UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

MEMORANDUM

To:	Executive Committee of Faculty Council (March 21, 2019)
	Faculty Council (April 11, 2019)
From:	Professor Markus Bussmann
	Chair, Department of Mechanical & Industrial Engineering
Date:	March 28, 2019
Re:	**Creation of the Centre for Analytics and Artificial Intelligence Engineering (CARTE) as an Extra-Departmental Unit, Type C**

REPORT CLASSIFICATION

This is a major policy matter that will be considered by the Executive Committee for endorsing and forwarding to Faculty Council for vote as a special motion (requiring a 2/3 majority of members present and voting to carry).

SUMMARY

With a growing cohort of world-class researchers in A/AI and the surging demand for engineers who are well-trained in this field, FASE has identified a need and opportunity to increase its impact and visibility through a coordinated approach to A/AI research and education. This will be facilitated through the creation of the Centre for Analytics and Artificial Intelligence Engineering (CARTE) as an extra-departmental unit type C with a mandate to facilitate collaborative, cross-disciplinary basic and translational research in A/AI, attract and develop experts in this area, and be a catalyst for the Faculty's partners to make a significant and lasting impact in the global marketplace.

Further details regarding the Centre, such as its academic rationale, vision and benchmarks for success, faculty participation, administrative structure and budget, are described in the attached proposal.

MOTION

THAT the Centre for Analytics and Artificial Intelligence Engineering (CARTE) be created as an Extra-Departmental Unit Type C, effective July 1, 2019.

Proposal to establish the Centre for Analytics and Artificial Intelligence Engineering (CARTE) at the University of Toronto

March 26, 2019

1. EXECUTIVE SUMMARY

As the top-ranked university in Canada, the University of Toronto (U of T) is a key player in the federal government's Pan-Canadian Artificial Intelligence strategy. U of T's Institutional Strategic Research Plan 2018-2023 names "Data Analytics, Computation, and Artificial Intelligence" as one of three focus areas within the theme of "INNOVATE: Technologies for the Future". Similarly, "Data Analytics and Intelligent Systems" is one of the four research foci identified in the 2017-2022 Faculty of Applied Science and Engineering (FASE) Academic Plan. FASE researchers have expertise in analytics and artificial intelligence (A/AI) methodologies across a wide range of areas including finance, human health, transportation, asset management, sustainability, advanced manufacturing, and robotics.

With our growing cohort of world-class researchers in A/AI and the surging demand for engineers who are well-trained in this field, FASE has identified a need and opportunity to increase its impact and visibility through a coordinated approach to A/AI research and education. Accordingly, in 2017, coinciding with the FASE Academic Planning process, FASE initiated discussions around the development of a Faculty-wide centre for A/AI, which would serve as a hub for activity in this space and help fill this major gap in the Faculty's portfolio of educational units.

Under the leadership of Professor Timothy Chan (Department of Mechanical and Industrial Engineering), consultations with all FASE Departments, EDU:A and EDU:B units revealed widespread support for a centre in A/AI that would present a coordinated, public-facing "storefront" for A/AI expertise and serve as a matching platform, connecting academic FASE stakeholders with both external (e.g. industry) and other internal U of T stakeholders.

To complement FASE consultations, meetings were also held with other A/AI ecosystem stakeholders. These include the Faculty of Arts and Science, the Faculty of Medicine, the Rotman School of Management and the Vector Institute. Interest in A/AI was widespread, with each unit identifying distinctive opportunities and needs. Given the growing demand for engineering-specific A/AI technologies and solutions, we identified the need for a centre focused on engineering applications and the translation of A/AI knowledge into real-world impact. We will continue to engage deeply with other academic units post-launch with the goal of bringing on participating faculty from outside Engineering.

We recommend the creation of the Centre for Analytics and Artificial Intelligence Engineering (CARTE) as an EDU:C within the Faculty of Applied Science and Engineering, effective July 1, 2019.

The Centre will be organized around three pillars: research, education and training, and partnerships. It will drive collaborative research between technical A/AI experts and those with domain-specific knowledge across the Faculty. It will also act as a central resource for up-to-date information on FASE programs and courses that cover A/AI, including the Engineering Science stream (known in FASE as majors or options) in Machine Intelligence, the undergraduate minor

and certificate in AI, and the MEng emphasis in Analytics. Partnerships with industry and government will be the foundation for long-term financial sustainability. Additionally, through its industry relationships, the Centre will cultivate new experiential learning opportunities for students, including internships, professional experience year co-op placements, capstone projects and MEng projects.

