Comparing engineering leadership curricula in Canada and the United States: The role of external and internal influences

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***Abstract*—This research full paper analyzes the engineering leadership curriculum at universities in Canada and the United States. Through an adapted curriculum development framework, we analyze key documents for five engineering programs in each country. Using a pair-wise approach, curriculum are compared to investigate how programming might differ between the two countries. We also examine the external and internal factors that might shape the curriculum, such as accreditation, labour markets, and unit relationships. Findings indicate that despite a wide range of approaches used, there are no apparent systematic differences in content, sequence or instruction processes based on nationality. In fact, a number of common trends in curriculum delivery were observed, most notably, a strong focus on personal leadership and reflective practice. Relating to influences, some differences were observed related to funding approaches and accreditation. Similarities included strong links to engineering school missions. These results point to the conclusion that there is a strong overlap in the engineering curriculum between the Canada and the United States. This commonality provides excellent opportunities for engineering leadership educators to leverage through pedagogic exchange across the two national contexts. Future research should continue to seek explanations for these observations, through continued analysis and by expanding the size of the sample to gather more structured data on how instructors build their curriculum and respond to the internal and external influences on the programs.**

Keywords—engineering leadership, academic plan, curriculum development

I. Introduction and Literature Review

Engineering leadership education programs are prominent in the United States and gaining profile in Canadian universities. Despite this, it remains a challenge to develop a clear picture of how 'engineering leadership' is being operationalized in these different contexts. Two types of studies have been presented or published on the topic of engineering leadership education in North America. The first type is individual program descriptions, usually conference papers, explaining leadership learning activities, courses or programs in some detail [1]–[6]. These studies provide depth and identify what others are doing. The second type is comparative studies that look across several universities to identify patterns and interesting differences in programmatic delivery [7]–[10]. These tend to have less depth, and focus heavily on the United States because of its higher concentration of well-resourced, established engineering leadership programs. A minority of studies have included Canadian programs [7], [9].

This paper builds on work by the authors which has led to a comparative framework for examining specific dimensions of engineering leadership 'curriculum'. Our modified version of Lattuca and Stark's academic plan model [11] has been operationalized and tested to apply directly to document analysis of curriculum plans for engineering leadership. The original framework, presented in Figure 1, presents curriculum as a series of intentional decisions, captured by seven elements of an academic plan: purpose, content, sequence, learners, instructional processes, instructional resources, and evaluation. The model also captures external influences such as market forces, accreditation agencies, and donors, and internal influences such as institutional mission, faculty roles, available resources, and governance, all of which have been shown to shape curriculum decisions [11]. It is useful to note that while not exclusive to engineering, Lattuca and Stark have both led major research projects that do look specifically at engineering education [12]–[15], which has informed their framework.

An important finding of our previous work is that the background of faculty who teach engineering leadership shapes the content, curriculum delivery and assessment – with marked differences between engineering professors and business professors [16]. We also found that external influences, such as donors, industry sponsors and the labour market, significantly enable or constrain program offerings. Building on this work, we embark here a comparative study of Canadian and American programs. Canada and the United States have many broad similarities in the structure of their engineering labour markets, and a long-standing relationship between the national accreditation boards to harmonize the broad curriculum policy. On the other hand, there are fundamental differences in the structure and design of the higher education system, in the type and extent of philanthropic and corporate funding relationships with universities [17], and most important to our topic, there is a marked difference in the date of establishment of explicit engineering leadership programs. To what extent do the findings from Canada hold for the US? Do the structural differences in the higher education systems affect faculty profile and funding? These are some of the questions motivating our cross-national comparison.

II. Methodology

Our research questions are: (1) How does the engineering leadership curriculum in Canada compare with that in the United States, for similar types of delivery modes?; and, (2) What external and internal influences might explain major curricular differences? To build directly on past work, we use our analysis of five Canadian programs, alongside five American programs that were a useful 'match' in terms of the student demographics, course purpose, and high-level content emphasis. Our unit of analysis is the individual course or program element, rather than the broader minor or degree structure.

