the Faculty. The rest will retain their existing appointments within their home departments.

This new Institute must be created as an EDU: A as only an EDU: A can provide a dedicated administrative home that unites these existing faculty through budgetary appointments, so as to support review and promotion based on a shared interdisciplinary scholarship. This EDU: A will not from the outset offer its own academic program, but will work collaboratively with other FASE units offering academic programs. Specifically, affiliated faculty will continue to provide the extensive instruction in existing courses they are already delivering. They collectively teach thousands of students each year, reaching all 5500 undergraduate engineering students at different points in their programs with the demand continuing to grow. This Institute will also create an academic space to promote their leadership in teaching and learning, encourage related scholarship, and advance and develop engineering education as a distinct and valued field.

ISTEP will support a well-established and well-defined area of academic study. It will partner with departments and institutes from across FASE and beyond (e.g., OISE) to foster scholarship in engineering education and engineering practice. The Institute's mission will be *to understand the practices of today's engineers so as to graduate engineers who are better equipped to address tomorrow's societal challenges*. Specifically, ISTEP will:

- Deliver existing graduate and undergraduate courses and instruction in technical communication, leadership, business, multidisciplinary design and engineering education.
- Provide leadership through the development of innovative models of effective teaching in engineering.
- Engage in the scholarship of teaching and learning (SoTL).
- Extend the understanding of new engineering competencies and practices, and translate this knowledge into curricular design and learning experiences.
- Bring together colleagues within and beyond FASE to promote community and promote inter-disciplinary scholarly conversation.

In summary, ISTEP will bring together faculty, programing and initiatives that have led the way in expanding the capabilities of engineering students, thereby advancing the academic goals of FASE and enhancing its reputation with national and international, academic and business communities. Combining these strengths as an EDU:A will help promote and strengthen cross-departmental collaboration, and promote FASE's reputation as an innovator and leader in engineering education and related scholarship.

An Interim Director will be appointed to oversee the launch of the Institute. Once the EDU is established, the Dean will work with a search committee to bring forward the Director of ISTEP in accordance with the Policy on Appointment of Academic Administrators.

ISTEP will occupy available space within the new Centre for Engineering Innovation and Entrepreneurship in addition to retaining space already occupied by its faculty and co-existing units.

Extensive consultation was undertaken in support of the development of this proposal over the period September 2016 to February 2018. This consultation included a survey of faculty members, discussions with students, discussions with impacted faculty members, presentations at department meetings, a meeting with students, two discussions at Faculty Council, presentations at two FASE Chairs and Directors meetings, discussion with the Head Librarian in the Engineering and Computer Science Library, consultation with potentially interested U of T Faculties beyond FASE (FAS, OISE, Rotman, DLSPH) and some consultation with the broader engineering education community in Canada.

FINANCIAL IMPLICATIONS:

The Faculty of Applied Science and Engineering will assume administrative and budgetary responsibilities for ISTEP. Creation of this EDU:A will not have major resource implications or

budgetary impacts, as described in the proposal. New funding will be required for the Director and one administrative staff along with operational support to help ISTEP pursue its mission.

RECOMMENDATION:

Be It Recommended:

THAT the proposal to establish the Institute for Studies in Transdisciplinary Engineering Education and Practice as an Extra-Departmental Unit Type A, be approved effective July 1, 2018.

DOCUMENTATION PROVIDED:

Proposal to establish the Institute for Studies in Transdisciplinary Engineering Education and Practice as an EDU:A



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Proposal to Create a Transdisciplinary Institute for Engineering Education and Practice



Feb 11, 2018

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1. SUMMARY

Engineering graduates face a rapidly changing, ever more challenging world. Those who are creative, professional, ethical, effective communicators, team players, life-long learners and systems thinkers will amplify their technical knowledge and increase their contribution to society. Thought leaders, accreditation agencies and employers are calling for engineers to have greater knowledge in the realms of multidisciplinary design, leadership, communication, business, education, entrepreneurship, sustainability and globalization. These challenges are driving changes to both what and how we teach our students, and the need to adopt leading edge engineering education so as to integrate broader competencies and enhance engineering student learning.

Fortunately, the Faculty of Applied Science and Engineering (FASE) has been bolstering its capability to respond to these challenges for some time through key initiatives:

- The Engineering Communication Program(ECP): established in 1995
- The Institute for Leadership Education in Engineering (ILead): established in 2010
- The Engineering Business Minor: established in 2011
- The Collaborative Specialization in Engineering Education; established in 2014

Through related hires, FASE now has a critical mass of faculty who actively collaborate and are strongly engaged in cutting-edge scholarship and exemplary pedagogy in engineering education. It is proposed that this core of existing faculty and initiatives be brought together, effective July 1, 2018, in an Extra-Departmental Unit Type A (EDU:A), called the *Institute for Studies in Transdisciplinary Engineering Education and Practice* (ISTEP).

This new Institute must be created as an EDU:A as only an EDU:A can provide a dedicated administrative home that unites these existing faculty through budgetary appointments, so as to support review and promotion based on a shared interdisciplinary scholarship. This EDU:A will not from the outset offer its own academic program, but will work collaboratively with other FASE units offering academic programs. Specifically, affiliated faculty will continue to provide the extensive instruction that they are already delivering. They collectively teach thousands of students each year, reaching all 5500 undergraduate engineering students at different points in their programs with the demand continuing to grow. This Institute will also create an academic space to promote their leadership in teaching and learning, encourage related scholarship, and advance and develop engineering education as a distinct and valued field.

