A QUANTITATIVE ANALYSIS OF FIRST-YEAR ENGINEERING STUDENT PERSISTENCE AND INTEREST IN CIVIC ENGAGEMENT AT A CANADIAN UNIVERSITY

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by

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Abstract

This study explored what variables engineering students self-identify as reasons they persist from first to second year, and what areas of civic engagement appeal to students, in order to identify areas of local relevance that could inspire academic improvements. The research found that the study group is similar to first-year students in general at the subject university and to first-year engineering students at other universities. No compelling evidence was found that the study group would perform differently than previous cohorts. Results also showed that first-year engineering students were interested in and had prior experience in civic engagement activities. Overall, female and rural students consider civic engagement more important than their counterparts, particularly with community action program participation and becoming community leaders. Findings include a descriptive profile of a dual-cohort, first-year engineering class at a Canadian university that contributes Canadian data and experience to the body of knowledge on engineering student persistence.

Acknowledgments

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Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1: Introduction

Attention to education for professional disciplines like engineering often originates from external factors such as workforce issues (Congressional Commission on the Advancement of Women and Minorities in Science, 2000; Engineers Canada, 2006). Unfortunately, the assurance of a North American engineering workforce that can keep pace with technology is not certain. Engineering enrolments in Canada reached a peak of 42,322 in 1993, a low of 40,619 in 1995, then another peak of 55,248 in 2005 (Engineers Canada, 2006). Even if the numbers were stable or increased, there is no real assurance that existing engineering education programs will be able to graduate engineers with the required skills needed in North America today and in the future. The situation in Canada may be more elusive as Canadian literature on engineering student retention appears to rely on research originating in the United States (Sarkar, 1993) that does not account for Canadian differences. The preeminent organization in this area, the American Society for Engineering Education (ASEE), however, recently launched a Canada ASEE website as a portal to begin a Canadian dialogue (Canada ASEE, 2008).

Engineering education can benefit by drawing from current student retention theories and research findings, which may provide insight into areas known to influence student persistence and retention that could also be important to engineering. In particular, Braxton and Hirschy's (2005) theory of student departure in commuter colleges and universities proposes that student entry characteristic, the internal campus environment, the student's environment external to campus, and the student's academic integration each influence the student's subsequent institutional commitment and the student's decision to stay at the institution (Astin & Oseguera, 2005; Bean, 2005; Braxton & Hirschy, 2005; Braxton & Lee, 2005; Cabrera, Burkum, & La Nasa, 2005; Hagedorn, 2005; Nora, Barlow, & Crisp, 2005). The framework proposed by Braxton and Hirschy makes it possible to identify other areas of influence not yet examined. One topic - civic engagement - spans all four areas of influence posited by Braxton and Hirschy and has the potential to influence engineering education in new ways. The work of engineers is inextricably tied to the quality of human life and health of our communities. How engineering and community mutually shape each other through civic engagement is worthy of examination.

Why civic engagement?

There are many definitions for civic engagement from volunteering to voting to political action. In order to explore the relationship of engineering students and civic engagement, this study assumes the broad definition offered by The Pew Charitable Trusts and endorsed by the American Psychological Association. Specifically, civic engagement is "individual and collective actions designed to identify and address issues of public concern" (American Psychological Association, 2007, Definition of Civic Engagement section, para. 1).

For engineering education, there are several reasons to consider civic engagement. First, the work of engineers has a significant impact on people; however, its effect is masked by the business priorities of the companies and industries that fund the work. The speed of technological development, including such things as electronic voting, genetically modified foods, and personal privacy, has far outpaced the ability of many individuals to comprehend the scope of the resulting changes. The result is a public that may not understand much about modern technology and is increasingly dependent on a much smaller group that does understand (Pearson & Young, 2002). Engineers are in an ideal position to surface the needs of individuals and communities during the design process, however this breadth of understanding is difficult to achieve if the educational experience of engineering students is limited to the vision of profit-focused organizations.

Second, engineers create wealth by bringing form to ideas in cost effective ways that manipulate our habitat and create artifacts. As Darin Barney, Canada Research Chair in Technology and Citizenship at McGill University, indicates, wealth rooted in technology comes at a price to society.

> Something is at stake whenever people live in the midst of technology.... One of the things at stake for those who inhabit the world of technology is citizenship. (Barney, 2007, p. 4)

Barney also places the practice of political judgment at the heart of citizenship and proposes that technology affects citizenship as a means, an object, and a setting for political judgment. Another Canadian researcher, Caroline Baillie, Dupont Canada Chair of Engineering Education Research and Development at Queens University, examines the learning experience of engineering students with an eye towards developing student understanding of the social and ethical impact of their disciplines (Baillie, 2007). Baillie and her colleague, Jane Pritchard, challenge us to broaden our thinking regarding engineering education and a sustainable future (Pritchard & Baillie, 2006, p. 557)

Finally, leading engineering educators and technical industry executives in North America have begun to examine the engineering profession for solutions to the relatively stagnant nature of the engineering workforce. The result is growing recognition that the profession needs rejuvenation and has increased calls for diversification within its ranks as a solution (National Academy of Engineering, 2005; Papadopoulos, 2006; Watson & Froyd, 2007; Wulf, 2002). One way to achieve diversification is to expand the engineer's definition of diversity to include diversity of thought as represented in those for whom civic mindedness is a priority. By identifying and cultivating civic engagement interests starting with first-year students, valued out-of-box thinking can be nurtured and student retention can increase.

Purpose of This Study

This study has three broad objectives. First, this study examines what variables engineering students self-identify as the reasons why they persist from first to second year in engineering. Second, this study examines the areas of civic engagement that appeal to students. The first two objectives attempt to identify areas of local relevance that could inspire academic improvements. The third and final objective is to identify a practical model for engineering student retention that can accommodate results from the first two objectives and lead towards meaningful and appropriate action.

For the first objective, this study examines why engineering students at Memorial University of Newfoundland (Memorial University) persist in engineering using validated survey tools that invite year-to-year comparisons between Memorial University and other institutions of higher learning in North America. A review of the literature did not reveal any studies directly focused on engineering student retention; however, 22 other Canadian universities subscribed to the service that provides the validated survey tool. The findings from this research are used to create a descriptive profile of a class of first-year engineering students and the profile is then used to uncover potential differences between students who were admitted to the engineering program under the different criteria described below. The findings are also examined by gender and size of community of origin. Early detection of potential obstacles could allow faculty to make appropriate adjustments.

Memorial University is the largest university in Atlantic Canada and the sole university in the province of Newfoundland and Labrador (NL). The Faculty of Engineering and Applied Sciences (the Faculty) offers a mandatory co-operative education program leading to a bachelor of engineering degree in Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, and Ocean and Naval Architectural Engineering. The Faculty also offers graduate programs leading to degrees of Master of Engineering, Master of Applied Science, and Doctor of Philosophy.

Starting in the Fall Semester 2007, the Faculty reduced the length of time to complete the engineering program from six years to five years, and changed its admission policy to allow students to enter the engineering program directly from high school (Osmond, 2006). This move was designed so that Memorial University would be more competitive with other universities, especially universities in the Atlantic regions that are mostly four-year programs (J. Quaicoe, personal communication, May 1, 2008). Under the new program, course content and offerings were modified to accommodate the level of academic preparation of direct entry high school students. Previously, prospective engineering students were required to successfully complete a set of specific university courses, typically encompassing an academic year, before promotion into engineering. At Memorial University, the first incoming engineering class to consist completely of direct entry high school graduates will begin studies in the Fall Semester 2008. The engineering class entering in the Fall Semester of 2007 is a transition class consisting of a mixture of direct entry high school students following the five-year program and students following the six-year program.

The possible consequences of this change in admissions policy are presently not known. Studies indicate that components of previous university experience, such as an established grade point average, social experiences, and exposure to faculty all influence student persistence (Burtner, 2004). Institutions that require students to successfully complete university level courses before official admission into engineering may not detect the number of students who, by the end of the first year of university, choose to not pursue engineering. Such lack of awareness also makes it difficult to introduce interventions in a timely manner. Attrition rates in the range of 30% to 60% are reported by engineering programs in the United States that monitor retention from the freshman year onward (Besterfield-Sacre, Atman, & Shuman, 1997; Budny, Bjedov, & LeBold, 1997; Richardson & Dantzler, 2002).

At the University of Notre Dame, a closer look at gender differences revealed an even lower freshmen retention rate for women (Pieronek et al., 2005). Attrition of male students ranged from 34% to 40% while female attrition ranged from 50% to 59% attrition. Interestingly, after three interventions (described later), female attrition dropped to 31%, which is on the lower end of the attrition range.

With regard to the second objective, this study examines the areas of civic engagement that may appeal to first-year students in an effort to identify enhancements that could improve the academic experience of engineering students. Civic engagement overlaps many of the areas in student retention theory that are known to influence persistence and retention. For example, the theory of student departure in commuter colleges and universities, proposes that student entry characteristics, the internal campus environment, the student's environment external to campus, and the student's academic integration can each influence the student's subsequent institutional commitment and the student's decision to stay at the institution (Braxton & Hirschy, 2005). The emphasis on civic engagement is justifiable on several fronts such as the change in demographics, the need for diversification, and the negative effect of engineering study on social activism.