We employed a purposive sampling method, using knowledge of existing networks of peer practitioners and publications in the American Society for Engineering Education's Engineering Leadership Development (LEAD) Division to identify possible paired programs. In a few cases we contacted instructors to request access to their course syllabi, several of whom replied to this request. Ultimately, the data sources we used were course syllabi, institutional and program websites, college of engineering strategic plans, and published conference papers. The ten universities and courses are summarized in Table 1.

Our analysis, as presented in the findings, commences with a pairwise comparison of each sub-element of the academic plan and the internal and external influences. In Appendix A, an example table for University of Guelph and the Massachusetts Institute of Technology (MIT) is shown to illustrate our approach. In our discussion, we look broadly across all ten examples to look for patterns; paying attention to differences across the two countries.

TABLE I. Paired Leadership Programs Selected in Study

Canada		**United States**	
University	***Unit of Analysis***	***University***	***Unit of Analysis***
University of Prince Edward Island (UPEI)	3rd/4th year design course	East Carolina University (ECU)	3rd year lab course on microprocessors
University of Toronto (U of T)	Co-curicular "Summer Fellowship	Northwestern University (NWU)	Elective 'Field Study in Leadership' course
University of British Columbia (UBC)	Graduate course on leadership within Master's program	Tufts University	Graduate course on leadership within Master's program
University of Guelph	Graduate course on leadership	Massachusetts Institute of Technology (MIT)	Graduate course on innovative teams
Western University	Undergraduate leadership & innovation course	Penn State University	Undergraduate introduction to leadership course

III. Findings

Our findings walk through each of the five pairings, following a similar structure. First we identify and describe the two courses or programs, then compare the curriculum itself, before comparing the internal and external influences..

A. Pairing 1: Mandatory undergraduate technical/design course (UPEI and ECU)

The first pairing compares courses that are part of the compulsory technical curriculum in two undergraduate engineering programs – a third year microprocessors course in the Electrical Engineering program at East Carolina University (ECU) [18] and the linked third and fourth year Engineering Design courses in the Sustainable Design Engineering program at the University of Prince Edward Island (UPEI) [19]. Each of these courses enhances the traditional core technical curriculum by intentionally embedding explicit leadership content. Although the courses themselves are quite different in nature, there are a number of similarities: Class sizes are small (< 30 students) and the focus is on personal leadership leveraging the experiential opportunities in each course, with no references to the use of formal textbooks. UPEI leverages semester long design projects and ECU builds on multiple short lab projects over the semester. In both instances explicit leadership concepts, such as working in teams (ECU) or reflective practice (UPEI), are provided to students, with the leadership evaluation taking the form of reflection or self-assessment. In each instance, leadership assessment represents a small percentage of the course grade (e.g. 5% at ECU). The UPEI design course provides the opportunity to include some formal leadership concepts, such as authentic leadership, and using personality type inventories such as "social styles" [19].

Both programs are externally influenced by the market with a career focus on the leadership and teamwork needs in the workforce. At UPEI, the linkages to industry are directly realized through industry participation in capstone projects, and at ECU, funding from industry led to the creation of leadership content through an instructional innovation and leadership fund. Accreditation is a strong external influence in the case of UPEI, as the program has been recently accredited and the leadership curriculum provides a strong linkage to the non-technical graduate attributes such as teamwork and professionalism. Although not explicitly mentioned for ECU, this would likely be useful for ABET accreditation. From the internal perspective both engineering programs are small, with UPEI growing to 200 students and ECU at approximately 600 students. In the case of UPEI the program is new, and with the strong influence of accreditation and a focus on design practice in the capstone project, the course content has much stronger oversight from the department than the ECU microprocessor course, where the professor has full autonomy over changes. That said, the ECU leadership components connect well with the overall institutional culture of leadership development. Both UPEI and ECU also explicitly mention experiential learning in their schools' strategic plans which fits well with the approach to leadership content in each of the courses.