ISTEP will support a well-established and well-defined area of academic study. It will partner with departments and institutes from across FASE and beyond (e.g., OISE) to foster scholarship in engineering education and engineering practice. The Institute's mission will be *to understand the practices of today's engineers so as to graduate engineers better equipped to address tomorrow's societal challenges*. Specifically, ISTEP will:

- Deliver existing graduate and undergraduate courses and instruction in technical communication, leadership, business, multidisciplinary design and engineering education.

- Provide leadership through the development of innovative models of effective teaching in engineering.
- Engage in the scholarship of teaching and learning (SoTL).
- Extend the understanding of new engineering competencies and practices, and translate this knowledge into curricular design and learning experiences.
- Bring together colleagues within and beyond FASE to promote community and promote inter-disciplinary scholarly conversation.

In summary, ISTEP will bring together faculty, programming and initiatives that have led the way in expanding the capabilities of engineering students, thereby advancing the academic goals of FASE and enhancing its reputation with national and international, academic and business communities. Combining these strengths as an EDU:A will help promote and strengthen cross-departmental collaboration, and promote FASE's reputation as an innovator and leader in engineering education and related scholarship.

2. THE EVOLVING LANDSCAPE OF ENGINEERING EDUCATION AND PRACTICE¹

Major shifts are occurring in the teaching and practice of engineering. The quest to address complex societal needs is broadening the scope of engineering to bring in practices from domains such as design, leadership, communication, education, business, sustainability, globalization and entrepreneurship. These shifts are in turn expanding the competencies required of engineers to make full and productive use of their technical strengths. Competencies that transcend the boundaries between disciplines are increasingly becoming essential to engineering graduates^{2,3}. These transdisciplinary competencies enable engineers to be creative, professional, ethical, effective communicators, team players and systems thinkers. As such, they both amplify the technical knowledge of engineers and characterize who they are.

The nature of post-secondary educational pedagogy is also evolving. Major catalysts for change include: the need to generate and incorporate evidence-based teaching methods; the role of STEM education in promoting innovation and prosperity; and emerging educational technologies that are enabling more effective and accessible instruction but that, at the same time, are commoditizing education and opening the door to private-sector competition.

Engineering education has been formally recognized in the United States as a distinct area of academic study since the late 1890s. Globally there are many related academic units and programs. Sadly, Canada has lagged behind. Momentum, however, is growing: the Canadian Engineering Education Association was established in 2010 with the mission to “enhance the competence and relevance of graduates from Canadian Engineering schools through continuous improvement in engineering education and design education”. Through FASE and

¹ See the [Report of the Working Group to Establish an Institute for Engineering Education](#) for a detailed description of the evolving landscape of engineering education and practice.

² Transdisciplinary professional learning and practice, edited by Paul Gibbs, Springer 2015

³ <http://www.jscimedcentral.com/TranslationalMedicine/translationalmedicine-spjdc-collaboration-science-translational-medicine-1024.pdf>

OISE, U of T launched the Collaborative Specialization in Engineering Education in 2014 – the only PhD-level engineering education offering in Canada – as an intra-Faculty program that provides a multidisciplinary experience for students enrolled in and completing the degree requirements of participating doctoral degree programs.

The shifting landscape and developing state of engineering education programs in North America and abroad creates a need that offers a crucial opportunity for FASE to act. Creation of this Institute now, will enable FASE to lead and prosper in this evolving environment.

3. PROPOSED INSTITUTE

Creation of ISTEP will be groundbreaking in Canada and will provide a structure to help bring engineering education in Canada to the global leading edge. With a distinct identity synthesized from a solid interdisciplinary academic foundation, ISTEP will integrate and augment initiatives already begun in FASE and the University, bringing a Canadian perspective to this field and building on FASE's culture of excellence and preeminent global position. FASE and U of T can take yet another leadership role in post-secondary education.

This academic community will be a place of synthesis for creating and applying new knowledge that reinforces the collaborative nature of engineering. Already embedded in multiple programs across FASE, the Institute will bring together existing initiatives (see summary), existing faculty and existing programing, to enhance teaching and learning competencies for the benefit of students, faculty and the broader community. Although several categories of Extra-Departmental Units (EDUs)⁴ were rigorously debated, only an EDU Type A can hold the majority budgetary appointments needed to allow review and promotion of these faculty, based on their shared cross-disciplinary scholarship and its application to teaching and learning. Further, an EDU:A will also advance scholarship to support existing academic programing and provide a platform for a leading presence in this growing field.

4. ACADEMIC RATIONALE

The Institute will foster scholarship and teaching in engineering education. It will be an EDU:A based in FASE, whose Dean will assume active administrative and budgetary responsibility. Other divisions, such as the Ontario Institute for Studies in Education (OISE), Faculty of Arts and Science (FAS), and the Rotman School of Management may become associated with ISTEP through the involvement of their individual faculty members.