First, student characteristics have changed in the last decade. For example, more of today's students are racially and ethnically diverse and more come from single-parent or blended families (Broido, 2004). Students in university today grew up during the technological revolution and they use technology in many ways that older generations do not (NAS, 2006). Called "digital natives", some believe that today's students think and process information in fundamentally different ways than previous generations (Prensky, 2001). They have also been described as "becoming more politically conservative, while holding more liberal attitudes towards social issues" (Wilson, 2004, p. 65). While most definitions for generational groups are anecdotal or opinion based, empirical evidence that the generations are different does exist. Specifically, significant overall differences were found in intrinsic, altruistic, social, and prestige work values between generations, but not in extrinsic work values (Lyons, Duxbury, & Higgins, 2005). By framing the purpose of engineering in the context of community rather than industry or business, first-year students may identify issues of generational value that could inform academic improvements.

Second, research has shown that engineering study has a negative influence on civic engagement in the United States. Linda Sax (2004) examined data collected by the Cooperative Institutional Research Program at the Higher Education Research Institute, University of California at Los Angeles. Sax chose the three measures to reflect attitudinal and behavioural aspects of citizenship: student commitment to social activism (personal importance a student assigns), sense of empowerment (level of disagreement with the statement that individual can do little to bring about change), and community involvement (engagement in volunteer work or community service). Her research showed a long-term pattern where overall student commitment increases in colleges and then drops after leaving. With respect to commitment to social activism, Sax found two variables with significant influence. The first was the positive influence of a student body that was committed to social activism, and the second was the negative influence of a course of study in engineering (Sax, 2004). Given the declining trend after university, the reinforcement of civic engagement by engineering students is a necessary step towards increased civic engagement by engineering professionals.

Lastly, authorities in the engineering profession and engineering educators alike are calling for diversification as a way to enrich and broaden the contribution of engineers (Wulf, 2002). By identifying and cultivating the civic engagement interests of first-year students, valued new and creative thinking can be nurtured and may lead to greater retention of good students who would otherwise leave engineering because they were dissatisfied with instruction they did not feel they belonged in engineering, or found engineering too narrow or not creative or people-oriented enough (Marra, Bogue, Shen, & Rodgers, 2007; Seymour & Hewitt, 1997).

The third and final objective of this study is to identify a practical retention model that suits engineering education. To date, there is no formal model guiding the examination of engineering student retention by the Faculty of Engineering and Applied Science at Memorial University. The Faculty tracks net enrolment and graduation data for each year of the program; however, no overall tracking and analysis of students to the individual level is done (J. Quaicoe, personal communication, May 1, 2008). A practical model can produce reliable retention data and also facilitate and inform future discussions on whether the retention rates are acceptable to the Faculty.

In engineering, a pipeline is a commonly used model and it describes student retention as a linear progression through the education system. Engineering educators, however, argue that the pipeline model is an oversimplification that does not allow for the choices that students face on their way to becoming an engineer (Johnson &

Sheppard, 2004). In student retention theory, a plethora of models exist; however, the language of its roots in psychological, sociological, and education research make the models challenging to understand. A more comprehensive model that communicates in the language of engineers could help engineering faculty understand the nuances of engineering student retention and guide future interventions.

Hypothesis

In the absence of proven interventions, a traditional engineering program may experience typical attrition rates in the 30% to 60% range when retention is measured starting with the first-year of university (Budny et al., 1997; Pieronek et al., 2005; Richardson & Dantzler, 2002). At Memorial University, the net attrition rate over the first two years of the engineering program varies between 7% and 45% (Centre for Institutional Analysis and Planning, 2007). When the data were taken, year one in the engineering program corresponded to year two in university. Under the new engineering admissions criteria, year one of the engineering program moves to align with year one of university so it is possible that Memorial University will see higher attrition rates in the 30% to 60% range. By observing the results from each admissions group, it may be possible to anticipate whether Memorial University will see significant attrition of direct entry students. With advanced or early notice, implementation of proven interventions can minimize negative effects.

As previously mentioned, student interest in civic engagement is a topic that overlaps four areas known to influence student persistence. It is possible that first-year students entering the engineering program at Memorial University are inclined towards civic engagement. Backed with knowledge of these attitudes, the Faculty is in a position to intervene in ways that positively affect engineering student persistence. Interventions that capitalize on student interest in civic engagement could range from enhancing activities sponsored by student groups (e.g., Engineers Without Borders, and Women in Science and Engineering) to the development or refinement of engineering courses to the incorporation of more experiential or service-learning methodologies.

Research Questions

1. What reasons did this cohort of first-year students self identify for choosing engineering?
2. To what extent are students in first-year engineering at risk for attrition?
3. What do first-year students plan to do upon graduation?
4. How do the answers to questions 1-3 above compare with other studies?
5. To what extent are first-year engineering students civically engaged?
6. Do first-year students envision that an engineering education can benefit their families and communities?

Theoretical Framework

The terms persistence and retention are often used interchangeably. Both terms are used to quantify student involvement in educational institutions; however, the National Center for Education Statistics differentiates between the terms where retention is an institutional measure and persistence is a student measure (Hagedorn, 2005).

This study uses two theoretical models: 1) Braxton and Hirschy's (2005) theory of student departure in commuter colleges and universities, and 2) Watson and Froyd's (2007) transmission line model for diversifying engineering.

As previously noted, Braxton and Hirschy's (2005) theory of student departure in commuter colleges and universities, identifies four areas that influence student persistence - student entry characteristic, the internal campus environment, the student's environment external to campus, and the student's academic integration.

The transmission line model (see Figure 2.3) describes five factors that influence persistence. The first three - cognitive development, occupational choice development, and self-identity - are major factors that are also strongly coupled with each other. The other two factors are the source and the receiver, which are analogous to the student and the professional engineer. As with real transmission lines, this model emphasizes the need to match the characteristics of the first three factors while considering the characteristics of source and receiver in order to achieve a balanced system. This model draws from education, psychological, and sociological research (Watson & Froyd, 2007).

The transmission line model is similar to Braxton and Hirschy's better-known theory of student departure in commuter colleges and universities. Both models are based on the fundamental idea that the student and the institution interact with each other to affect student persistence or departure. The influence of professional engineering interests on the undergraduate engineering student is not insignificant and should not be ignored. The engineering profession recognized that it is in need of rejuvenation and looks to diversification in its ranks as a solution (National Academy of Engineering, 2005; Watson & Froyd, 2007; Wulf, 2002). The transmission line model, in addition to speaking in the language of engineers, allows inherent student characteristics to influence the engineering education process and ultimately the engineering profession.

Scholarly Significance

This study potentially contributes in three ways. First, by posing questions to students that are framed within the context of civic engagement as opposed to industry or business interests, it may be possible to identify new areas that both engage the engineering students and justify future academic enhancement by the Faculty.

Second, engineering education researchers recently published a conceptual model of education in engineering that includes the influence of the professional engineering environment. By applying survey results to this new model, a practical model for engineering student persistence may emerge.

Third, most of the research on engineering education originates in the United States. This study contributes a perspective based on Canadian data and experience.

Definitions

The following definitions, taken verbatim from various sources, apply to this study:

> *Academic integration* consists of structural and normative dimensions. Structural dimensions entail meeting the explicit standards of the college or university, whereas normative dimensions pertain to an individual's identification with the normative structure of the academic system (Seidman, 2005, p. 67).

> *Attrition* refers to students who fail to re-enrol at an institution in consecutive semesters (Berger & Lyon, 2005, p. 7).

> *Civic engagement* is defined as individual and collective actions designed to identify and address issues of public concern (American Psychological Association, 2007, Definition of Civic Engagement section, para. 1).

> *Persistence* refers to the desire and action of a student to stay within the system of higher education from beginning year through degree completion (Berger & Lyon, 2005, p. 7).

> *Retention* refers to the ability of an institution to retain a student from admission to the university through graduation (Berger & Lyon, 2005, p. 7).

> *Social integration* pertains to the extent of congruency between the individual student and the social system of a college or university Tinto (1975, p. 107) holds that social integration occurs both at the level of the college or university and at the level of subcultures of an institution (Seidman, 2005, p. 67).

Chapter 2: Literature Review

> *Research on student retention is voluminous. It is easily one of the most widely studied topics in higher education over the past thirty years. (Seidman, 2005, in Foreword).*

As Vincent Tinto (2005) indicates in the quote above, there is a great deal of research on the topic of student retention in higher education. This research reveals a complex interaction between many variables that can be organized into contextual factors such as students, campuses, educational roles, socioeconomic context, policies and interventions, knowledge bases, and the conceptualization of student persistence, attrition and retention (Berger & Lyon, 2005). The challenge is to bridge the gap between what researchers know and what practitioners do to identify and address persistence and retention issues in their particular organization (Seidman, 2005).

Engineering introduces a couple of unique dimensions worth investigating. First, through its role in the advancement of technology, engineering has an enormous impact on our quality of life and that same technology adds a level of complexity that can easily tip the delicate balance between individual needs, our social structure, and our habitat. A closer look at the relationship between engineering education and civic need is in order. Second, engineering is a professional discipline and consequently, the profession and industry employers assert great influence on engineering education. This external influence warrants a closer look at the demands placed on engineering education from the professional sector.