The Centre will be led by a Director and an Executive Director; together they will actively promote the Centre and seek new partnership opportunities. An Academic Steering Committee and Industry Advisory Board will provide guidance to the Centre's leadership.

2. STATEMENT OF PURPOSE

We propose the creation of the Centre for Analytics and Artificial Intelligence Engineering (CARTE) as an EDU:C within the Faculty of Applied Science and Engineering, effective July 1, 2019. FASE will assume administrative and budgetary responsibility for the Centre.

3. VISION AND MISSION

Based on broad consultations across FASE and with other U of T and external stakeholders (see Appendix 3), we have formed the following vision and mission for the Centre:

Vision: Engineering impact through Analytics and AI (A/AI)

This vision reflects the reality that as the world becomes increasingly data rich, there will be a critical need to leverage advanced A/AI tools for insight generation and improved decision making across all industries. The true potential of A/AI will only be realized if the models and algorithms that have demonstrated impressive performance in the laboratory setting can be effectively translated to the industries where they can have the most impact. Thus, we see the primary role of the Centre as facilitating the translation of A/AI research, technologies and solutions to a range of industrial sectors spanning the Faculty's research foci, as well as training the next generation of engineers to meet market demand in this sector. The Centre will also support basic research in A/AI methodologies that may have broad application. To enable our vision, the Centre will act as a platform and integrator, bringing together both consumers (those with domain-specific expertise or sector-specific applications) and producers (technical experts) of A/AI technology. For this "matchmaking" to be effective and sustainable, the Centre will play an active role in cultivating demand from industry, lowering the barriers for collaboration with faculty, and accelerating the training of highly qualified personnel.

Mission: To facilitate collaborative, cross-disciplinary basic and translational research in A/AI; attract, educate and develop expert personnel in this area; and be a catalyst for our partners to make a significant and lasting impact in the global marketplace.

The Centre will carry out this mission by providing a coordinated, public-facing "storefront" for A/AI expertise within FASE. It will be an important vehicle to promote engineering and its contributions to A/AI externally. It will connect academic stakeholders within the Faculty and across U of T, as well as build strategic relationships with global, leading academic partners and external stakeholders. The Centre aims to catalyze collaboration between researchers within FASE who might otherwise not work together, as well as with other academic units and U of T's affiliated hospitals.

Our heightened visibility will enable us to cultivate new industry partnerships and attract top engineering students and faculty. It will also enhance alumni and philanthropic engagement. Funds brought into the Centre will primarily be used to support the training of highly qualified personnel including undergraduate students, graduate students, and post-doctoral fellows, who will play an integral role in all partnerships and collaborations. The talent pipeline that flows through the Centre will be a key resource for attracting continued industry investment.

The Centre will support engineering education and training in A/AI through the various programs that currently exist including the undergraduate minor and certificate in AI, the Engineering Science Machine Intelligence undergraduate stream, and the graduate MEng emphasis in Analytics. This support may take the form of providing input into curriculum development, helping students find internships, project, and career opportunities, and acting as a resource to attract qualified instructors.

The acronym CARTE speaks the main elements of the name of the Centre (ART for (Analytics/aRTificial intelligence or ARTificial intelligence; E for engineering). A "carte" is also another word for "map", which is a fitting descriptor for the Centre, since its primary goal is to bring people together and form new connections.

4. ACADEMIC RATIONALE

U of T's Strategic Research Plan 2018-2023 names "Data Analytics, Computation, and Artificial Intelligence" as one of three focus areas within the theme of "INNOVATE: Technologies for the Future". The Faculty's 2017-2022 Academic Plan identifies "Data Analytics and Intelligent Systems" as one of our four research foci, which is supported by world-class expertise within FASE that spans analytics, AI, robotics and a range of enabling technologies for intelligent, connected systems. Through a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, we identified the lack of a dedicated FASE centre to support the growing academic demand in A/AI and also, an opportunity to increase the Faculty's impact and visibility through a coordinated approach to research and education in this domain. Establishing a centre within FASE, with a mandate to foster basic and applied research, support A/AI-focused educational programs, and grow industry partnerships, will complement existing, specialized efforts and further build U of T's international brand in A/AI.

It is estimated that by 2030, AI will deliver over $17 trillion CAD of economic impact worldwide [1]. However, creating broad impact with A/AI will requires expertise beyond models and algorithms. As described in a recent *Globe and Mail* opinion article, it requires "complements" [2]; we need to surround these technical advances with other enablers like access to data, infrastructure, training, and domain-specific expertise to realize the broad economic and societal benefits promised by the AI revolution. McKinsey reports that most companies are only capturing a fraction of the potential value from data and analytics and that market demand is expected to lead to a shortfall of up to 250,000 highly trained individuals in these fields in the US by 2024 [3].