The Institute's mission will be executed by an initial contingent of twelve existing teaching- and tenure-stream faculty, through transfer of their budgetary appointments and cross-appointments, along with non-budgetary cross-appointments both from within and beyond

⁴ See the *University of Toronto Guidelines for Academic Units* at <http://vpacademic.utoronto.ca/wp-content/uploads/2015/08/edu-guidelines.pdf> for characteristics of the four types of EDUs, and Appendix 3: Administrative Structures Considered.

FASE (see Section 5). It will offer existing and new undergraduate and graduate courses, the existing undergraduate certificates in Leadership and in Communication, the existing Collaborative Specialization in Engineering Education and will support the delivery of other courses and learning activities (see Section 4.2.2 for a list of existing courses).

The Institute's scholarship will focus on bringing new aspects of engineering practice and related transdisciplinary competencies into our classrooms. The resulting knowledge will be mobilized to support innovative teaching and academic programming for all engineering students. This programming will promote integrative transdisciplinary learning through active and technology-enriched pedagogy, and prepare students to identify, learn and apply the engineering principles, practices and competencies needed to resolve global challenges.

4.1 Alignment with Academic Plans and Existing Academic Foundation

With a strong track record in teaching, FASE's Academic Plan⁵ also emphasizes diverse pursuits such as entrepreneurship, leadership, global citizenship, community service and the creation of facilities such as the new Centre for Engineering Innovation and Entrepreneurship (CEIE) that "support innovative learning pedagogies, increase opportunities for experiential learning and offer purpose-built space for student clubs and teams"⁶. In particular, the Academic Plan identifies a number of strategic goals that will be directly or indirectly supported through the creation of the Institute:

- Establish U of T Engineering as a global leader in pedagogical development and teaching innovation in engineering education.
- Continue to develop rich opportunities for experiential learning and professional development for undergraduate and graduate students, including interdisciplinary fluency and working effectively and collaboratively across cultures.
- Further integrate active learning pedagogies into curriculum delivery to encourage lifelong learning and knowledge creation.
- Prepare students with the technical and transdisciplinary competencies necessary for them to identify, learn, and apply these along with engineering practices to resolve global challenges, create new technologies and contribute to the prosperity of society.
- Provide outstanding leadership and influence for excellence in education.

Further, creation of the Institute will support implementation of elements within the 2017-2020 Strategic Mandate Agreement between the Ministry of Advanced Education and Skills Development and the University of Toronto. This agreement outlines the role the University currently performs in the postsecondary education system and how it will build on its current strengths to achieve its vision and help drive system-wide objectives articulated by the

⁵ Faculty of Applied Science and Engineering Annual Plan 2017-2022

⁶ Faculty of Applied Science and Engineering Annual Report 2016, p. 13

Ministry's Differentiation Policy Framework; performance in terms of this agreement will increasingly influence University funding. ISTEP will support the 2017-2020⁷ agreement by:

- Supporting technology-enhanced learning and pedagogical innovation and research.
- Enhancing the instruction of student competencies that improve student employability and career success.
- Enriching teaching and learning for students through increased opportunities for experiential learning.
- Promoting teaching excellence, the implementation of high impact teaching practices and the scholarship of teaching and learning.

Finally, ISTEP will provide a formal academic home for collaboration to support a strong existing suite of internationally recognized initiatives, helping to preserve and enhance their distinct strengths, reputations and identities:

- The Engineering Communication Program (ECP, established 1995), which works with faculty and students across all departments to integrate technical communication into the undergraduate and graduate curriculum.
- The Institute for Leadership Education in Engineering (ILead, established 2010), which provides leadership education through curricular and co-curricular programming.
- The Collaborative Specialization in Engineering Education (launched in fall 2014), which is offered to Master's and PhD students registered in FASE and OISE degree programs.

FASE is in a strong position to lead within the area of engineering education and practice, drawing not only from the breadth of its teaching activities but the diverse mix of teaching- and tenure-stream faculty whose contributions to teaching excellence have been recognized locally, provincially and nationally. Creating the Institute will influence engineering faculties across Canada and further enhance FASE's reputation for leadership.

4.2 Academic Focus

4.2.1 Education Mandate

The Institute will partner in the delivery of existing courses and certificates. Further, ISTEP will collaborate to help integrate the instruction of transdisciplinary competencies and new engineering practices into targeted programming so as to help develop truly distinctive educational experiences. Finally, ISTEP will help influence and encourage pedagogical scholarship, teaching innovation and the development of high impact learning experiences. Specifically, the Institute's education mandate will cover the following themes:

⁷ <https://www.utoronto.ca/sites/default/files/University%20of%20Toronto%20SMA%202017-20%20%28for%20publication%29.pdf>

- **Existing programing:** ISTEP will support and help build on the existing instructional activities of ECP, ILead and the Collaborative Specialization in Engineering Education. Together, these offerings include 20 undergraduate, 36 co-instructed and 13 graduate courses. The mechanisms currently used to administer these courses will continue. Specifically, courses with APS⁸ and JRE designations will continue to be administered at the Faculty level while others (e.g. CIV, ESC and MSE⁹) will continue to be administered by these programs. Over a multi-year transition, ISTEP will take on administration of some APS courses coordinated by its faculty members through FASE's normal governance processes. At this point, these courses will then adopt an ISTEP-based designation (e.g. ISP). ISTEP faculty will also deliver courses as part of the First Year and the Business Minor, and support the undergraduate certificates in Leadership and in Communication.