Student Retention Theory

Persistence, attrition, and retention are different sides on the same triangle and are often used interchangeably. Persistence and attrition are essentially attributes of individual students, where persistence refers to the desire and action of a student to stay within the system of higher education from the beginning year through degree completion and attrition refers to students who fail to re-enrol at an institution in consecutive semesters (Berger & Lyon, 2005). Retention refers to the ability of an institution to retain a student from admission to the university through graduation. It is campus-specific and is the interplay between the institution-provided environment and how well that environment addresses the needs of its students (Berger & Lyon, 2005). Said differently, attrition studies ask the question: Why do students leave? Persistence studies ask: Why do student stay? Retention studies ask: What role does the institution play?

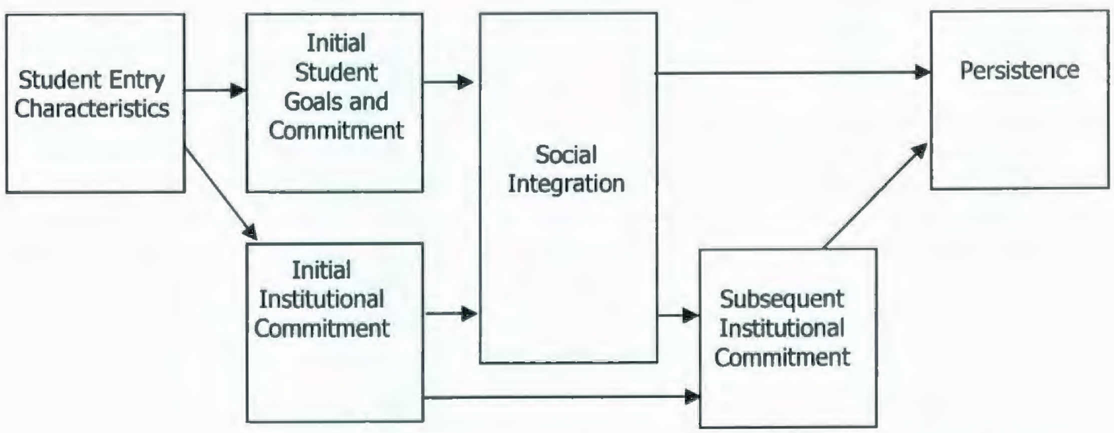
A number of theories address aspects of retention and persistence that could apply to education for a professional discipline like engineering. They include Bean's Model of Work Turnover to Student Attrition, Astin's Theory of Involvement, and Bean and Eaton's psychological model.

Bean's Model of Work Turnover to Student Attrition identified 10 external variables that influence student satisfaction that, in turn, influence a student's intent to leave (Bean, 1980, 1983). A student's intent to leave directly affects student persistence. Those ten variables are routinization, participation, instrumental communications, integration, distributive justice, grades, practical value, development, courses, and membership in campus organizations (Braxton & Hirschy, 2005, pp. 62-63).

Astin's Theory of Involvement focused on the amount of energy, both physical and psychological, that a student puts into the academic experience. In general, the more a student is involved, the more likely they are to persist. This theory included five areas of significance - a) involvement is generalized or specific, b) involvement continues on a continuum that is distinct for each student, c) involvement has quantitative and qualitative components, d) the amount of student learning and development in an education program is directly influenced by the quality and quantity of the student's involvement, and e) the effectiveness of an educational policy or practice is directly related to its capacity to increase student involvement (as cited by Braxton & Hirschy, 2005, p. 64).

Bean and Eaton offered a psychological model based on the belief that a student's entry characteristics shaped the way he or she perceived the university environment. Specifically, student involvement in the university environment resulted in psychological processes that affected the student's motivation and led to academic and social integration, institutional fit and loyalty, intent to persist, and persistence. Those psychological processes include positive self-efficacy, declining stress, increasing efficacy, and internal locus of control (as cited by Braxton & Hirschy, 2005, p. 63).

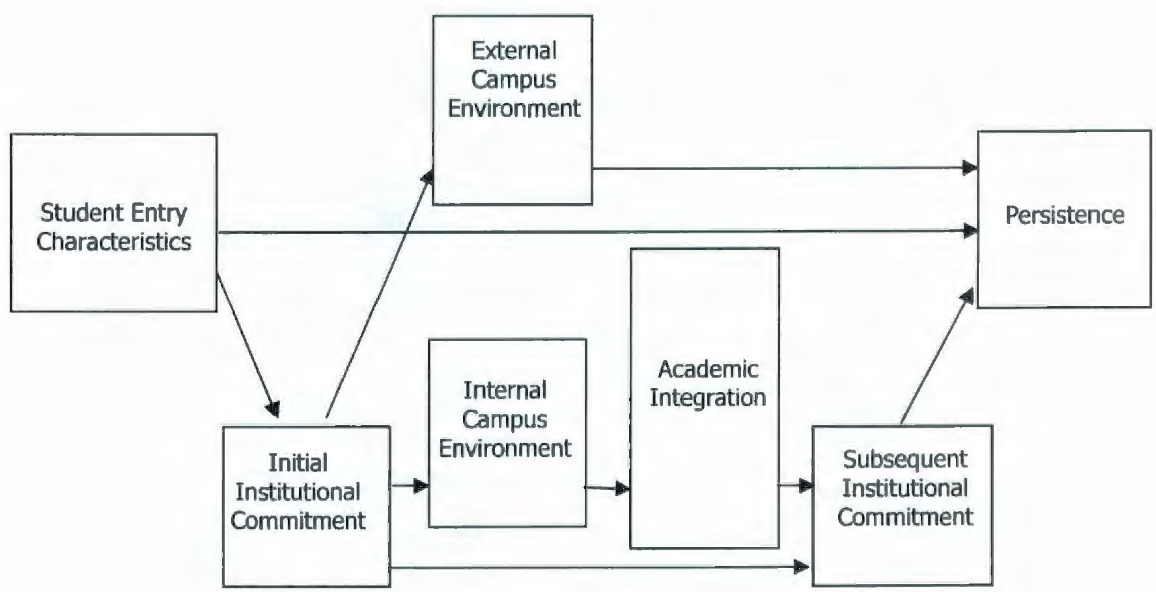
The pivotal framework of understanding, on which many education researchers were able to base subsequent theories, was Vincent Tinto's Interactionalist Model. Tinto offered that a student's decision to depart was influenced by the student's initial commitment to the institution and to the goal of graduating. Tinto's theory was revised (see Figure 2.1) further to expand a student's initial commitment to include individual characteristics such as family background such as socioeconomic level and parental education, individual attributes such as race and gender, and pre-college experience and achievement in school. The theory proposed that institutional factors such as the commitment to the welfare of students, institutional integrity, and communal potential, influenced the social integration of the student. The level of social integration then combined with subsequent institutional commitment to influence student persistence (Braxton & Hirschy, 2005, p. 67).



Source: Adapted from Braxton & Hirschy (2005, p. 71)

Figure 2.1 Tinto's Interactionalist Model revised

Tinto's theory works well for traditional students who attend university full-time and live on campus, however, it was limited when considering non-traditional commuter students. Braxton, Hinchey, and McClendon refined Tinto's interactionalist model to accommodate differences between residential and commuter institutions. Their theory of student departure in commuter colleges and universities (see Figure 2.2) proposes that student entry characteristic, the internal campus environment, the student's environment external to campus, and the student's academic integration each influence the student's subsequent institutional commitment and the student's decision to stay at the institution (Braxton & Hirschy, 2005, pp. 71, 75).



Source: Adapted from Braxton & Hirschy (2005, p. 75)

Figure 2.2 Theory of Student Departure in Commuter Colleges and Universities

Within the realm of engineering, the dominant model for viewing student retention and diversity is the pipeline (see Figure 2.3). More of a metaphor than a complete model, the pipeline describes retention as a linear flow of students through the engineering education system. The model implies a single path towards the engineering workforce where students can leak from the path at joints in the conduit. Those joints correspond to transition points such as from high school to university or from one university program year to the next. Under this pipeline model, interventions fall into three major categories: stopping leaks through community building, stopping leaks through cognitive ability development, and increasing intake through occupational choice development (Johnson & Sheppard, 2004; Watson & Froyd, 2007). While the model is useful in identifying major problem areas, researchers argue that the pipeline model is an oversimplification that does not allow for the choices that students face on their way to becoming an engineer (Johnson & Sheppard, 2004).