To realize the full potential of A/AI, a complementary strategy that focuses on translating research into effective application-specific solutions, as well as the training of individuals who can implement these solutions will be critical. As the top-ranked university in Canada, located in the heart of Canada's financial, technology, and healthcare sectors, U of T is well-placed to bolster its current position as a globally recognized leader in A/AI research and teaching, and to leverage that expertise to create economic and societal impact.

Within FASE, there are an increasing number of researchers who are engaged in A/AI research across our units in a variety of areas including finance (e.g., Centre for Management of Technology and Entrepreneurship), human health (e.g., Institute for Biomaterial and Biomedical Engineering), transportation (e.g., University of Toronto Transportation Research Institute), asset management (e.g., Centre for Maintenance, Optimization and Reliability Engineering), sustainability (e.g., Institute for Sustainable Energy), advanced manufacturing (e.g., Toronto Institute for Advanced Manufacturing), and robotics (e.g., Institute for Robotics and Mechatronics). FASE also has a critical mass of researchers working on the complementary elements required for the effective implementation of these techniques in industry. These include human factors engineering, human-computer interfaces, operations research, and data management tools, as well as the hardware and virtual infrastructure needed to support high-performance computing. Additionally, FASE's Engineering Science stream in Machine Intelligence is Canada's first undergraduate engineering program in this discipline.

To address the immediate demand from our faculty, students and industrial partners, the Centre will be launched as an FASE-focused initiative. It can serve as an engineering pilot of a potentially larger initiative. Pending development of a university-wide data science initiative, it can be the local receptor for those activities and its mandate can be adjusted accordingly. We will continue to engage with colleagues from other units post-approval. The primary goal for the first year post-launch will be to solidify the vision and create a detailed implementation plan.

Driven by the central goal of advancing engineering-focused A/AI research and translating the associated technologies into real-world impact, the Centre will be organized around the three pillars of **research**, **education and training**, and **partnerships**. Funding from industry will seed research collaborations and accelerate student training, which will inject new innovations and a robust talent pipeline back into the global economy, forming a virtuous cycle.
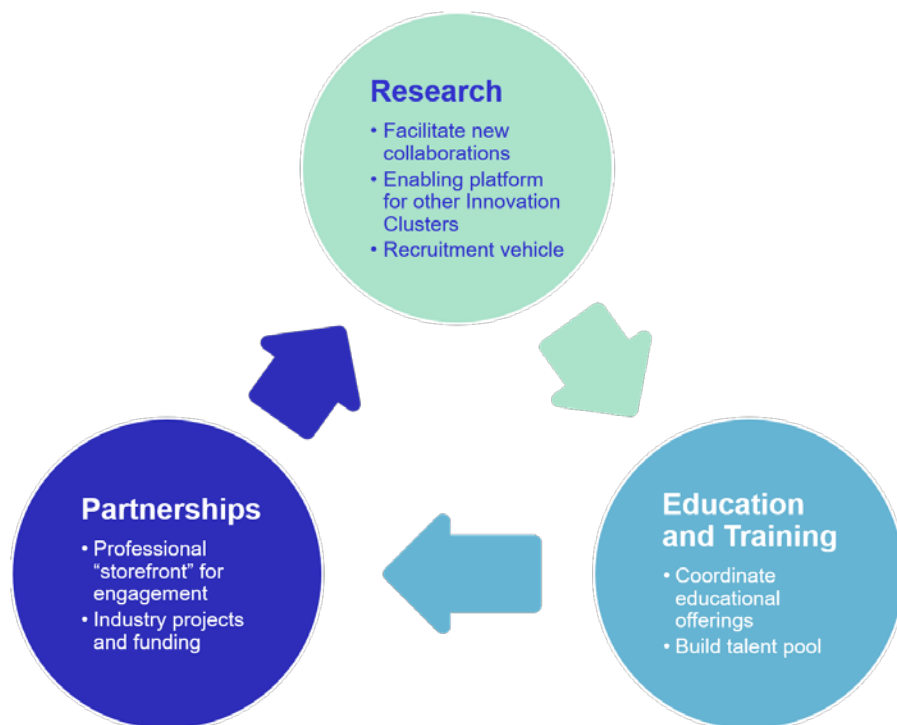
Research

The Centre will capitalize on Toronto's unique position as a world-class research powerhouse and its close proximity to a diverse range of industry clusters including financial services, life sciences, information and communications technology, transportation, energy, advanced manufacturing, and robotics. Leveraging our critical mass of expertise, the Centre aims to expand the Faculty's reach by building new research partnerships with a diverse industry base.