Undergraduate Courses

- 1) APS281H1: Language and Meaning
- 2) APS320H1: Representing Science on Stage
- 3) APS321H1: Science and Technology in the Popular Media
- 4) APS322H1: Language and Power
- 5) APS324H1: Engineering and Social Justice (new in Winter 2018)
- 6) APS325H1: Engineering and Science in the Arts
- 7) APS343H1: Engineering Leadership
- 8) APS442H1 The Cognitive and Psychological Foundations of Effective Leadership
- 9) APS444H1 Positive Psychology for Engineers
- 10) APS445H1 The Power of Story: Discovering Your Leadership Narrative
- 11) APS446H1 Leadership in Project Management
- 12) APS447H1 Ethics (new in winter 2018)
- 13) CIV282H1: Communication I
- 14) CIV382H1: Communications II
- 15) ESC203H1: Engineering and Society
- 16) ESC203H1: Engineering and Society
- 17) JRE300H1: – Fundamentals of Accounting and Finance
- 18) JRE410H1: Markets & Competitive Strategy
- 19) JRE420H1F/S: People Management & Organizational Behaviour
- 20) MSE298H1: Communications I

Co-Instructed Courses^a and Supported^b

- 1)**First Year:** APS111^a, APS112^a, APS113^a.
- 2)**Engineering Science:** ESC101^a, ESC102^a, ESC297^a, ESC301^a, ESC496^b, ESC499^a, AER407^b, BME489^b, BME498^b
- 3)**CHE:** CHE204, CHE230^a, CHE299^a, CHE326^b, CHE430^b
- 4)**CIV:** CIV201^b, CIV220^b, CIV331^b, CME368^b, CIV382, MIN466^b, MIN430^b, MIN467^b
- 5)**ECE:** ECE297^a, ECE496^b
- 6)**MIE:** MIE221^b, MIE240^a, MIE243^b, MIE301^b, MIE315^b, MIE350^b, MIE490^b, MIE491^b
- 7)**Faculty Wide:** APS490^a

a: courses co-taught with engineering professors b: in-course support on specific assignments

⁸ APS: Applied Science and Engineering, JRE: Joint Rotman and Engineering

⁹ CIV: Civil Engineering, ECS: Engineering Science, MSE: Material Science and Engineering, CHE: Chemical Engineering. MIE: Mechanical and Industrial Engineering, ECE: Electrical and Computer Engineering

Graduate Courses

- 1) APS1011H: Concepts and Applications of Authentic Leadership
- 2) APS1010H: Cognitive and Psychological Foundations of Effective Leadership
- 3) APS1019H: Leadership in Project Management
- 4) APS1026H: Positive Psychology for Engineers
- 4) APS1027H: Engineering Presentations
- 5) APS1029H: The Science of Emotional Intelligence and its Application to Leadership
- 7) APS1030H: Engineering Careers – Theories & Strategies to Manage your Career for the Future
- 8) APS1203H: Engineering Teaching and Learning
- 9) APS1204H: Instructional Design in Engineering Education
- 10) APS1205H: Engineering Education Research Seminars
- 11) APS1206H: Engineering Education Research Seminars
- 12) APS1501H: Leadership and Leading in Groups and Organizations
- 13) APS1502H: Leading Engineering Design Projects

- **Design and delivery of new programing:** ISTEP will contribute to the design of new courses relating to engineering education, emerging engineering practices and transdisciplinary competencies. These may include new courses on business, communication, leadership, instructional design, education research methodologies and the development of education technology. Consistent with current process, these new curricular offerings will be submitted by ISTEP's steering committee for approval by the FASE undergraduate or graduate curriculum committees and Faculty Council. ISTEP affiliated faculty may also help support development of curricula for future minors such as the proposed Engineering and Public Policy minor. Courses or instructional modules may be designed to introduce engineering concepts to non-engineering majors. For example, transdisciplinary courses that bring together engineering and non-engineering students to address local urban issues or global challenges may be created.
- **Support the instruction of engineering through the infusion of transdisciplinary competencies:** ISTEP faculty already support the instruction or co-instruction of communication and teamwork in a wide range of courses. These include first year design courses, core technical courses, thesis courses and a multidisciplinary capstone course. During the first five years, ISTEP faculty will grow the instruction of team skills into a larger number of technical courses. Instruction of leadership in the multidisciplinary capstone course will also be supported. Similarly, instruction of the other transdisciplinary competencies and new engineering practices will be combined with technical knowledge in selected courses to create more holistic learning experiences.

Instruction of transdisciplinary competencies will also be extended beyond the classroom. ILead is currently providing co- and extra-curricular learning opportunities that enable and amplify the development and refinement of leadership competencies. These offerings will be sustained and enriched to leverage additional learning in conjunction with internships, research, entrepreneurial design project experiences and

other experiential learning opportunities. A priority in the first five years will be the development of curricular and co-curricular instruction to more comprehensively support and promote work-integrated learning.

- **Influence and guide pedagogical development and teaching innovation across FASE and beyond:** ISTEP faculty will help build and grow FASE's strengths in the areas of technology-enhanced learning, cooperative learning, experiential learning and active learning, along with the assessment of learning outcomes. Another focus will be the development of digital learning tools to enhance and enrich undergraduate education and extend FASE's online offerings. These initiatives will be pursued in conjunction with ISTEP-related scholarship or as products of the mobilization of this scholarship.