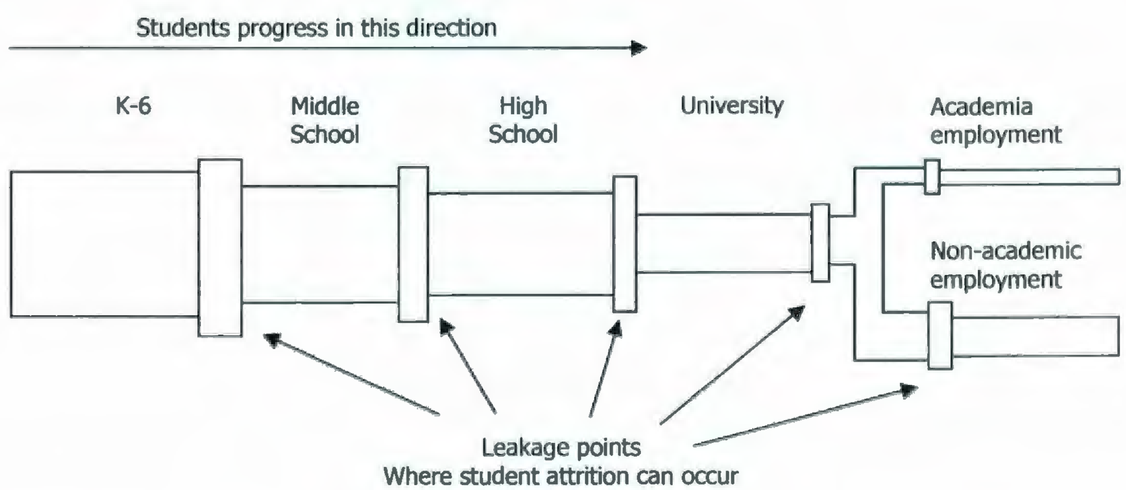
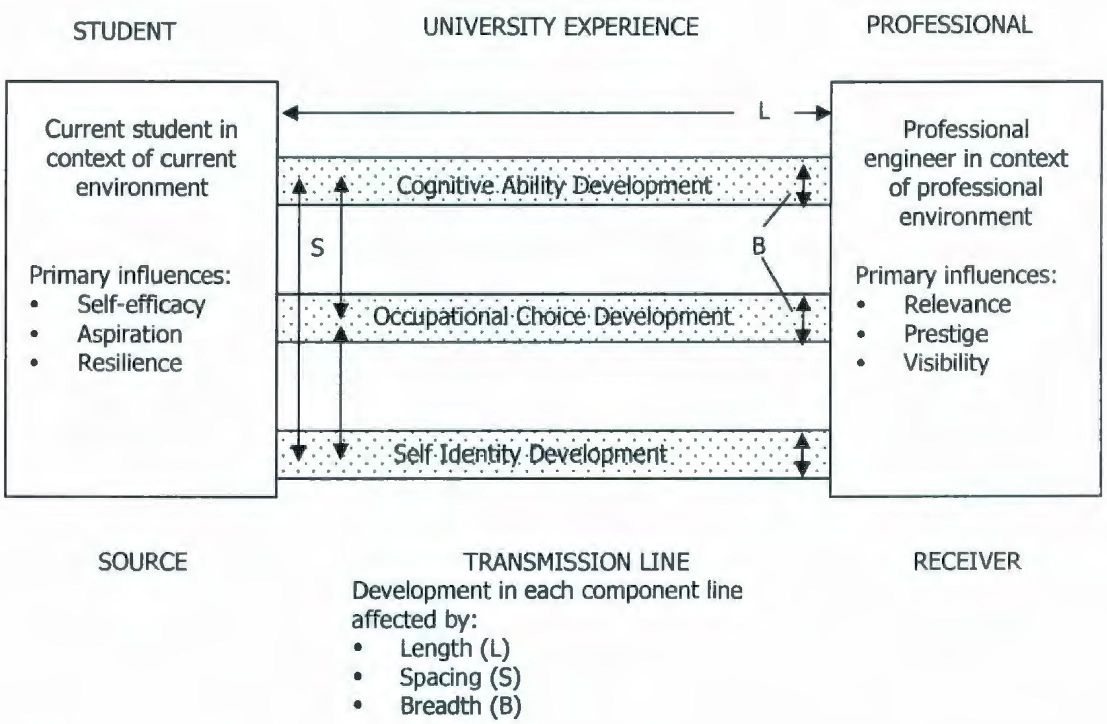


Figure 2.3 Pipeline model

A new analogical model for engineering, emphasizing personal and interpersonal energy flows within educational systems, was offered to guide future interventions in engineering education (Watson & Froyd, 2007). That model draws from education, psychological, and sociological research, accommodates the influence of the engineering profession, and speaks in the language of the engineer. Illustrated in Figure 2.4, the transmission line model proposes that five factors influence retention. The first three, cognitive development, occupational choice development, and self-identity are major factors that are also strongly coupled with each other. These three factors are analogous to the parallel cables that one sees on transmission lines that cross the landscape. The other two factors are the source (energy generator) and the receiver (energy consumer), which are the student and the professional engineer, each in their respective environments.

As with real transmission lines, this model highlights the interdependence between all five factors and emphasizes the need to match the characteristics of the factors in order to achieve a balanced system. A balanced transmission line means minimized energy loss, which is synonymous with a system that yields higher student persistence. Similar to the theory of student departure in commuter colleges and universities, the transmission line model calls attention to the influence of factors that are external to the university environment. One set of factors, student entry characteristics, is synonymous in both models. Cognitive ability development and self-identity development are similar to academic and social integration. The last set, characteristics related to occupational choice development, assert their influence in largely unexamined ways throughout a university student's development. Note that Figure 2.4 depicts an ideal scenario in which the components are balanced, whereas the current state of engineering education is generally not balanced and is more heavily weighted towards cognitive ability development.



Source: Adapted from Watson & Froyd (2007, p. 26)

Figure 2.4 Transmission Line Model

Related Research in Newfoundland and Labrador

A review of the literature did not reveal any studies directly focused on engineering student retention at Memorial University. Three studies on student retention in the broader area of post-secondary education in the province of Newfoundland and Labrador are worth noting.

The first study, entitled *Student attrition and retention in the post-secondary education and training system in Newfoundland and Labrador*, was an exploratory study of 1433 people from the Youth Transition into the Labour Market research project. This study examined youth who had entered a non-university post-secondary program since leaving high school in 1989 (Sharpe & Spain, 1993). The population in that study consisted of students who entered a non-university program, however, some of those students could now qualify for university admission and acceptance into the engineering program under the new criteria set by the Faculty. That study identified many issues and defined logistical parameters that are of value to any retention study of Newfoundland and Labrador students. Sixteen recommendations were made and of those, two recommendations provide meaningful context for this study. One recommendation (p. 182) called for the development of a conceptual framework of attrition from post-secondary education to guide further development and study in this area. The second recommendation (p.183) called for the actual consequences of attrition from post-secondary education to be assessed from the perspectives of the student, the institution, and the provincial and federal governments. The development of a conceptual framework and the assessment of actual consequences of post-secondary attrition are incomplete without considering all types of post-secondary education, including university.

The second is an attrition study at Memorial University that was conducted in 1998 by the Centre for Institutional Analysis and Planning (CIAP) (Bryant, 1999). That study found that the reasons respondents gave for leaving were so varied that no clear predictor emerged. The study also found that one of the major reasons students gave for not returning to Memorial University was career indecisiveness meaning they were unsure of their educational goals.

The third study examined various aspects of attrition of first-semester students enrolled in Engineering Technology programs at the College of the North Atlantic (CNA) (Kirby & Sharpe, 2001). Results from this study showed that 24.9% of first-semester Engineering Technology students withdrew prior to the winter 2000 semester, and that student academic difficulties played a significant role in student decisions to withdraw or persist at the College. Because of similar admission requirements and student preparedness, this type of attrition rate could be reflected in engineering. Prior to fall 2008, students from CNA could enter the engineering program at Memorial University through a bridging agreement between the institutions. Starting in fall 2008, students can apply directly to Memorial University under the direct entry criteria

Engineering Education Literature

As in the general case, there exists a vast amount of Unites States based literature related to engineering student retention. The preeminent organization in this area, the American Society for Engineering Education (ASEE), however, recently launched a Canada ASEE website as a portal to begin a Canadian dialogue (Canada ASEE, 2008).

Published papers cover a wide range of topics such as self-efficacy (Hutchinson, Follman, Sumpter, & Bodner, 2006; Marra, Bogue, Rodgers, & Shen, 2007), learning styles (Felder, Forrest, Baker-Ward, Dietz, & Mohr, 1993), attitude (Besterfield-Sacre et al., 1997), high school and first-year grade point average (Burtner, 2004), SAT scores (Pieronek, Uhran, McWilliams, & Silliman, 2004), student integration (French, Immekus, & Oakes, 2003), and gender and ethnicity (Busch-Vishniac & Jarosz, 2004; Cannon, Wallace, & Haines, 2006; Felder, Felder, Mauney, Hamrin, & Dietz, 1995). Much of the reviewed literature summarized episodic activity or were specific to an institution making it challenging to apply findings in a more generalized way.

Many have speculated on why more women are not in engineering. Over the last 30 years in North America, the number of women in undergraduate engineering programs has held steady at approximately 18% and at approximately 11% in the engineering workforce. As one can imagine, a great deal of information on gender and engineering is published each year; so much so that the Society of Women Engineers (SWE) in the United States has published an annual review of the literature in *SWE Magazine* since 2002. The latest SWE literature review turned its attention toward larger structural issues that affect women's underrepresentation (Frehill, Fabio, Hill, Traeger, & Buono, 2008).

On the topic of recruitment and retention to engineering, the authors found in the literature a clear recognition of the need to engage students across socioeconomic levels in all ethnic groups. They also saw a stronger emphasis at the K-12 level, especially high school and middle school, which addresses the point that more engineers are needed for the economy rather than engineering is what you do if you are good in math and science. The result is a shift in focus as described here.