B. Pairing 2: Optional elective program for students leading organizations (U of T and NWU)

The second pairing consists of optional programming for undergraduate students leading organizations. The first is the 'Field Study in Leadership' elective course at Northwestern University (NWU), and the 'Summer Fellowship', which is a co-curricular 16-week intensive summer cohort program at the University of Toronto (UofT). Both programs target students actively involved in leadership activities. Thus, accessing the opportunity is not only optional, but competitive in nature, requiring an application to access. The resulting cohorts are likely to be highly motivated and have relevant leadership experience. Although very different in structure of delivery (i.e. course vs. boot camp), the programming shows a number of common elements. First, with the context of student clubs as background, both programs are heavily focused on personal leadership development using experiential approaches. In the case of UofT, this is also explicitly supported by relevant organizational culture and leadership theory [20]–[22]. Common personal leadership content included leadership crucibles [23], [24], personal value development, and skill-development such as active listening, critical thinking and reflection. Each program also structured the delivery with an iterative/tiered approach. For example the UofT program worked through levels of organizational change within a summer long change project. Both programs used a variety of delivery methods, including workshops, discussion groups, reflection journals, and leadership projects. Coaching was also a key feature of the NWU delivery. Because the NWU program was curricular, student assessment was formal, based on presentations, class participation, journaling activity and a final paper, whereas UofT utilized facilitator and peer evaluations for student feedback. UofT also gathered from participants, formal feedback on the program itself through mid-point, end-point and a 4 month follow up survey.

From an external influences perspective, the impetus for the two programs seems to have come from different perspectives. At NWU the Center for Leadership was initially funded in 1990 by the Kellogg Foundation, the namesake of the NWU business school, whereas at UofT the leadership programming was built through an internally generated vision and self-funding. The programs are similar in that they emphasize personal development more than career development. Neither program has explicit links to engineering accreditation. Both institutions have relatively large engineering schools (NWU with approximately 4,000 students evenly split between graduate and undergraduate students and UofT with 5,400 undergraduates and 2,300 graduate students). Accordingly, the engineering programs are well resourced as a whole. Internally, the leadership programming fits well with the mission of each of the engineering schools and the universities themselves. NWU has a Center for Leadership hosted by the School of Engineering, and the UofT Faculty of Applied Science and Engineering has an established Institute for Leadership in Engineering Education (ILead). In both cases these leadership education units are spotlighted in institutional fundraising efforts and the resulting well-established units have been able to integrate leadership into the activities of the school, connect to units outside of the school, and provide opportunities for attracting engineering students to leadership.

C. Pairing 3: Industry-focused course embedded in master's degree focused on engineering leadership or management (UBC and Tufts)

The third pairing compares graduate courses on engineering leadership, both embedded in professional master's degree programs – the Masters of Engineering Leadership (MEL) at the University of British Columbia (UBC) [25] and the Masters of Science in Engineering Management (MSEM) at Tufts University [26]. The two courses have small class sizes, populated by engineers with industry experience spread across engineering disciplines. Both emphasize teams and teamwork. Despite structural similarities, these two are quite different in content, sequence, and instructional processes. The UBC course is a standalone class taught by business school professors; it emphasizes managerial roles and structures, organizational learning and results, assessed through case studies and presentations. In contrast, the Tufts course is split into modules intertwined with technical modules across the whole degree. Taught by 'professors of the practice', Tufts emphasizes personal leadership styles and leadership skills using experiential learning activities, assessed through discussion, reflection and application to a degree-wide industry change project.

The two courses, and the broader master's degrees in which they are embedded, are shaped by external influence of the market, enacted through industry input into the design of program. The two universities, Tufts and UBC, are quite different: the former, a small, private university, and the latter, a large, public university, and yet both are responding to similar external pressures to create similar professional master's programs in order to increase tuition revenues. Ultimately, the internal influences offer the best explanations for the curriculum differences noted above: Tufts' program was launched by a major gift by Bernie Gordon that ultimately led to the creation of the Tufts Gordon Institute, a semi-autonomous unit that offers the MSEM program. In contrast, UBC's programs were driven by the Dean's office, positioning the new MEL degree as part of a university-wide strategic mandate. These translate into differences in culture, faculty roles and unit relationships. Tufts Gordon Institute has a teaching team of 'professors of the practice' dedicated to the program enabling more team teaching and modular integration. In contrast, UBC is drawing on the expertise of individual faculty members from engineering and business, quite separately, so the leadership course examined here is a standalone offered by a single professor – a more traditional mode.