Instructional workshops and seminars will be offered with faculty, librarians and students to solidify and grow the community of colleagues engaged in the scholarship of teaching and learning. This will also increase opportunities for research collaboration and co-supervision of graduate students. Finally, ISTEP will help to foster FASE initiatives such as the Hart Teaching Innovation Professorships and TEAL (Technology Enhanced Active Learning) Fellows program. Overall, ISTEP will aim to become a renowned hub for engineering education activities, research and workshops nationally and internationally.

4.2.2 Research Mandate

ISTEP will create and translate to teaching and learning knowledge relating to new engineering practices and transdisciplinary competencies. Internally, this scholarship will enhance student learning and develop models of effective teaching, help make full and effective use of new teaching infrastructure in the delivery of education and create a foundation for the design of new academic programming. Externally, ISTEP will promote scholarly conversation to help shape the evolving nature of engineering education, develop the underlying competencies and related practices, and understand the identity of Canadian engineers.

Collaboration with students, alumni, librarians, industry and government will be essential so as to ground this scholarship in terms of the changing nature of our students and the many career paths they now take after graduation. The Institute **will thereby help to guide what we teach, how we teach, and our understanding of the evolving identity of engineers and the very nature of the engineering profession itself.** Specifically, ISTEP will bring together scholarship spanning the following themes:

- **Instructional Methods and Tools:** ISTEP will pursue scholarship on pedagogy, andragogy, learning, instructional design, assessment methods and learning technologies to create knowledge to support the development of teaching methodologies and innovative educational tools. Foci will span from the design of digital tools for on-line and technology enhanced learning and assessment, to tools and techniques to support active and cooperative in-person learning. Methods will be

developed and applied to assess the effectiveness of these teaching tools and techniques.

- **Engineering Practice:** ISTEP's faculty will investigate how knowledge and practices from other domains are being integrated into the practice of engineering. This scholarship will help generate theoretical conceptualizations and empirical case studies to help guide the integration of these domains into engineering contexts. For example, current ILead research is exploring engineering-based leadership, focusing on how it is applied in industry, engineering-intensive companies and in broader society. Another theme will be exploring approaches and processes that can enhance teaching of multidisciplinary engineering design. This research will also help identify essential transdisciplinary competencies to support their integration into engineering curricula, instruction and assessment.
- **Curricular Design:** Research findings on pedagogy, transdisciplinary competencies and new engineering practices will be synthesized into the design of new learning experiences and the development of models of effective teaching. Courses will be designed to enable and evaluate integrative transdisciplinary learning through active and/or technology enriched pedagogies. This learning may, for example, be problem-based rather than content-based, and might focus around solving global challenges. These pilot courses will serve as "test-beds" to develop and evaluate new holistic models of teaching and learning that integrate technical knowledge with competencies and practices using enriched pedagogy.

This scholarship of teaching and learning (SoTL) will be an integration rather than an expansion of existing research activity. Related research and scholarship are already underway involving both the tenure- and teaching-stream faculty listed in this proposal. Some of this is being pursued by the graduate students in the Collaborative Specialization in Engineering Education under the supervision of the tenure-stream faculty; 15 PhD-stream students are currently registered, nine from FASE and six from OISE. These tenure-stream faculty are already engaged and committed to these lines of research and this will be further enhanced through ISTEP. For example, in 2012 FASE created the Institute for Multidisciplinary Design and Innovation. Further, ILead's Senior Research Associate and two Research Associates, all with PhDs in education, are also actively pursuing related research.

Most of the teaching-stream faculty are also pursuing related scholarship for presentation at conferences or publication in texts and journals. This scholarship includes studies on writing in engineering, diversity, professional identity, team skills, and digital learning objects. As such, the University of Toronto typically has the largest Canadian delegation of faculty at engineering education conferences and is in this regard already leading the way in Canada. These teaching-stream faculty will continue to engage in their SoTL-related research, practices and scholarship within their discipline, in line with the Policy and Procedures on Academic Appointments and the University and unit workload policies. The intent is for ISTEP to enhance opportunities for scholarship rather than increase expectations of existing faculty. The degree of engagement in

research and scholarship is expected to increase particularly as more tenure-stream faculty become affiliated with ISTEP and the three new hires, Profs. Marzi, Olechowski and Sheridan, settle in.

5. FACULTY PARTICIPATION

FASE currently has a critical mass of faculty who are heavily engaged in instructional practice and SoTL. As an EDU:A, ISTEP will provide an academic home for these faculty that allows budgetary appointments and cross-appointments, and supports review and promotion based on a shared interdisciplinary scholarship. This will include at the outset the budgetary appointment of 12 existing teaching- and tenure-stream faculty (nine full appointments and three cross-appointments). All faculty will be encouraged to seek non-budgetary cross-appointments with other academic units within FASE and beyond, so as to promote collaboration, and to apply for SGS Associate Membership when appropriate.