> Recruitment has been recast away from research literature that focuses on specific psychometric traits of engineers and how to identify people with these traits. Instead, the more socially grounded approach of increasing the information about engineering and ensuring that the content of these messages is sensitive to younger age cohorts, women, and underrepresented minorities is gaining attention. (Frehill et al., 2008, p. 52)

Despite tremendous effort over the years, educational improvements have been incremental and engineering enrolments remain relatively flat. This general lack of growth, combined with rapid changes in the worldwide engineering enterprise, was strong motivation for engineering educators to rethink the way that future engineers are educated (American Society for Engineering Education, 2006a, 2006b). A new approach was needed and, in the United States, a systemic response is seen in two fundamental ways. First, engineering education research became a recognized subfield of engineering in acknowledgement that rigorous research should drive engineering education as it drives traditional engineering disciplines. Second, after much discourse, the Engineering Education Research Colloquies (EERC), representing a collaborative effort of more than 70 engineering, science, and mathematics educators and researchers, leading scientists, and practitioners introduced a research agenda (see Table 2.1) that reflects a transformational paradigm shift in engineering education research from one of reform to one of rigor.

In support, the Journal of Engineering Education (JEE) also shifted its review criteria to emphasize qualitative research and research done in interdisciplinary collaboration with social science and education researchers. The result is an increasing body of knowledge on engineering education that reflects the existing body of knowledge in the social sciences (Borrego, 2007; Foor, Walden, & Trytten, 2007; Li, McCoach, Swaminathan, & Tsang, 2008). Borrego (2007) investigated experiences of trained engineers as they became engineering education researchers and found five areas of conceptual difficulty in learning to design rigorous engineering education studies: framing the research questions with broad appeal, grounding the research in theoretical frameworks, appreciating qualitative or mixed-methods approaches, fully considering implementation and measurement of constructs, and pursuing interdisciplinary collaborations. The first four areas of difficulties were seen to stem from prior grounding of the faculty in high consensus nature of engineering research rather than in the low consensus nature of education research. The April 2008 issue of the JEE includes an article, *Characteristics of Successful Cross-disciplinary Engineering Education Collaborations*, that discusses findings from interviews with 24 authors in joint engineering and non-engineering teams whose articles were published in the JEE. Theoretical frameworks from education and psychology were used to ground the results, and "the data suggested that the way an individual understands and appreciates the nature of knowledge affects the way he or she collaborates with colleagues in different academic disciplines, especially when the disciplines are fundamentally different" (Borrego & Newswander, 2008, p. 123). In the end the authors suggest that, given the number of participants, the results from interdisciplinary collaborations are of higher quality than multidisciplinary collaborations. These findings are important to this research because they highlight the limits of a purely traditional engineering perspective and the applicability of broader social science frameworks and methodologies in improving the value of engineering education.

Table 2.1 US Engineering Education Research Agenda

Area 1	Engineering Epistemologies: Research on what constitutes engineering thinking and knowledge within social contexts now and into the future.
Area 2	Engineering Learning Mechanisms: Research on engineering learners' developing knowledge and competencies in context.
Area 3	Engineering Learning Systems: Research on the instructional culture, institutional infrastructure, and epistemology of engineering educators.
Area 4	Engineering Diversity and Inclusiveness: Research on how diverse human talents contribute solutions to the social and global challenges and relevance of our profession.
Area 5	Engineering Assessment: Research on, and the development of, assessment methods, instruments, and metrics to inform engineering education practice and learning.

In contrast, the Canadian Academy of Engineering (1999) issued a report that included five recommendations specific to engineering education. The recommendations, listed below, broaden engineering education; however, the academy acknowledges that there is little flexibility in Canadian engineering education to address the issues.

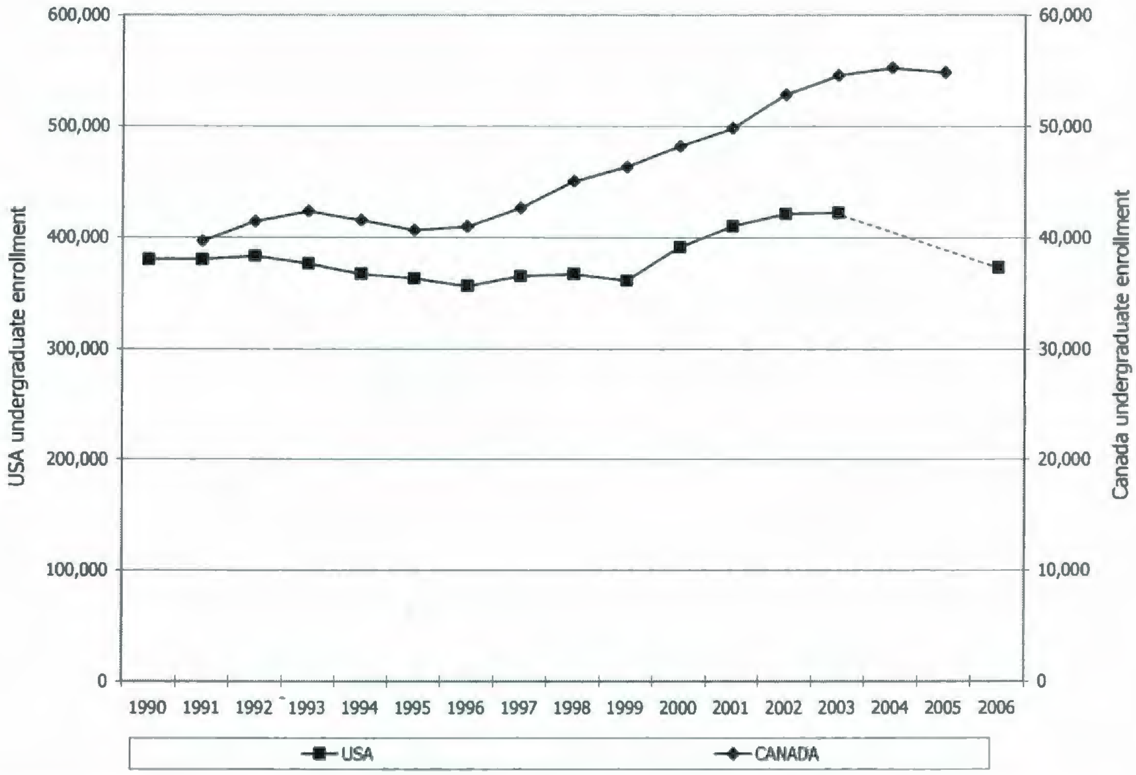
> 1. Engineering faculties should ensure that breadth of learning, beyond the technical aspects of the specialist engineering discipline, is a major thrust in engineering education.
>
> 2. Engineering faculties should emphasize the development of the learning skills of their students.
>
> 3. Leaders of engineering faculties should ensure that their faculty members have the vision, values and behaviours needed for their evolving role in preparing undergraduate and graduate students to function effectively in our rapidly changing world.
>
> 4. Research conducted in engineering faculties should be characterized by excellence, by relevance to industrial and social issues and by concern for the life preparation of the graduate students involved.
>
> 5. Engineering faculties should participate in providing liberal education opportunities for all university students, and in improving the technological literacy of the general public.

Engineering Enrolment and Degrees Granted

In order to set a proper context for why engineering student retention is important, it is useful to present statistics. These statistics present a fluctuating scenario where women and minorities leave engineering study in the greatest numbers. Please note that while the Canadian and US statistics reported here appear similar, caution should be used in making direct comparisons. For example, the fields counted as engineering, such as computer science, software engineering, or computer engineering, differ between the National Science Foundation, the American Society for Engineering Education, and Engineers Canada.

Undergraduate engineering enrolment in Canada peaked at 42,322 students in 1993, declined to a low of 40,619 in 1995, and then reached another peak of 55,248 in 2005. A closer look at the Canadian enrolment data after 2000 shows a 10.1% increase for 2001-2005 followed by a slight 0.7% decrease in 2005. The number of degrees granted in Canada follow the same trend as enrolment -- a 19.3% increase from 2001 to 2005 and a 1.1% increase in 2005 that includes increases of 20.4% to women and 6.2% to foreign students (Engineers Canada, 2006).

The United States experienced a similar up-down pattern with engineering enrolments reaching a peak of 441,000 students in 1983, and then declined steadily throughout the 1980s and 1990s to a low of 361,000 in 1999. Engineering enrolment peaked again at 422,000 students in 2003, and then dropped to 373,074 in 2006. A closer look at the US enrolment data after 2000 shows the undergraduates enrolled in fall 2006 was 1.9% greater than in 2005, but still lower than either 2003 or 2004 (Gibbons, 2006; National Science Foundation, 2006a). For the 2005-2006 academic year, 74,186 bachelor's degrees in engineering were awarded in the US. The number of bachelor degrees increased by more than 20% since 1999; however, the past two years (2004-2006) have seen annual growth less than one percent.



Source: United States - Engineering Workforce Commission, Engineering & Technology Enrolments, Fall 2003, American Association of Engineering Societies (2004). Science and Engineering Indicators 2006. Canada - Engineers Canada (2006)

Figure 2.5 Undergraduate engineering enrolments in Canada and the United States

A survey of published papers shows an *engineering* student attrition rate in the United States between 30% and 60% within the first two years of university. Unfortunately, a literature search failed to uncover similar published papers, doctoral dissertations, or master theses by Canadian authors. After an extensive study of the published literature on general student attrition and retention in Canada and the United States, Gerlinde Sarkar (1993) concluded that Canadian studies did not differ substantially from the United States where the bulk of the research originates.