The Centre will both seed small-scale research projects and catalyze the launch of large-scale multi-investigator initiatives. Recognizing the interdisciplinary nature of many A/AI applications, the Centre will facilitate the formation of collaborations between faculty and with industry/government partners. The goals will be to support research collaborations that might not otherwise form, generate a research base to enable the pursuit of larger opportunities, support the development of highly qualified personnel, and engage deeply with partners.

Education and Training

The Centre's education mandate is to foster the development of highly qualified personnel with a specialization in A/AI across all engineering disciplines. The Centre will act as a central resource for up-to-date information on the numerous programs and courses in FASE that cover A/AI, including the Engineering Science stream in Machine Intelligence, the undergraduate minor and certificate in AI, and the MEng emphasis in Analytics. In addition, the Centre will support FASE units to develop and implement A/AI curricula at both the graduate and undergraduate levels. Through its industry connections, the Center will cultivate new experiential learning opportunities for our students, including internships and professional experience year co-op placements in coordination with the Engineering Career Centre, as well as undergraduate capstone and MEng projects in coordination with the respective departments and institutes.

Partnerships

Industry and government partnerships will be key to launching and sustaining thriving world-class research programs in A/AI. Partner funding will both seed collaborative research and provide support for the day-to-day operations of the Centre. To catalyze partnerships, the Centre will organize networking events to bring together faculty (both within FASE and beyond), students and cross-sector industry leaders as a means to connect consumers and producers of A/AI expertise. Once the Centre is formed, several partnership models will be explored including a consortium model with pooled funding or a model where each individual partnership is based on specific projects and deliverables. Ongoing consultations with FASE's large, existing partner base will be used to guide the development of our partnership model. The structure of the partnership model is expected to adapt as new partnerships are formed and the funding landscape evolves. The Centre leadership, including advisory bodies (described below), will regularly review and augment the model.

5. CONSULTATION

The consultative process within FASE for developing the Centre began in March 2017, with the kick-off of the 2017-2022 FASE Academic Plan development process. In the Academic Plan, Data Analytics and Intelligent Systems (which includes AI as a core component) is identified as one of four research foci for the Faculty. The need and opportunity to establish a centre within FASE focused on A/AI was further discussed with FASE Vice Deans of Research, Graduate and Undergraduate in early 2018 and during the October 2018 FASE Dean's search committee meeting. It was also discussed at the annual budget review meeting with the Provost in November 2018.

Once a faculty member was identified to lead the consultation process and the development of the vision and mission of the Centre, extensive consultations were held. A list of individuals who have participated in these consultations is provided in Appendix 3.

Within FASE, these included Chairs and/or Directors of each department, EDU:A and EDU:B, as well as select faculty identified as being active and/or having a strong interest in the field of A/AI. The objectives of the FASE consultations were to:
- (i) Obtain high-level feedback and determine support for such a centre;
- (ii) Start framing a preliminary vision and mandate for the centre.

Overall, support within FASE for establishing this EDU:C was universal both at the level of departmental leadership, as well as with individual faculty members engaged in A/AI. All Chairs and/or Directors from FASE departments, EDU:As and EDU:Bs have provided letters of support for this initiative. These letters are on file in the Dean's Office.

Outside of FASE, additional consultations were conducted to:
- (i) Communicate the Faculty's plans to submit an EDU:C proposal for the Centre;
- (ii) Learn about similar initiatives, either ongoing or planned, outside of FASE and identify opportunities for collaboration.

Constituents outside of FASE were selected for consultation based on research and educational activity in A/AI and include the Faculty of Arts and Science, the Faculty of Medicine, the Rotman School of Management, and the Vector Institute. Consultations to date have reaffirmed the need and opportunity for an organized initiative in this domain. Ongoing consultations are aimed at advancing plans for collaboration beyond FASE.

Several key themes have emerged from the consultations to date:

1. **"AI translation":** Driven by engineering applications across the Faculty's research foci, the Centre should focus on translating existing and emerging A/AI knowledge to create solutions with broad economic and societal impact across a range of industries.
2. **A strong and inclusive community:** The Centre should provide value to both internal and external stakeholders beyond the sum of its parts. It should support increased accessibility and coordination of research and educational offerings in the A/AI space and build a culture of collaboration, inclusive of all engineering disciplines and all engineering stakeholders (faculty, students, alumni, industry).
3. **A professional "storefront" for external engagement:** The Centre should serve as a single access point in the Faculty for external stakeholders seeking A/AI expertise and collaboration opportunities. It should connect demand and supply of A/AI expertise. It needs to create compelling value for donors and industry to remain sustainable.
4. **Be focused and nimble:** To build momentum and initial successes, the Centre should start with a focus on core FASE strengths. Sustainable expansion can follow once the model is proven successful.