D. Pairing 4: Elective graduate course on leadership open to any graduate students in research or professional streams (Guelph and MIT)

The fourth pairing also looks at graduate courses, but this time standalone elective courses that are open to a wider range of graduate students, in both research and professional degrees. The courses are 'Engineering Leadership' at the University of Guelph, and 'Creative Teams' at the Massachusetts Institute of Technology (MIT). The Guelph course is broader in its aims to help engineers learn about leadership in life, school and work, using a single overarching leadership framework to tie the course together, and emphasizing the engineering identity context. The MIT course focuses more on leadership in innovation teams in industry, using a wide set of intriguing personality assessments including creativity and grit. Despite this, the two have a clear overall alignment. Both focus on personal and team leadership using observational, experiential and theoretical philosophies to engage students. Both use projects to get students to practice skills and competencies, and broadly are sequenced to start with personal leadership before progressing to team and ultimately organizational leadership. There is a high degree of overlap in delivery methods of lectures, discussion groups, industry speakers and presentations; as well as a wide range of common assessment methods such as participation, group presentations, team reports and reflection papers.

Again, the external influence of the market emerges as leadership is positioned as relevant to engineering careers. On the other hand, MIT's course focuses more on engineering leadership in private sector corporations, possibly an extension of the philosophy of the namesake donor, Bernie Gordon, whose mission to fund leadership programs stems from a perceived lack of engineering leaders in particular industries. Guelph, in contrast, draws legitimacy from connecting course learning outcomes to the Canadian accreditation board's graduate attributes – foregrounding the importance of leadership to engineering professionalism and identity. Institutionally, MIT and Guelph are extremely different: the former is a globally top-ranked urban private research institute with strong private sector and military connections; the latter is a rural, public university with a strong public service mission focused on undergraduate teaching for agriculture, environment and engineering. The MIT course also has the benefit of the resources, brand and legitimacy of the widely known undergraduate Gordon Engineering Leadership (GEL) program whereas the Guelph course is a stand-alone effort. So what explains the remarkable consistency in the elements of the academic plan? In both cases, the course is developed and taught by a single instructor passionate about engineering leadership, with industry experience but also a research/tenure-track orientation. The courses also fill similar niches in the wider graduate course offerings, particularly for research-stream graduate students. They offer creative, non-technical, experiential and multi-disciplinary learning that has great application to careers in both research and industry.

E. Pairing 5: Undergraduate leadership course included in a certificate/minor on engineering leadership/innovation (Western and Penn State)

The fifth pairing is two undergraduate elective courses on leadership which are mandatory for students taking the Engineering Leadership in Innovation Certificate at Western University, or the Engineering Leadership Development Minor at Penn State University. The courses, for upper year undergraduate students from all disciplines of engineering, share a purpose of teaching personal leadership through observation, reflection and theory. Their content overlaps on organizational vision, character and ethics, personality inventories. Both use lectures, industry speakers and discussion groups to engage students; while assessing learning through participation, reports, and presentations. Western's course, taught in conjunction with the Ivey business school, focuses more on organizations, workplace and management contexts including conflict management. The course is sequenced from personal to team to organizational leadership and draws heavily on case studies, a distinctive strength of the business school. Penn State's course has more content emphasis on project teams and cross-cultural interactions; it progresses from theory to practice, and relies on hands-on learning and application in a co-requisite engineering project team involving work on technology for the developing world.