An examination of the academic performance at Memorial University shows failure rates of 8.6% for all first-year students (new matriculates), 15.3% pre-engineering students, and 2.1% for engineering students overall (Centre for Institutional Analysis and Planning, 2005a). This may be misleading because the failure rates reported by CIAP are based on a minimum grade point average of 50% overall whereas the Faculty requires an grade point average of 65% for selected mathematics, physics, chemistry, and engineering classes before promotion (Memorial University of Newfoundland, 2008).

The university also publishes enrolment data annually in its "Fact Books" (Centre for Institutional Analysis and Planning, 2008). An examination of the enrolment data from 1999 to 2006 that was reported by CIAP and is summarized in Table 2.2, shows a fluctuating retention rate from Y1 to Y2 between -10% and +18%. Between Y1 and Y3, the enrolment data show a retention rate between -7% and -45% (Centre for Institutional Analysis and Planning, 2008). Note that there are two limitations to the data in the Table 2.2. First, until the Fall Semester 2008, the engineering program was a six-year program; however, the Fact Book reports data over a five-year spectrum. Second, this data is based on the number of academic credits completed. For example, Y1 data corresponds to students with no more than 18 credit hours and Y2 data corresponds to students with 18 to 47 credits hours. Except for the direct entry cohort admitted to engineering in the Fall Semester 2007, engineering students had to successfully complete approximately 30 credit hours before admission to the engineering program. A closer examination of how the data reported in the Fact Book was derived is warranted.

Table 2.2 Annual engineering enrolment reported in Table 10 of the Memorial University Fact Book and calculated year-to-year change

	Program year					Calculated Year-to-year change		
Enrolment semester	Y1	Y2	Y3	Y4	Y5	Y1-Y2	Y2-Y3	Y1-Y3
Fall 1999	301	270	166	146	275	-10%	-39%	-45%
Fall 2000	306	276	208	152	291	-10%	-25%	-32%
Fall 2001	218	257	202	167	308	18%	-21%	-7%
Fall 2002	215	243	174	149	312	13%	-28%	-19%
Fall 2003	267	301	222	185	320	13%	-26%	-17%
Fall 2004	236	256	204	189	-	8%	-20%	-14%
Fall 2005	259	282	221	-	-	9%	-22%	-15%
Fall 2006	283	300	-	-	-	-	-	-

Y1=Year 1, Y2=Year 2, Y3=Year 3, Y4=Year 4, Y5 =Year 5

Berger & Lyon (2005) report that according to the American College Testing, 25.9% of freshmen (first-year students) at 4-year institutions do not return to school. At highly selective institutions, the dropout rate is 8%. Less selective institutions experience drop out rates as high as 35%, while open enrolment institutions encounter nearly 50% dropout.

The Center for Institutional Data Exchange and Analysis reported that approximately half of the 1993-94 freshmen majoring in science, technology, engineering, and math left their majors before reaching their junior year. Thirty-one percent left in the first year, 16% in the second year, and 12% in the third and subsequent years (Tan, 2002).

In the United States, most students who leave engineering do so by the end of the second year. According to the National Academy of Engineering, "only 40 to 60 percent of engineering students persist to an engineering degree, and women and minorities are at the low end of the range" (National Academy of Engineering, 2005, p. 40). In historical data from Purdue University, 1975-1990, an average of 78% of the first-year engineering students remained through graduation, and of those who graduated, 57% received degrees in engineering. From 1976 to 1993, approximately 64% of first-year students completed first-year classes and transferred into an engineering professional school, which is a 36% attrition rate (Budny et al., 1997). The University of Massachusetts Dartmouth reported 62% retention 1991-1997 (Richardson & Dantzler, 2002). A recent longitudinal study of students who left engineering showed that the average time spent in engineering before leaving was 13 months (Marra, Bogue, Shen et al., 2007).

At the University of Notre Dame a closer look at gender differences revealed a lower freshmen retention rate for women than for men. Retention of male students ranged from 60-66% (34-40% attrition) while female retention ranged from 41%-50% (50%-59% attrition). Interestingly, after three interventions were implemented, female retention rose to 69% for a 31% attrition rate (Pieronek et al., 2005). One intervention involved moving a computer-programming segment of the course into the second semester. This allowed students to adjust to the rigors of a college engineering program without the frustration of mastering a completely new subject. They also made programming a separate course module. This allowed students to see computers as a tool in solving engineering problems instead of treating programming as aspect of the student engineering project for the semester. The second intervention consolidated female engineering students into fewer than half of the women's residence. This relieved feelings of isolation. Lastly, they included two lectures at the beginning of the course to describe the relevance of the engineering profession to society, which helped to address new understanding of female student motivations for enrolling in the course.

The Engineering Workforce

> *The mission of engineering changes when its dominant problems no longer involve the conquest of nature but the creation and management of a self-made habitat. To adapt to this new habitat, engineers have to retool, starting with their understanding of engineering education. Today, technological change is something that happens to engineers as much as to anyone else. (Williams, 2003, para. 1)*

Times have changed as the quote above by Rosaline Williams (2003) in *Education for the Profession Formerly Known as Engineering* illustrates. This part of the review on engineering literature concludes with a look at the engineering workforce, the ultimate goal for many engineering students. Today, the diversification of the engineering workforce is generally accepted as a positive benefit in both Canada and the United States. Arguments in favour of increased breadth and diversity in thought and perspective are cited as economically valuable and good for business as well as necessary to maintain the viability of the profession. For example, the Canadian Coalition of Women in Science, Engineering, Trades and Technology reports, "Women's increased participation and advancement in the science, engineering, trades, and technology (SETT) workforce bring significant economic benefit to organizations and to Canada" in our global knowledge-based economy (Emerson, 2006, p. 1).

Interventions introduced during the 1980s and 1990s, when engineering enrolment in the United States declined, did little to reverse a trend that is today being offset only through the employment of foreign engineers. Recently, engineering educators, professional engineering authorities, and industry leaders have begun to include the engineering profession itself in the areas examined for root causes and potential solutions to the relatively stagnant nature of the engineering workforce. The result is growing recognition that the profession is in need of rejuvenation and increased calls for diversification within its ranks as a way to imbue the innovation and creativity considered essential for a nation to remain competitive in today's global economy (Canadian Academy of Engineering, 1999; National Academy of Engineering, 2005; Papadopoulos, 2006; Watson & Froyd, 2007; Wulf, 2002).

In the United States, the Engineer of 2020 Project was launched in 2001 by the National Academy of Engineering (NAE) to "envision the future and to use that knowledge to attempt to predict the roles that engineers will play in the future" (National Academy of Engineering, 2004, p. xi). The NAE followed by publishing its report, *The Engineer of 2020: Visions of Engineering in the New Century*, which includes14 recommendations related to engineering education. This landmark report serves as an important guide to reinvent engineering education so that engineering is "able to adapt to new trends and provide education to the next generation of student so as to arm them with tools needed for the world that will be, not as it is today" (National Academy of Engineering, 2004, p. 5).

Greg Papodapoulus (2006), chief technology officer at Sun Microsystems, a major computer company in the United States, sees the lack of diversity in engineering as a deterrent and limiting factor.

> (The lack of diversity) troubles me because our field is in serious need of greater diversity simply to remain competitive, let alone to further advance society... Why? Because engineering is an art. A constructive art, yes, but still very much an expression of the life experiences that one brings to the drawing board. The quality of what engineers create, from the core approach to the problem being solved all the way to an artefact's usability, are all informed by judgment, sensibilities, passions and taste. (para. 3 & 4)

About the need for diversification in engineering, William Wulf (2002), former president of the National Academy of Engineering said the following.

> Without diversity, life experiences we bring to an engineering problem are limited. As a consequence, we may not find the best engineering solution. We may not find the elegant engineering solution. As a consequence of a lack of diversity, we pay an opportunity cost, a cost in designs not thought of, in solutions no produced. Opportunity costs are very hard to measure, but they are very real. (pp. 8-9)

This movement towards examining the profession makes it possible to expand the engineer's definition of diversity to include diversity of thought as represented in those for whom civic mindedness is a priority. Over the last couple of decades, the engineering profession attracted people from underrepresented groups; however, the numbers remain a small percentage. Engineering in North America is still largely a homogenous group and the impact of people from underrepresented groups remains unmeasured. By identifying and cultivating the civic engagement interests starting with first-year students, it becomes possible to nurture systematically the ability to think creatively. This can lead to greater retention of students who would otherwise leave engineering because they were dissatisfied with instruction, they did not feel they belonged in engineering, or found engineering too narrow or not creative or people-oriented enough (Marra, Bogue, Shen et al., 2007; Seymour & Hewitt, 1997).

To address the improvement of engineering education, two approaches are gaining visibility in the United States. The NAE advocates the adoption of a five-year education process used by other professions like the medical profession and proposes that the additional time is required to cover all the additional material that reflects our increased dependence on technology. In effect, the bachelor's degree would become a pre-engineering degree and a master's degree would be required for licensing (National Academy of Engineering, 2005). The topic is under discussion among the professional engineering societies and engineering educators, and has attracted critics. Irene Busch-Vishniac, former Dean of Engineering at Johns-Hopkins and now Provost and Vice-President Academic at McMaster University, acknowledges that past focused efforts have increased diversity; however, she also cautions that improvements have stopped and notes mounting evidence that diversity of engineering student bodies is backsliding. Further, she says the following.