Primary Budgetary Appointments to ISTEP

Name	Current Budgetary Appointment (%)	Budgetary Appointment with ISTEP (%)	Appointment Category (Stream and Rank)	Appointment to other units (%)	Graduate Faculty Membership, Unit & Status
Chong, Alan	Engineering Communication Program (100%)	ISTEP (100%)	Associate Professor, Teaching-Stream	n/a	none ^a
Irish, Rob	Engineering Communication Program (100%)	ISTEP (100%)	Associate Professor, Teaching-Stream	n/a	none ^a
Marzi, Elham	FASE (100%)	ISTEP (100%)	Assistant Professor, Teaching-Stream	n/a	none ^a
Romkey, Lisa	FASE (100%)	ISTEP (100%)	Associate Professor, Teaching-Stream	n/a	none ^a
Sheridan, Patricia	FASE: ILead (100%)	ISTEP (100%)	Assistant Professor, Teaching-Stream	n/a	none ^a
Tallman, Ken	Engineering Communication Program (100%)	ISTEP (100%)	Associate Professor, Teaching-Stream	n/a	none ^a
Tihanyi, Deborah	Engineering Communication Program (100%)	ISTEP (100%)	Associate Professor, Teaching-Stream	n/a	none ^a
Variawa,	FASE: First Year	ISTEP (100%)	Assistant Professor,	n/a	none ^a

Name	Current Budgetary Appointment (%)	Budgetary Appointment with ISTEP (%)	Appointment Category (Stream and Rank)	Appointment to other units (%)	Graduate Faculty Membership, Unit & Status
Chirag	(100%)		Teaching-Stream		
Weiss, Peter	Engineering Communication Program (100%)	ISTEP (100%)	Associate Professor, Teaching-Stream	n/a	none ^a

a: These faculty may seek Associate Graduate Faculty Membership or Associate Membership (Restricted Duties), as appropriate, with existing graduate units.

Budgetary Cross-Appointments to ISTEP

Name	Home Unit (%) before establishing ISTEP	Home Unit (%) after establishing ISTEP	Appointment Category (Stream and Rank)	Budgetary Cross-Appointment (%)	Graduate Faculty Membership, Unit & Status
Evans, Greg ^a	CHE (100%)	CHE (55%)	Professor	ISTEP (45%)	Full, CHE
Olechowski, Alison	MIE (51%) FASE/ILead (49%)	MIE (51%)	Assistant Professor, Teaching-Stream	ISTEP (49%)	Associate, MIE
Reeve, Doug ^a	CHE(70%)/ILead(30%)	CHE (70%)	Professor	ISTEP (30%)	Full, CHE

a: as Interim Director of ISTEP and Director of ILead.

This cohort of core faculty will be supplemented with non-budgetary cross-appointments of tenure- and teaching-stream faculty from within FASE who are also engaged in SoTL.

Faculty with Non-Budgetary Cross-Appointments (NBCA) to ISTEP

Name	Home Unit (%)	Appointment Category (Stream and Rank)	Appointment to other units	Graduate Faculty Membership, Unit & Status (Associate or Full)
Behdinan, Kamran	MIE (100%)	Professor	ISTEP (NBCA)	Full, MIE
Foster, Jason	CIV (100%)	Associate Professor, Teaching-Stream	ISTEP (NBCA)	none
Karney, Bryan	CIV (100%)	Professor	ISTEP (NBCA)	Full, CIV
Kilkenny, Dawn	IBBME (100%)	Assistant Professor, Teaching-Stream	ISTEP (NBCA)	Associate, IBBME
McCahan, Susan	MIE (100%)	Professor	ISTEP (NBCA)	Full, MIE
McCabe, Brenda	CIV (100%)	Professor	ISTEP (NBCA)	Full, CIV

Metcalfe, Murray	CIV (0%)	Adjunct Professor	ISTEP (NBCA)	Associate, CIV
Norval, Graeme	CHE (100%)	Associate Professor, Teaching-Stream	ISTEP (NBCA)	none
Paradi, Joseph	CHE (100%)	Emeritus Professor	ISTEP (NBCA)	Emeritus, CHE
Sleep, Brent	CIV (100%)	Professor	ISTEP (NBCA)	Full, CIV
Stickel, Micah	ECE (100%)	Associate Professor, Teaching-Stream	ISTEP (NBCA)	none

It is expected that additional teaching- and tenure-stream faculty in specific engineering and non-engineering disciplinary subfields who are engaged in pedagogical or related cross-disciplinary research may choose to engage in the work of the unit through non-budgetary cross-appointments after ISTEP is established.

ISTEP will also provide a structure and mechanism for the full or joint appointment of future teaching- and tenure-stream faculty whose expertise transcends FASE's existing departments and institutes. Cross-appointments and possibly future hires will help sustain the critical mass of colleagues with shared expertise and interests so as to foster a vibrant community and avoid colleagues working in isolation. Externally, faculty members in OISE have indicated interest in non-budgetary cross-appointments and increased involvement of FASE in the integration of engineering in education of future kindergarten to grade 12 teachers through the main teacher education program, their Master of Teaching. Adjunct appointments of "engineers in residence" from companies and government along with sabbatical leaves of ISTEP faculty in industry are also envisioned to help contextualize the instruction of transdisciplinary competencies within FASE. ISTEP will not initially offer an undergraduate or graduate degree program but rather will integrate its instruction across existing academic programs in FASE.