The external influence of career relevance shows up differently in each school: Penn State emphasizes the importance of global competency vis-à-vis international development and uses large engineering employers to communicate this to students; whereas Western highlights the opportunities for entrepreneurship and new venture creation in the broader certificate program. Both programs highlight their clear linkage to non-technical accreditation outcomes. The internal influences shaping the courses include strong support from the Dean at different key moments to support approvals in academic governance – partly linked to explicit identification of leadership and entrepreneurship as strategic priorities in faculty/college level strategic plans. However, Penn State's course was launched by internal stakeholders in 1995. This is a full 20 years earlier than Western, which initiated programming based on a major external donation to fund a Chair in Engineering Leadership and Innovation. Over time, Penn State's course and the minor have been institutionalized in a distinct department for professional practice, relying on the industry experience of its program director as a 'professor of the practice'. Western, on the other hand, explicitly leverages and continues to build bridges with the business school for teaching expertise and stronger ties to the leadership and entrepreneurship research expertise available. Given ongoing development of the Chair and the connection to the business school, there are prospects for the Western initiative to involve into a new department of its own.

IV. DISCUSSION

The academic plan model provides a structured approach to review and compare curriculum examples from paired Canadian and American leadership programs. Consistent with the findings of our recent work looking at Canadian-only programs [16], the American programs in our sample show a wide variety of approaches, materials and resources when delivering leadership curricula. Despite this variety, we observed no systematic differences in the content, sequence or instructional process based on nationality. In fact, these elements were surprisingly similar when looking in a pairwise fashion across the elements of the Academic Plan, as demonstrated in the pairwise example in Appendix A (Guelph vs. MIT), with a number of common elements. This is partly an intentional sampling bias: we sought our pairs that had broad similarity in their scope and mode of delivery, and only looked at ten universities. Another plausible explanation is that the leadership programming emerging in engineering schools is an approach that is consistent with underlying professional values which are shared across countries [27], [28]. Beyond the pairwise comparisons, a number of common trends were observed all ten examples: Delivery in small cohorts of less than 30 students, the use experiential approaches and working with teams with a foundational grounding in personal values and self-leadership.

When looking at the external and internal influences on the curriculum, there are some differences. In the Canadian context, the influence of engineering accreditation is a strong factor. The mapping of the leadership curriculum to relevant graduate attributes is explicitly mentioned in the Canadian undergraduate curriculum and even extends into the content in some graduate level courses. Both Canada and United States were influenced by the labour market, with leadership skills positioned by universities as providing a competitive advantage in job-seeking. From an internal perspective, the greatest differences in program creation were that Canadian programming largely grew out of internal funding, that perhaps evolved into some external fundraising efforts (e.g. Toronto, UBC), whereas in the US, the development of the curriculum in several cases was initiated by significant donor funded initiatives that were later internalized into significant self-sustaining entities in the institution (e.g. MIT, Tufts, NWU, ECU). An exception is Penn State, where early decisions to launch a minor in the 1990s were internally driven by the dean and other academic stakeholders. This suggests a possible relationship between the type of institution (publicly funded vs. privately funded), as the majority of US examples were drawn from private universities with a strong tradition of alumni philanthropy; whereas all Canadian examples were from public universities. Regardless, as the case of Western University shows, Canadian public research universities too are looking for private funding of engineering leadership initiatives, as part of a broader trend that "has made large-scale, private fundraising a growth activities for Canadian universities" [17, p. 100].

Another important internal influence is the mission of engineering schools, which in practically all cases was strongly aligned by explicitly valuing engineering leadership ideals. In both Canada and the United States, the extent of the overall engineering leadership programming does depend on the strengths of the unit relationships. Programs varied in the nature of their institutional home: from standalone centers and institutes (NWU, Tufts, U of T), to distinctly branded programs and degrees (UBC, Penn State, Western, MIT), to individual courses (Guelph, UPEI, ECU). Units with closer relationships to the power centers of the university (Dean or Provost) have opportunities to make more direct links to strategic planning priorities, access more core funding, and institutionalize leadership within the core curriculum [11]. Units or programs that are more isolated, or independent, may require ongoing external funding and a harder fight for legitimacy. Anecdotally, in looking for comparable examples for analysis in the study, we noticed a tendency toward more co-curricular initiatives in Canada (where there is no academic credit for participation); whereas the majority of visible examples in the United States centred on courses that offered academic credit. Although not as rigorously developed, this is something to review in the future as we look to analyze a larger data set of curriculum examples.