> Most diversity initiatives aimed at the undergraduate engineering student population have started with a curriculum that is known to be unattractive to women and minorities and have tried using "add-ons" or minor changes to rectify the situation. We believe that this approach fails because the curriculum is fundamentally flawed and because the rigors of the typically engineering program are not conducive to permitting add-ons without increasing the pressure on students. (Busch-Vishniac & Jarosz, 2004, pp. 255-256)

A second approach, advocated by other engineering educators, would keep the traditional four-year program and make experiential education central to all engineering education and use it to build models for continuous, career-long learning (Jamieson, 2007). The rationale for this approach is that much of the material now taught to engineering students no longer reflects the realities of today's technology-based world and that a fundamentally different way of teaching engineering is needed. Unlike experiential learning, which is learning through doing, experiential education is what educators do to purposefully engage learners in direct experience and personal reflection that results in increased knowledge (Association for Experiential Education, 2008). Experiential education at the core of engineering programs can be a very effective way to instil the value of civic engagement in the minds of engineering students and faculty alike because they can both incorporate active participation.

Civic Engagement

This review of the literature concludes by elevating the context to include the area of civic engagement. A significant challenge that today's university students inherit is a world in which technology permeates every aspect. The speed of technological development including such things as electronic voting, genetically modified foods, and personal privacy, has far outpaced the ability of many individuals to comprehend the scope of the resulting changes. The result is a lot of technology that the public does not understand, and a public that is increasingly dependent on a much smaller group that does. The increasing separation between the creators of the technology and the users of that technology is stripping North American citizens of their sense of responsibility and ability to participate consciously and effectively in our technology-based society (Barney, 2007; Pearson & Young, 2002). One way to bridge this gap - so that the majority of the population is able and willing to participate in technology decisions that affect a nation - is to emphasize civic engagement as an essential aspect of experiential engineering education.

The literature regarding civic engagement employs many definitions depending on factors such as scope of program and desired outcomes. General definitions for civic engagement range from "adding one's voice to community conversations" to "an institutional commitment to public purposes and responsibilities intended to strengthen a democratic way of life" (Campus Compact, n.d.). A more specific two-part definition was developed by students attending three Raise Your Voice conferences organized by Campus Compact and sponsored by The Pew Charitable Trusts (Raill & Hollander, 2006, p. 5).

> Engagement is more than just volunteering—although volunteering can be engagement. Engagement is more than just voting—although voting can be engagement. Engagement is a combination of voice, action, and reflection. Engagement exists when individuals recognize that they have responsibilities not only to themselves and their families, but also to their communities—local, national, and global—and that the health and well-being of those communities are essential to their own health and well-being. They act in order to fulfill those responsibilities and try to affect those communities for the better. Those actions, in turn, give them an even deeper understanding of their interdependence with communities.

This study is exploratory in nature and intends to examine how civic engagement can play a stronger part in engineering student retention. This necessitates a broad definition of civic engagement to allow the scope to extend into the engineering profession and the outcome to encompass diversification of thought within the profession. As a result, the definition for civic engagement assumed in this study is the broad definition offered by The Pew Charitable Trusts and endorsed by the American Psychological Association.

> (Civic engagement is) individual and collective action designed to identify and address issues of public concern (American Psychological Association, 2007, Definition of Civic Engagement section, para. 1).

Civic engagement is a valuable contextual alternative through which to expand engineers' perspectives and develop future leaders of society. Engineers create wealth by bringing form to ideas in cost effective ways that manipulate our habitat and create artifacts. Because the impact of engineers on the environment and society is so significant, it is essential that engineers are aware of and take into consideration the full breadth of issues of concern to the public. Such a breadth of understanding is difficult to achieve if the educational experience of engineering students, and the field of vision that working engineers eventually develop, is limited to addressing issues of business and industry concern.

People in North America have heard the message from the business, government, and engineering sectors that a strong engineering workforce is essential for a nation's security, global competitiveness, and economic growth (Business Roundtable, 2005; Congressional Commission on the Advancement of Women and Minorities in Science, 2000; Pearson & Young, 2002). Equally recognized is the role that engineers play in the creation and maintenance of our civilization's infrastructure. Increasingly researchers call attention to the need for engineering and engineering education to broaden its singular focus on problem solving towards also considering the impact and affect of how technology and society mutually shape each other.

In Canada, the Canada Research Chairs program funds research professorships to advance the frontiers of knowledge in their fields. Darin Barney, Canada Research Chair in Technology and Citizenship at McGill University, investigates the relationship between technology and citizenship in order to help Canadians balance the benefits of technological innovation with the requirements of democratic citizenship. One of Barney's research projects, Education and Citizenship in the Digital Age, investigates the recent restructuring of education in Canada in response to new technologies, the imperatives of innovation, and our knowledge-based economy. Barney asks whether the transformation of our education system has adequately provided for the cultivation of citizenship in the context of technological dynamism (Canada Research Chair, 2005, Citizenship in a technological society section). In a speech delivered at the University of Toronto, Barney proposed, "... a conception of citizenship that places the practice of political judgment at its core" and then talked about "three ways in which technology bears on citizenship in this way: as a means, as an object, and as a setting for political judgment" (Barney, 2007, p. 4).

Another Canadian researcher, Caroline Baillie, Dupont Canada Chair of Engineering Education Research and Development at Queens University, examines the learning experience of engineering students with an eye towards developing student understanding of the social and ethical impact of their disciplines (Baillie, 2007). Baillie and her colleague, Jane Pritchard, raise the bar and challenge us to broaden our thinking regarding engineering education and a sustainable future.

> What does an engineering education experience look like, for students and faculty alike, that globally reflects the goals of social equity, justice, and sustainability without merely adding on courses or options but as implicit underpinning criteria in their overall engineering programmes and individual courses?
> (Pritchard & Baillie, 2006, p. 557)

In the United States, the National Academy of Engineering (NAE) published *Technically Speaking: Why Americans Need to Know More About Technology*. The report and companion website were the final products of a two-year study by the Committee on Technological Literacy (Pearson & Young, 2002). The committee consisted of experts in various areas and operated under the umbrella of the NAE and the National Research Council's Center for Education. The committee was tasked to develop a common understanding of what technological literacy is, how important it is to the nation, and how it can be achieved. In short, the report identified the scope of issues related to technological literacy and outlined compelling arguments on how increased technological literacy helps to improve decision making, increases citizen participation, supports a modern workforce, enhances social well-being, and narrows the digital divide (Montano, 2007). The report also made the case that a good understanding of our technology-based society is a requirement for effective participation and that participation is the foundation of a democratic nation. Unfortunately, in an effort to protect the public from the public's fear of technology, many engineers hide technical details through black-box designs that in turn reinforces public technophobia. A scared public is not likely to participate in technology-based decisions on issues that affect them and that lack of participation undermines a democratic society.

> Democratic principles imply that decisions affecting many people or the entire society should be made with as much public involvement as possible. As people gain confidence in their ability to ask questions and think critically about technological developments, they are likely to participate more in making decisions. Increased citizen participation would add legitimacy to the decisions about technology... [and] would also give policy makers and technical experts a better understanding of citizens' hopes and fears about technology. (Pearson & Young, 2002, p. 4)

Lastly, an examination of data collected by the Cooperative Institutional Research Program (CIRP) at the Higher Education Research Institute (HERI), University of California at Los Angeles measured student commitment to social activism, sense of empowerment, and community involvement, all characteristics of civic engagement (Sax, 2004). CIRP is the largest and oldest empirical study of American higher education and involves data from over eleven million college students at more than 700 institutions. The researcher, Linda Sax, specifically chose the three measures to reflect attitudinal and behavioural aspects of citizenship: student commitment to social activism (personal importance a student assigns), sense of empowerment (level of disagreement with the statement that individual can do little to bring about change), and community involvement (engagement in volunteer work or community service). Her research showed a long-term pattern where overall student commitment increases in colleges and then drops after leaving. With respect to commitment to social activism, Sax found two variables with significant influence. The first was the positive influence of a student body that was committed to social activism. The second was the negative influence of a course of study engineering and on that topic Sax (2004) states the following.

> Students who major in engineering are less likely to develop a personal commitment to social activism. This effect is consistent with Astin's findings (1993) that majoring in engineering is associated with an increase in materialism and conservatism and a decline in concern for the larger society. Findings in the present study suggest that these deleterious effects of engineering persist in the years after college. (p. 75)

That engineering study stands out as the lone negative factor with respect to commitment to social activism and a strong indicator that the reinforcement of civic engagement in engineering students is important. It is a necessary step towards developing a professional engineering workforce that is able and willing to participate much more fully in efforts to harness technology that better serves communities and society.

Chapter 3: Methodology

Education research commonly uses both quantitative and qualitative methods to develop a more complete understanding of the factors that affect student experience. Quantitative approaches allow for a systematic determination of *what exists* and how what exists was related to prior events or conditions. Qualitative approaches can uncover underlying causes that could explain *why* something came to be. The application of two or more methods, known as triangulation or mixed methods, is a process considered effective in demonstrating validity from multiple perspectives (Cohen, Manion, & Morrison, 2000; Denzin & Lincoln, 1998).

The overall purpose of this study to develop a descriptive profile and gauge student interest in a specific area, lends itself a quantitative approach for several reasons. First, the research data and findings on the characteristics of engineering students are plentiful. A quantitative approach can establish a baseline of information on engineering students at a specific university that allows comparisons with other research findings from other institutions. Second, most of the literature on engineering students originates in the United States so characteristics that may be uniquely Canadian are hidden. Quantitative research methods can provide a repeatable process that allows Canadian characteristics to emerge and contribute to the greater body of knowledge in a system. Lastly, the ultimate goal is to positively affect student retention over time. That requires longitudinal studies and quantitative approaches can simplify the collection and analysis of data over extended periods of time.