These key learnings shaped the development of this proposal and the nature of the proposed Centre. A Faculty-wide strategic planning workshop was held on March 7, 2019 to engage a broader set of FASE researchers in the consultation process.

6. FACULTY PARTICIPATION

As an EDU:C, the Centre will hold non-budgetary faculty cross-appointments. A preliminary list of confirmed faculty participation is given in Appendix 2. This list includes users, consumers and enablers of A/AI within FASE and was generated through the consultations listed in Appendix 3. All listed researchers have confirmed their interest in participating in the Centre. The Chairs and Directors of Departments and EDUs are supportive of the proposed vision, mission and structure of the EDU:C, as well as the involvement of the faculty listed in Appendix 3, conditional on approval of the proposal.

7. ADMINISTRATIVE STRUCTURE

The Centre's leadership will consist of two key positions, a Director and an Executive Director. The latter will be a senior, full-time position held by an individual with industry/business development experience. These two individuals will be supported by an Academic Steering Committee and an Industry Advisory Board.

Director: With guidance from the Academic Steering Committee and Industry Advisory Board, the Director will:

- Develop the Centre's vision, strategic priorities and implementation plan
- Prepare annual reports to the Dean or designate based on clearly defined deliverables
- Conduct a self-study as part of the Centre's periodic review process
- Coordinate with the Dean and Vice-Deans on Faculty-level strategic vision
- Liaise with senior university administrators
- Chair the Academic Steering Committee and Industry Advisory Board
- Promote the vision and goals of the Centre to the external community

Professor Timothy Chan will serve as the interim Director. Prof. Chan is currently an Associate Professor in the Department of Mechanical and Industrial Engineering. Upon approval of the Centre, the Dean will appoint a Director for a fixed term of not more than five years, renewable once by the Dean.

The Director is accountable to the Dean or designate and is responsible for administrative and financial operation of the Centre. All monies and research funding will flow through the Dean's Office or designated department, in line with the Faculty's normal practice. Any research contracts or agreements will be approved through the Dean's Office and Central Administration (IPO), as required. An EDU:C may not administer research funds or enter directly and on its own authority into commitments / agreements / contracts.

Executive Director: The Executive Director will work closely with the Director to:

- Co-lead the development of the Centre's strategic priorities and implementation plan
- Execute the strategy and implementation plan, with clear deliverables
- Support the Director in preparing the Centre's annual report to the Dean or designate
- Support the Director in conducting an EDU self-study
- Build and manage relationships with the Centre's industry and government partners
- Coordinate with Faculty Advancement and Partnerships to attract funding and projects
- Promote the vision and goals of the Centre to the external community

A search for the Executive Director will begin immediately following approval of the Centre.

Academic Steering Committee (ASC): The ASC will advise on the Centre's priorities, mandate and strategy with a focus on research and education. It will review and approve the Centre's annual report and self-study, and oversee major academic activities including awarding of research funding to participating faculty and contributing to curriculum development. The committee will comprise:

- The Director (chair of committee)
- A representative of the FASE Dean
- At least three faculty members drawn from across FASE units
- At least one member of the Industry Advisory Board
- At least one student (undergraduate or graduate) drawn from across FASE units

Members of the ASC are appointed by the Director, in consultation with the Dean and Chairs and Directors, for a three-year term. Membership in the ASC may be renewed for no more than one additional three-year term. The ASC will meet at least once a year. Additional members may be added to the ASC, particularly from academic units outside FASE, conditional on them joining as participating members of the Centre.

Industry Advisory Board (IAB): In accordance with the Provost's *Statement on the Role of Advisory Bodies* (April 30, 1998), the Dean, with input from the Director, will establish an Industry Advisory Board consisting of senior industry representatives with a direct interest in A/AI, to provide non-binding advice. Board members will fill one or more primary roles:

- Provide strategic connections between the Centre's researchers and industry leaders
- Secure projects and speakers for educational initiatives
- Raise industry and government-sponsored research funding with support from FASE Partnerships
- Raise philanthropic funds with support from FASE Advancement

Continued service on the Industry Advisory Board will require tangible contributions in one or more of these areas.