Broadly, we did not find any stark differences in the content of the engineering leadership curriculum based on nationality. There were significant similarities in philosophy, content, sequencing and instructional processes, at times even using the same theories, frameworks, assessments and even interactive activities. From the ten examples identified, the core elements defining this field are personal leadership and an understanding of self; experiential approaches to learning (with grounding in theory); application in team contexts; and the development of reflective practice a relevant skill and discipline for engineering.

We thus conclude that it is both reasonable and desirable to increase connectivity and the exchange of pedagogic learning among educators across the two national contexts. This is already evidenced by the presence and cross-fertilization of individuals and conference papers across the flagship engineering education conferences in each country. The clear alignment in emphasizing personal leadership development and reflective practice indicate this is a domain of practice that can benefit from identification of good practice and 'core knowledge' including approaches to sequencing, delivering and assessing student learning. This would represent a new step forward for networks of engineering leadership educators – moving towards stronger classification of the boundaries around the nascent field of knowledge and practice [29]. Defining and codifying this type of leadership knowledge (which is drawn from various social science fields and implicitly quite contextual) will no doubt be a challenge for engineering educators, who are used to operating in knowledge structures that are much more 'vertical' [30] – as scientific and mathematical concepts build directly on one another [31], [32].

Future research should continue to seek explanations for how and why the domain of engineering leadership has intuitively or instinctively focused on personal leadership and reflection as critical elements for educating student engineers in leadership in university settings. A deeper exploration of the experiences and backgrounds of engineering leadership instructors and program designers, such as that pursued by Schell and Kauffmann [33] is one approach to doing so. Another approach, and extension of this research in this paper, is to expand the sample size. By using a more structured approach to data collection that allows us to capture the content material (textbooks, readings, inventories) and the sequence of learning activities, statistical generalizations may be possible. This can be pursued through data collection methods such as a structured interview guide or an online survey.

V. Conclusions

Engineering leadership is a growing field of education in both Canada and the United States. Despite a pattern of largely organic growth influenced by labour market demands and reinforced by private philanthropy and professional accreditation requirements, we find strong overlap in the curriculum content in ten examples of engineering leadership curricula split evenly across the two countries. This common core centers on personal and team leadership, taught in small courses with a much higher experiential content than typical engineering courses, bringing together students from across engineering disciplines to develop their reflective practice.

More cross-national variation was evident in the internal and external influences on curriculum: American examples were more influenced by individual philanthropic donors, which is related to the higher prevalence of private universities in that half of the sample. Canadian examples were more closely linked to accreditation requirements, had stronger relationships with power centers such as the dean's office.

Future research work should expand the size of the sample to gather more structured data on the decisions by instructors to select, sequence and assess engineering leadership knowledge and skill through course and program design and evaluation. An important implication for practitioners is to continue building bridges between programs on either side of the border, as the similarities in curriculum alongside differences in institutional context produce conditions for fruitful exchange and learning.