6. STRUCTURE AND ADMINISTRATION

As an EDU:A, ISTEP will be subject to the *Policy for Approval and Review of Academic Programs and Units* (June 24, 2010), with the authority to hold primary academic appointments (e.g., majority budgetary appointments of 51% or more), cross-appointments (e.g., minority budgetary appointments of 49% or less) and status-only and adjunct appointments and administer and be responsible for the Institute's budget. Further ISTEP will be eligible to administer research programs and serve as the administrative home for research accounts of affiliated tenure-stream faculty, for research that is aligned with ISTEP's scholarship and research mandate.

ISTEP's initial structure will be built around its foundation of existing pillars. The Engineering Communication Program (ECP) will be administratively housed entirely within ISTEP yet persist as a distinct pillar, in order to preserve its identity and international reputation. Specifically, budgetary appointments of all ECP-affiliated faculty members will be in ISTEP. ILead will be a

second pillar and continue as an EDU:C that is primarily affiliated with ISTEP; ISTEP will serve as the academic and administrative home for its faculty.

6.1 Director

An Interim Director will be appointed to oversee the launch of the Institute. Once the EDU is established, the Dean, FASE will work with a search committee to bring forward the Director of ISTEP for a five-year term, renewable once. The Director will be the Institute's chief executive officer and accountable directly to the Dean, FASE for its overall direction. While the Director may elect to delegate authority to other academic administrators in the Institute, he/she will retain responsibility for the overall direction of the Institute and in particular for authority over the budget and recommendations for appointments and promotions. More specifically, the Director will:

1. Develop and implement policy and practices for ISTEP that reflect its vision and mandate.
2. Assume responsibility for all administrative decisions within his/her jurisdiction and authority.
3. Promote the teaching, research and scholarship of ISTEP's faculty and ensure an equitable distribution of work; and promote the career development of administrative staff.
4. Make recommendations for appointments. In the case of primary appointments, the Director will be responsible for all aspects of the appointment including, continuing status review or tenure, promotion, assignment of workload and the annual merit process.
5. Assume responsibility for the financial management of all the Institute's resources, including all operating and restricted funds. This includes establishing and managing budgets, revenue and expenditure decisions; safeguarding all assets; monitoring and annual financial reporting to the Dean, FASE; adhering to all financial management policies and procedures as described in the *Guide to Financial Management*; and overseeing any individuals within the EDU who are responsible for financial management activities.
6. Manage ISTEP's external relations effectively and efficiently, both within the University and in the wider community, to facilitate support for its educational and research activities.

A review of the Director will be undertaken in line with the University's *Policy on Appointment of Academic Administrators* (October 30, 2003), normally near the end of his/her term. The Dean, FASE will also commission periodic reviews of the Institute and its programs, as per the *Policy for Approval and Review of Academic Programs and Units*, normally every five years and aligned with the end of the Director's term. This review will normally assess the Institute's sustainability, performance and achievements relative to the goals set out at its establishment. Possible outcomes of the review could include closure.

6.2 Associate Directors

Associate Directors will be appointed by the Dean, FASE, with input from the Director, for a three- to five-year term. Initially, the existing Directors of ECP and ILead, and one additional faculty member from within ISTEP, will be appointed as the three Associate Directors. Their role will be to support the Director in his/her responsibilities, specifically to:

1. Provide administrative support to the Director.
2. Provide acting leadership for the Institute as needed.
3. Maintain and attract new partnerships.
4. Organize workshops and other activities to facilitate and create new collaborations to research the practice of engineering that is shared across disciplines.
5. Assist in the development of new courses and other academic programming.
6. Coordinate Institute resources to maximize benefit to constituent sub-units such as ILead and ECP.
7. Coordinate with the Faculty's Office of Advancement and Alumni Relations to attract funds from alumni and donors.
8. Maintain and grow Institute membership, including new faculty and student involvement.

6.3 Administrative Staff

The Institute will have three full-time administrative staff, creating one new position, to support the administration of the existing academic programming and support the Directors and Associate Directors in the execution of ISTEP's mission. Initially, FASE will provide central support for the administration of research grants and contracts, information technology, communications, external relations, purchasing and human resources.

6.4 Steering Committee

Given the importance of collaboration to ISTEP's success, its Steering Committee will play a key role in informing major decisions and overall direction. The inaugural Steering Committee will be appointed to three-year terms and consist of:

- The Director and Associate Directors of ISTEP.
- Two additional Institute faculty members.
- A graduate and an undergraduate student from within FASE.
- Two members from FASE units or other academic units affiliated with ISTEP.
- Two of the Vice-Deans FASE (Research, Graduate, Undergraduate, or First Year).

6.5 Advisory Board

In accordance with the Provost's Statement on the Role of Advisory Bodies (April 30, 1998), the Dean, FASE, with input from the Interim Director and Associate Directors, will appoint an Advisory Board to provide non-binding advice to the Director. Formal invitations will be sent pending approval of EDU:A status. The Advisory Board will consist of up to five leaders from industry, government and academia; members may serve for a period of up to three years.

Advisory Board members will fill one or more of the following roles: (1) provide input on the Institute's activities, initiatives, annual reports and plans (2) identify valuable new initiatives to members of the Institute (3) help develop ISTEP's influence by facilitating access, connections, and exposure and (4) assist with winning resources for programming, scholarship, infrastructure and awards. Continued service on the Advisory Board will require tangible contributions in one or more of these areas. In exchange, Board members will acquire knowledge through ISTEP's teaching and scholarship activities and have opportunities to meet and network with people who share their interests.