8. SPACE

The Centre will be housed on the 8th floor of the Myhal Centre for Engineering Innovation and Entrepreneurship, located at 55 St. George St. The Myhal Centre is envisioned as a hub for the Faculty's collaborations and partnerships in A/AI. The co-location of the Centre with other institutes/centres in Myhal that may be consumers of A/AI expertise provides an enriched environment for participating faculty and students. For example, the Institute for Robotics and Mechatronics (IRM), the Centre for Global Engineering (CGEN), and the Institute for Water Innovation (IWI) have their primary location for partner engagement within the Myhal Centre. This emerging A/AI ecosystem, combined with the Entrepreneurship Hatchery (the engineering-led start-up incubator), all anchored in the physical space provided by the state-of-the-art Myhal building, will be a key enabler of success of the proposed Centre.

9. RESEARCH FUNDS

As an EDU:C, the Centre will not administer research funds unless explicitly designated by the Dean in consultation with the Provost.

10. BENCHMARKS AND MEASURES OF SUCCESS

This Centre aims to be the premier centre in Canada and among the leading global centres for research and development of A/AI solutions for engineering applications. Consistent with the vision outlined in this proposal, a five-year strategic plan and a detailed implementation plan, including timelines and milestones, will be developed by the Director and Executive Director for approval by the ASC and the Dean or designate during the first year of the Director's term. In addition, annual reports outlining the Centre's progress against these milestones will be prepared and submitted to the Dean or designate for review.

Strategic planning will be centred around the major activities of the Centre, which will include:

Fundraising from industry/government/donors: We will aim to secure funding for the Centre through a combination of industry, government, and private donors. This funding will support research collaborations, student training, and day-to-day operations.

Securing industry partners: To ensure long-term sustainability of the Centre, we will aim to secure industry partners across a range of engineering disciplines that are looking to implement A/AI technology. Partner engagement may be monitored via funding, visits, collaborative projects, participation in educational events, and attendance at seminars and industry showcase events.

Recruiting graduate students: To increase the number of students in the engineering A/AI space, we will attract and fund qualified graduate students to participate in collaborative research projects and experiential learning opportunities that fall within the Centre's mandate. Student engagement and success may be tracked via their scholarly outputs, participation in national and international conferences, completed internships, and job placements post-graduation.

Metrics and key performance indicators for the annual review process will be developed as part of the year one strategic planning process and approved by the ASC. These may include:

- Number of participating faculty, undergraduate and graduate students
- Number of students enrolled in FASE A/AI programs
- Number of new research collaborations that begin as a result of the Centre's activities
- Total revenues including research funding
- Research publications and citations by the Centre's participating faculty
- Organization of events such as seminars, workshops, and the annual industry showcase
- Mentions in social and news media

The Centre will benchmark itself against and will aspire to be competitive with the top industry-supported analytics, AI and data science institutes in the US and internationally (See Appendix 1). Some, like the Stanford Artificial Intelligence Lab (SAIL), have been established for decades and are highly successful and sustainable with high-profile industry affiliates. These institutes are focused on interdisciplinary research with industry partners, but differ in the types of educational programs that are offered and in management structure, although a common theme is academic leadership coupled with non-academic staff for outreach and administration.

Key Canadian A/AI institutes include the Centre for Intelligent Machines at McGill, the Institute for Computing, Information and Cognitive Systems at UBC, and the Waterloo Artificial Intelligence Institute. Although these Institutes do not serve as a direct model for the Centre, we will follow their evolution and impact closely.

11. GOVERNANCE AND REVIEW

An EDU:C requires approval from the Council of the Faculty of Applied Science and Engineering. It will be reported to the Office of the Vice-President and Provost for information and for inclusion in the University's list of extra-departmental units.

In line with normal practice, an EDU:C is subject to periodic review at fixed intervals (normally every five years), conducted by the Dean. This would typically coincide with the term of the EDU Director. As part of this review process, the EDU Director is required to submit a self-study report to the Dean summarizing progress against the EDU's five-year strategic plan goals. Any review would normally assess the EDU's sustainability, performance and achievements relative to the goals set out at its establishment. Possible outcomes of the review could include closure.

An EDU:C is also expected to report annually to the Dean or designate on the progress made toward its goals.

REFERENCES
1. McKinsey Global Institute, "Notes from the AI Frontier: Modeling the Impact of AI on the World Economy", September 2018.
2. Vincent Bérubé, John Kelleher, Tiff Macklem, and Ajay Agrawal, "Competition for AI Complements is Heating Up", Globe and Mail, October 21, 2018.
3. McKinsey Global Institute, "The Age of Analytics: Competing in a Data-Driven World", December 2016.