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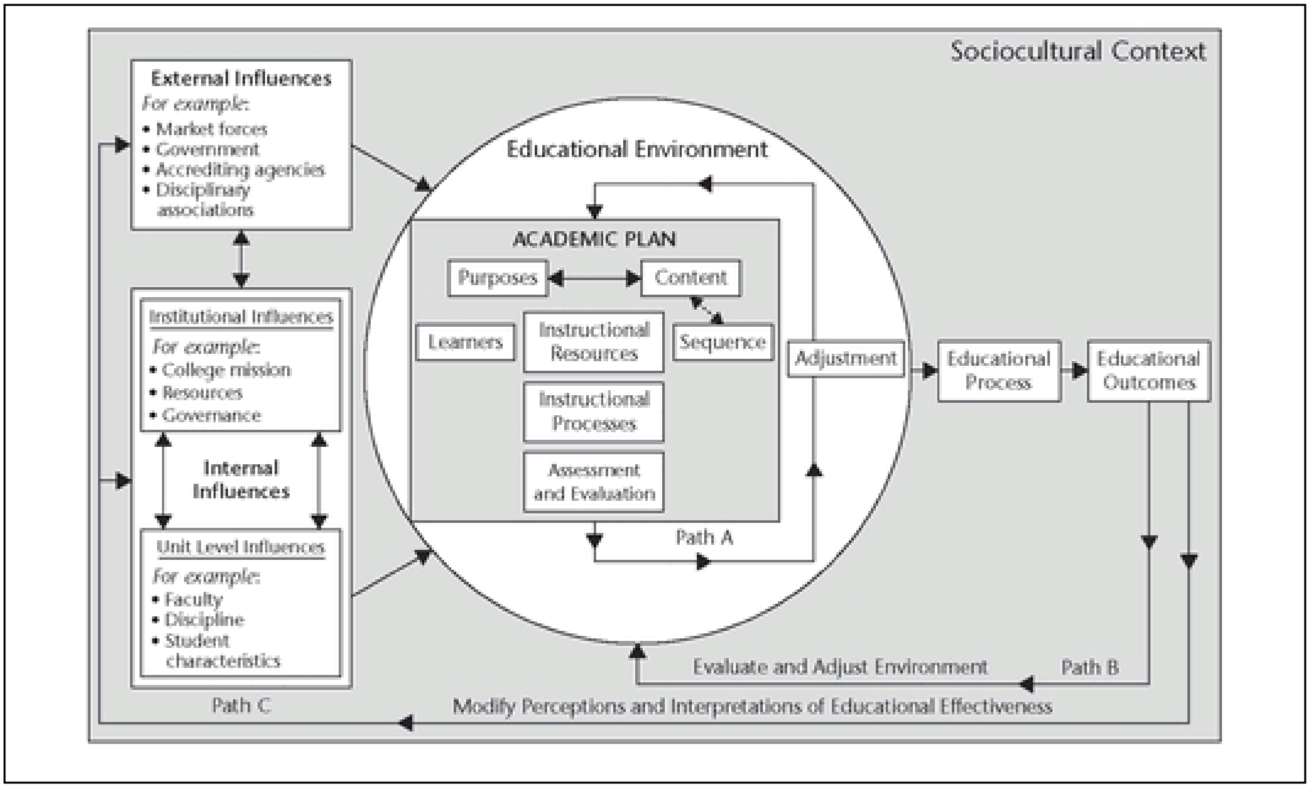

Fig. 1. Lattuca and Stark's Academic Plans in Sociocultural Context [11, p. 5]

APPENDIX A – EXAMPLE PAIRWISE ANALYSIS – USING THE ACADEMIC PLAN MODEL [11]