An Instructional Advisory Committee will be created with faculty and students directly involved in courses co-instructed by ISTEP faculty. Members will be appointed by the Director in consultation with the Departments and students. This committee will help assess instructional quality and impact, and provide recommendations to enhance teaching and learning.

7. RESOURCE IMPLICATIONS AND BUDGETARY IMPACTS

FASE will assume administrative and budgetary responsibilities for ISTEP. Creation of this EDU:A will not have major resource implications or budgetary impacts:

- ISTEP's budgetary faculty appointments have already been hired by FASE thus no additional funding will be required.
- ECP and ILead have existing budgets that are expected to continue to support their existing activities.
- ISTEP will occupy available space within the new Centre for Engineering Innovation and Entrepreneurship in addition to retaining space already occupied by its faculty and co-existing units.
- Only one of the three administrative staff positions will be new and FASE will provide central administrative support through existing staff.
- Existing funding for the Collaborative Specialization in Engineering Education will continue to provide support for graduate students.

New funding will be required for the Director and one administrative staff along with operational support to help ISTEP pursue its mission.

8. RESEARCH FUNDS

As an EDU:A, ISTEP will be entitled to directly administer its research funds in accordance with the policies, guidelines and procedures of the University of Toronto. While ISTEP will actively promote growth in research funding, initially it will not create infrastructure to administer this funding. This administration will be done centrally by FASE or, when more appropriate, the home department of cross-appointed principal investigators. Most of the existing research funding for engineering education research is currently held by cross-appointed tenure-stream

faculty. It is envisioned that these faculty will choose to administer these funds through their home department or ISTEP, depending on the nature of the project and in particular the extent to which it supports graduate students enrolled in the PhD programs of their home department. Teaching-stream faculty at the U of T may request permission to apply for research funding as principal investigators or co-principal investigators to support their research and scholarship. These applications will continue to be supported as appropriate to their workload and appointments. As research activity grows, it may eventually become more effective for ISTEP to establish dedicated administrative support for research.

9. GOALS, BENCHMARKS AND MEASURES OF SUCCESS

ISTEP will track its progress towards achieving its mission by measuring what it has delivered five and 10 years from its establishment in terms of:

Excellence in Teaching

- 1) Student enrolment in courses
- 2) Student evaluation of programing
- 3) Number of courses delivered
- 4) Total student contact through course integration and co-instruction

Innovative Teaching Initiatives

- 1) Number of courses adopting new in-person and digital tools and techniques
- 2) Number of new courses designed and delivered
- 3) Number of courses that are co-taught or integrate transdisciplinary competencies

Educational Leadership

- 1) Number of faculty applying instructional strategies encouraged by ISTEP
- 2) Attendance at seminars and workshops
- 3) Number of future educators who graduate from our Faculty, and propagate their knowledge and experience at other institutions
- 4) Community size and breadth in terms of membership within and beyond FASE
- 5) Number of collaborative initiatives and activities
- 6) Feedback from FASE and other partner departments on their collaboration with ISTEP

Engagement and Impact from Scholarly Discourse

- 1) Reputation in Canada and internationally
- 2) Recognition as a thought leader, based on the level of engagement with, and consultation requested from, academic units beyond FASE
- 3) Engagement in the educational divisions of scholarly societies and education associations
- 4) Perception of alumni and employers that U of T is producing better engineers

Discipline Based Scholarship

- 1) Number of texts, publications and presentations
- 2) The adoption of instructional knowledge and techniques beyond FASE
- 3) Contributions at conferences
- 4) Collaboration and studies with colleagues in other Faculties or external to U of T (nationally and internationally)

Overall, ISTEP's activities will promote educational leadership. The impact will be manifested through translation of scholarship into teaching and learning along with texts, publications, conference presentations and involvement in scholarly societies. ISTEP will build on its existing nationwide reputation for engineering education research to become recognized worldwide. Impact will also be achieved by educating Canada's next generation of engineering educators. ISTEP will thereby enhance FASE's visibility in engineering education and reinforce the Faculty's and University's reputations for scholarly leadership. Measures of success for individual activities are provided in the [Report of the Working Group to Establish an Institute for Engineering Education](#), along with associated metrics, goals and milestones.

10. CONSULTATION

Extensive consultation was undertaken in support of the development of this proposal over the period Sept 2016 to Feb 2018. This consultation included a survey of faculty members, discussions with students, discussions with impacted faculty members, presentations at department meetings, a meeting with students, two discussions at Faculty Council, presentations at two FASE Chairs and Directors meetings, discussion with the Head Librarian in the Engineering and Computer Science Library, consultation with potentially interested U of T Faculties beyond FASE (FAS, OISE, Rotman, DLSPH) and some consultation with the broader engineering education community in Canada. Valuable input was received that greatly helped to shape and refine the proposal. Issues were raised and many questions were asked but overall, the proposal was well received and most of the feedback was supportive.

11. GOVERNANCE

	Date Completed
Development of Proposal	Oct 2016-Nov 2017
Decanal and Provostial sign off	Feb 2018
FASE Faculty Council approval	Feb 27, 2018
Planning & Budget Committee approval	Apr 4, 2018
Academic Board of Governing Council approval (VP-AP submits)	Apr 19, 2018
Governing Council approval (VP-AP submits)	May 17, 2018
Program launches	Jul 1, 2018