APPENDIX 1: TOP INDUSTRY-SUPPORTED A/AI INSTITUTES

Institute	Scope	Management Structure	Educational Programs	Research Foci	Industry Engagement
International					
Data Science Institute, Imperial College London	University-wide	Director and three Deputy Directors, representing Education, Policy and Public Engagement and Academic Engagement in all four Imperial faculties; Board of Lab Directors; Advisory Board comprised of senior, external figures in the field of data science and other subject areas from industry, a range of public and private sectors and academia	No programs or courses listed	Research focuses on cross-cutting foundations of data science, including statistics, big data, machine learning, modelling, simulation, visualization and cloud computing. The Institute supports data-driven research in various application domains: astrophysics, particle physics, biology, meteorology, medicine, finance, healthcare, social sciences and more.	Key partnerships with industry: Jaywing, Thomson Reuters, HNA Group, Imperial College – Huawei Data Science Innovation Lab
USA					
Stanford Artificial Intelligence Laboratory (SAIL)	School of Engineering	Academic Director; Non-academic (though PhD) Executive Director of Strategic Research Initiatives	Lists courses but no degree granting program	Research comprising machine learning, computer vision, natural language processing, robotics, genomics, and autonomous vehicles	Corporate members provide $200,000 per year of unrestricted support with an expected three-year commitment. Members include: DiDi, Huawei, Panasonic, Google

Institute	Scope	Management Structure	Educational Programs	Research Foci	Industry Engagement
Berkeley Artificial Intelligence Research Lab (BAIR)	Electrical Engineering and Computer Sciences	Academic Steering Committee; 5 staff	Lists courses but no degree granting program	Core research around the themes of computer vision, machine learning, natural language processing, planning, and robotics; cross-cutting themes including multi-modal deep learning, human-compatible AI, and connecting AI with other scientific disciplines and the humanities	BAIR Industrial Affiliates are sponsors who support BAIR with unrestricted support for first and second year student stipends at the level of $200K/yr or greater – affiliates include Microsoft, Samsung, Facebook, Google Cloud, Netflix, Huawei, Adobe, etc.
Michigan Institute for Data Science, University of Michigan (MIDAS)	University-wide including the College of Engineering	Academic leadership and management board; Academic external advisory board; Industry Engagement Committee managed by the Director of the Business Engagement Center; 5 staff	Graduate Data Science Certificate Program; Masters in Data Science; MOOCs	Organized around 5 themes: transportation, education, social science, music, health science	Affiliates program with five listed: BASF, General Dynamics, Northrop Grumman, Quicken Loans, and Wacker
Columbia Data Science Institute	9 Schools at the University including the School of Engineering and Applied Science	Academic Director; Non-academic staff of 17 including a Manager of Industry Engagement	Master of Science in Data Science; Certification of Professional Achievement in Data Sciences; DSI PDF program; DSI supports Faculty hires across the University	Broad scope built around 8 research centers encompassing computing systems, cybersecurity, finance, data collection, mathematical models, smart cities, health, and social impact	Industry affiliates program – affiliates include Cisco, Yahoo, DiDi, Unilever, Johnson and Johnson, Microsoft, GE, Google Cloud, etc.

APPENDIX 2: PARTICIPATING FACULTY

The following table lists faculty who have confirmed their interest in participating in this Centre. All faculty are listed under their primary appointment. Additional appointments are listed in parentheses, for example where a faculty member is also the director of or holds an administrative appointment in an EDU. Faculty are tenure-stream, except when marked with an asterisk, which denotes teaching stream. This list is an initial list, cultivated primarily through departmental consultations or email confirmations from individuals who expressed interest. It is by no means exhaustive. Additionally, all attendees of the Strategic Planning Workshop are considered to have expressed interest in participating. We plan to seek broad participation across the Faculty and beyond following the launch of the Centre.

Department/Institute	Name
Department of Chemical Engineering and Applied Chemistry	Will Cluett
	Greg Evans (ISTEP)
	Yuri Lawryshyn
	Radhakrishnan Mahadevan
	Christopher Yip
Department of Civil and Mineral Engineering	Baher Abdulhai
	Tamer El-Diraby
	Kamran Esmaeili
Institute of Biomaterials and Biomedical Engineering	Hai-Ling Cheng
	Michael Garton
	Azadeh Kushki
Institute for Studies in Transdisciplinary Engineering Education and Practice	Elham Marzi*
	Lisa Romkey*
	Chirag Variawa*
Department of Electrical and Computer Engineering	Jason Anderson
	Dimitrios Hatzinakos
	Baochun Li
	Andreas Moshovos
	Kostas Platiniotis
	Stark Draper (Engineering Science)
	Deepa Kundur (Engineering Science)
Department of Materials Science and Engineering	Kinnor Chattopadhyay
	Chandra Veer Singh
	Yu Zou
Department of Mechanical and Industrial Engineering	Dionne Aleman
	Christopher Beck
	Timothy Chan
	Chi-Guhn Lee
	Scott Sanner
University of Toronto Institute for Aerospace Studies	Tim Barfoot
	Jonathan Kelly
	Angela Schoellig
	Steven Waslander