Institution	Guelph	MIT	Comparison
Unit of Analysis	Leadership Course	Leadership Course	Same
Academic Level	Graduate	Graduate	Same
1. Academic Plan - Purpose			
Leadership Focus	Personal Team	Personal Team	Common
Context	Workplace; Life	Team, Innovation	Different Focus
Educational Philosophy	Theory, Experiential & Observational	Experiential & Observational	Mostly Common
2. Academic Plan – Content			
Organizational (Org.) frameworks	Competing values	Creating a vision Creative environments	Different specifics with same context area
Personal leadership	Kouzes & Posner model	Leadership traits	Guelph more explicit
Personality type/inventories	Social styles	UPenn surveys (IPEP-NEO; VIA Survey of Character Strenghs; Grit survey)	Different inventories; more used in MIT
Leadership Skills	Reflective practice	Coaching	Guelph more on reflection
Teams	Intercultural leadership	Team Building	MIT more on teams
Management	Time & Project Management; Strategic Planning	Conflict Management	Guelph focused more on projects vs. interpersonal at MIT
3. Academic Plan – Sequence			
	Single course-long interview project. Personal-through organizational with iterative reflection.	Personal -> teams -> reflection Ongoing small projects Few larger projects	Common: use of projects to practice skills and competencies
4. Academic Plan – Learners			
Degree	Graduate	Graduate	Common
Course Type	Elective	Elective	Common
Discipline of engineering	Mixed	Mixed	Common
Experience requirements	Limited work experience	Not clear	n/a
5. Academic Plan - Instructional Resources			
Class Size	15-20	Small	Common: Small
Classroom Type	Lecture/Reconfigurable	Lecture	Similar
Texts	Accessible, personal Selected readings	Management Skills Selected Readings	Similar
External	Industry leaders Community leaders	Industry speakers	Common
6. Academic Plan - Instructional Processes			
Delivery	Lectures Discussion groups Industry speakers Leadership Project Student presentations	Lectures Reflection on reading Industry speakers Group discussions Peer learning	Mostly common
Student Assessment	Presentations Class participation Final paper/report Reflection journals	Class participation Skill application papers 3 leadership rojects Presentations	Mostly common
7. Academic Plan - Assessment and Evaluation			
	Formal feedback gathered from participants r	Not indicated	n/a
Socio-cultural Context - External Influences			
Market (e.g., donors, career)	Career Skill sets beyond technical	B.M.Gordon Foundation funding Start up – innovation environments	Common: appeal to careers as leadership skillset is viewed as important and complementary to technical skillset.
Government	None	None	Common
Accreditation Agencies	Accreditation graduate attributes provide an engineering context leadership	No link	Guelph explicitly connects to accreditation graduate attributes
Socio-cultural Context - Internal Influences – Institutional			
Institutional	UofG (28,000 undergraduate and graduate students)	MIT (4,500 UG, 6,900 Grad) School of Engineering (2,500 UG, 3,300 Grad)	Different

	School of Engineering (1800 UG, 300 Grad), 7 disciplines	Engineering is largest of MIT's 5 Schools Gordon Engineering Leadership (GEL) Program	
Mission, Type & Control	Guelph School of Engineering values include: multidisciplinary engineering education, dedication to teamwork, collaboration. - engineering design, responsive to the needs of society	MIT School of Engineering's mission is to educate the next generation of engineering leaders, to create new knowledge, and to serve society.	Common: similar stated aims around serving socety Difference: Guelph more oriented (in values) towards in achieving through teamwork, design, collaboration; MIT (GEL) focused on industry context.
Resources	Developed as an independent graduate course by the faculty member.	Significant funding for overall GEL program; unclear how graduate course is funded	Common: graduate course led by single faculty MIT: Large resource base GEL provides.
Governance	Individual faculty member has full autonomy over changes to individual course	Individual faculty member has full autonomy over changes to individual course	Common
Socio-cultural Context - Internal Influences – Unit Level			
Unit	Individulal graduate level course accessible to all graduate students in the engineering and physical sciences.	The GEL Program a separate unit endorsed by School of Engineering as a leadership development option. Co-curricular at undergraduate and "Leading Creative Teams" at graduate.	Gordon-MIT is a separate unit. Guelph has no equivalent, but course is available to all engineering and physical science graduate students.
Faculty Roles	Single instructor	Single Instructor	Common
Program Culture & Leadership	Course is opportunity for interdisciplinary interaction between graduate students and as a linkage to responsible leadership in engineering.	Program roots are from industry sponsored donation (Gordon program) Launched in 2007 MIT Engineering is highly ranked and recognized for engineering internationally.	Common: opportunity for graduate students to connect across disicplinary boundaries.
Student Characteristics	Mostly Master's interested in courses relevant to industry	Engineering graduate students..	Difference: MIT more research-stream graduate students (MSc, PhD); Guelph more professional masters (MEng)
Unit Relationships	Course is offered as a special topics course available to Engineering and Physical Sciences graduate students	This course is offered through the Gordon-MIT Engineering Leadership Program. The grad course is recognized as credit course for doctoral minors.	Common: course not strongly integrated into graduate curriculum.