APPENDIX 3: CONSULTATION

3.1 Consultations within FASE

Department/Institute	Name	FASE Departmental Consultations (Jan. 17th – 31st, 2019)	FASE Research Committee Meeting (Jan. 23rd, 2019)	FASE Chairs and Directors Meeting (Feb. 5th, 2019)	Strategic Planning Workshop (Mar. 7th, 2019)
Department of Chemical Engineering & Applied Chemistry	Grant Allen (Chair)			X	
	Sean Caffrey				X
	Radhakrishan Mahadevan	X			X
	Emma Master (Associate Chair, Research)		X		
	Joseph Paradi				X
Department of Civil & Mineral Engineering	Baher Abdulhai	X			
	Evan Bentz			X	
	Tamer El-Diraby				X
	Kamran Esmaeili				X
	Oh-Sung Kwon				X
	Heather MacLean (Acting Chair)	X		X	
	Khandker Nurul Habib	X			
	Daniel Posen	X			
	Matthew Roorda (Acting Associate Chair, Research)		X		
Department of Electrical & Computer Engineering	Jason Anderson (Associate Chair, Research)	X			
	Dimitiros Hatzinakos	X			
	Baochun Li	X			
	Ben Liang				X
	David Lie				X
	Farid Najm (Chair)			X	
	Kostas Platiniotis	X			X
	Jonathan Rose	X			
Division of Engineering Science	Deepa Kundur (Chair)	X		X	
	Stark Draper (Option Chair, Machine Intelligence)	X			
FASE Dean's Office	Cristina Amon (Dean)			X	
	Allison Brown (Director, Corporate and Foundation Partnerships)	X	X	X	X
	Ramin Farnood (Vice-Dean, Research)		X	X	X

Department	Name				
	Micah Stickel (Vice-Dean, First Year)			X	
Institute of Biomaterials & Biomedical Engineering	Warren Chan (Director)			X	
	Hai-Ling Cheng				X
	Rodrigo Fernandez-Gonzalez				X
	Michael Garton	X			
	Azadeh Kushki				X
	Jonathan Rocheleau (Associate Director, Research)		X		X
	Babak Taati				X
	Christopher Yip	X			
Institute for Studies in Transdisciplinary Engineering Education & Practice	Greg Evans (Director)	X		X	X
	Elham Marzi	X			
	Emily Moore (Director, Troost ILead)			X	
	Lisa Romkey	X			
	Chirag Variawa	X			X
Department of Mechanical & Industrial Engineering	Christopher Beck	X			X
	Markus Bussmann (Chair)	X		X	
	Mark Chignell				X
	Mariano Consens				X
	Roy Kwon				X
	Chi-Guhn Lee	X			X
	Hani Naguib (Associate Chair, Research)		X		
	Alison Olechowski				X
	Scott Sanner	X			
	Vahid Sarhangian				X
Department of Materials Science & Engineering	Jun Nogami (Chair)	X		X	
	Chandra Veer Singh (Associate Chair, Research)	X	X		X
	Yu Zou	X			X
University of Toronto Institute for Aerospace Studies	Tim Barfoot	X			
	Christopher Damaren (Chair)	X		X	X
	Steve Waslander	X			

3.2 Consultations External to FASE

Faculty	Name	Dean's Office Meeting	Other
Faculty of Arts and Science	Melanie Woodin (Dean, July 1, 2019)	March 15th, 2019	
	Angela Demke Brown		
	Ravin Balakrishnan (Chair, Computer Science)		February 14th, 2019
	Yashar Ganjali (Associate Chair, Research, Computer Science)		
	Arvind Gupta		
	Matt Medland		
Faculty of Medicine	Richard Hegele (Vice-Dean, Research)	February 14th, 2019	
	Rita Kandel		March 6th, 2019
	Kaveh Shojania		
Rotman School of Management	Kenneth Corts (Vice-Dean, Faculty & Research)	Proposal sent March 7th, 2019	
	Opher Baron (Area Coordinator, Operations Management and Statistics)		February 12th, 2019
	Peter Wittek		
Vector Institute	Garth Gibson (CEO)		February 26th, 2019
	David Fleet		