Study population

The defined study group was the incoming engineering class of 2007, specifically students enrolled in ENGI 2420 Structured Programming during the Winter Semester 2008. Successful completion of ENGI 2420 is a requirement for promotion to Term 3 in the program. The incoming engineering class of 2007 is a transition class comprised of two groups of students - Class of 2012 and Class of 2013A (see Figure 3.1).

The Class of 2012, called the *traditional cohort* in this study, entered engineering under the traditional six-year program that required the successful completion of a prescribed sequence of university courses before admission into engineering. This cohort was the last group of students to follow the traditional six-year program so their section of ENGI 2420 covered the traditional course content.

The Class of 2013 consisted of two groups entering engineering under new criteria that allows direct entry from high school. The Class of 2013A started in the Fall Semester 2007 and the Class of 2013B starts in the Fall Semester 2008. The Class of 2013A, called the *transition cohort* in this study, entered engineering under the *transition* six-year program and their section of ENGI 2420 covered content that was modified to address the requirements of the new five-year program. The Class of 2013B is the first cohort to follow the *new* five-year engineering program that redefines the first year of courses under the name Engineering One. The Class of 2013B is not part of this study.

	2006-2007		2007-2008			2008-2009			2009-2010			2010-2011			2011-2012			2012-2013			2013-2014		
	F	W	F	W	S	F	W	S	F	W	S	F	W	S	F	W	S	F	W	S	F	W	S
Class of 2012 *Traditional cohort*	TA	TB	T1	T2	W1	A3	W2	A4	W3	A5	W4	A6	W5	A7	W6	A8							
Class of 2013A *Transition cohort*			XA	XB		X1	X2	W1	A3	W2	A4	W3	A5	W4	A6	W5	A7	W6	A8				
Class of 2013B						Engineering One			A3	W2	A4	W3	A5	W4	A6	W5	A7	W6	A8				
Class of 2014									Engineering One			A3	W2	A4	W3	A5	W4	A6	W5	A7	W6	A8	

Legend: TA= Traditional Term A. TB= =Traditional Term B. T1= Traditional Term 1. T2= =Traditional Term 2
XA=Transition Term A. XB=Transition Term B. X1=Transition Term 1. X2=Transition Term 2
A= Academic Term. W=Work Term. F=Fall semester. W=Winter semester. S=Spring semester
Source: Plan of Operation of the Co-operative Engineering Program (Quaicoe, personal communication, May 1, 2001)

Figure 3.1. Illustration of Study Group Overlap by Semester and Year

The study group consists of the traditional Class of 2012 and the transition Class of 2013A, and the survey was given in the Winter Semester 2008 when both classes took ENGI 2420. The Classes of 2013A and 2013B start in different years and finish concurrently. The Class of 2013B is the first cohort to follow the new program.

Sample Size

All completed surveys were included in the analysis. The size of the class entering engineering in the Fall Semester 2007 was estimated at 450 students. This was based on 242 Term 1 enrolled students, approximately 150 Transition A students, and approximately 67 repeating students (Faculty of Engineering and Applied Science, 2007).

Research Design

The Interdisciplinary Committee on Ethics in Human Research at Memorial University approved the proposal for this research (ICEHR No. 2007/08-037-ED). This study employed quantitative research methods and evaluation begins through a single survey consisting of closed and open-ended questions entitled Engineering Student Persistence and Interest Survey.

The bulk of the survey used in this study draws from the Persisting in Engineering Survey v1.0 developed by the Assessing Women and Men in Engineering (AWE) Project. The survey also includes a question drawn from Your First College Year (YFCY) 2007 Survey, which was developed by the Higher Education Research Institute.

The Assessing Women and Men in Engineering Project, funded by National Science Foundation Grant # 0120642, was designed to develop exportable assessment instruments, literature resources, and methodologies for Women in Engineering and similar programs. These tools are adaptable to a specific institution and the set includes the Longitudinal Assessment of Engineering Self-Efficacys (LAESE), the Students

Persisting in Engineering Survey (SPES), and the Students Leaving Engineering Survey (SLES). In addition, the AWE Benchmarking Project Website gathers information about female and male students from programs and initiatives throughout the United States and Canada to provide baseline data for the development of effective instruments for use by those programs and initiatives (Assessing Women and Men in Engineering Project, n.d.-c).

The SPES (Assessing Women and Men in Engineering Project, n.d.-b), which measures student reasons for deciding to persist in engineering, is designed to be used with the SLES, which measures student reasons for deciding to transfer out of engineering, in order to compare characteristics of persisters and leavers. Students transferring out of engineering could switch to another academic field, switch educational institutions, or decide to drop out of school completely. Specifically, the SPES measures initial commitment to and preparation for studying engineering; impact of course workload, climate, advising, teaching, etc. on decision to persist; other factors or events that contributed to decision to persist; participation in academic and extra-curricular activities; confidence in completing an engineering degree; and post graduation plans. Similarly, the SLES (Assessing Women and Men in Engineering Project, n.d.-a) measures initial commitment to and preparation for studying engineering; impact of course workload, climate, advising, teaching, etc. on decision to leave; other factors or events that contributed to decision to leave; participation in academic and in extra-curricular activities; retrospective confidence in finishing a degree in engineering;

confidence in completing another degree; and post graduation plans (Assessing Women and Men in Engineering Project, 2005).

The YFCY is a survey developed by the Higher Education Research Institute (HERI) at the University of California at Los Angeles in conjunction with the Policy Center for the First Year of College. Each year, the survey is administered at over 700 two-year colleges, four-year colleges and universities and to over 400,000 entering students. The survey covers a wide range of student characteristics: parental income and education, ethnicity, and other demographic items; financial aid; secondary school achievement and activities; educational and career plans; and values, attitudes, beliefs, and self-concept (Higher Education Research Institute, 2006). Question 20 in the survey for this research is taken from the YFCY survey. Additional open-ended questions, described below, allow Canadian-specific responses to emerge.

In order to facilitate a comparison of data to other relevant studies, changes were made to the SPES instrument for this study. The specific changes were: 1) Canadian terminology replaced US terminology wherever the substitution did not change the intent of the question, 2) demographic information aligned with the intent of this study, and 3) question 10 included activities that are relevant at the university in which the research was conducted.

In order to draw information about the interest that students have in civic engagement, the survey includes two open-ended questions: 1) What community or civic activities were you involved in within the last three years? and 2) How can a bachelor's degree in engineering be helpful to your community of origin or anticipated community?

The first question is designed to reveal specific activities and level of engagement. The second question situates the students' perspective in a civic context as opposed to an industry or business context. This type of question was effective in drawing a variety of unanticipated responses during brainstorming workshops in another context in the United States (Anita Borg Institute for Women and Technology, 2006). Taken together, the results of these two questions should identify relevant themes for future consideration regarding civic engagement.

Classroom Administration of the Survey

Upon approval from ICEHR and with official support from the office of the Dean of the Faculty of Engineering and Applied Science, the instructors for each section of ENGI 2420 were contacted in order to request access to the students during a regularly scheduled class meeting time. The survey was distributed and completed in two separate sections on February 6, 2008. Participation was voluntary, and in order to assure students that participation would not affect their grades, all instructors left the room during the administration of the survey. As a small incentive to complete and return the survey, a coupon redeemable for a free cup of fair trade coffee from the student chapter of Engineers Without Borders was attached to each survey distributed. The Dean's office sponsored the cost for this incentive. The *Explanation of Study and Consent Form* is included in Appendix 4.

Processing of Completed Surveys

All of the information contained in the completed surveys from ENGI 2420 was transcribed to a Microsoft Excel spreadsheet where basic tallies and percentages were generated. The spreadsheet data were imported into SPSS and basic frequency reports were generated. The spreadsheet calculations and SPSS reports were compared to verify the data were consistent between tools. SPSS was used for statistical analysis and the results were exported to Microsoft Excel for charting.

Chapter 4: Results

The survey was administered on the same day to first-year engineering students during two sections of ENGI 2420. One of the sections was reserved for students in the transition cohort. As of the last day to add courses, a total of 491 students were enrolled in ENGI 2420 during the Winter Semester 2008, and 483 remained at the end of the semester. The survey of students in both sections yielded 353 valid surveys for a response rate of 71.9%. Eight (1.6%) of the returned surveys declined to participate, and 26.5% (130) students were not surveyed. While some individuals returned a blank survey, most of the students who were not surveyed were not in the classroom on the day the survey was distributed.

The data were further examined by term sequence, gender, and community size. Term sequence encompasses the two cohorts admitted to engineering in the fall semester 2007. The first group, the traditional cohort, entered engineering under the traditional six-year program, and the second group, the transition cohort, entered engineering under the transition six-year program. Examination of results by gender follows a classic grouping that is of particular concern to engineering because of the persistent underrepresentation by women. Lastly, aggregation by community size allows for an analysis of trends and differences that may be unique to the province of Newfoundland and Labrador to surface.

Where appropriate, chi-square or analysis of variance (ANOVA) tests were applied to the data and a level of confidence of 0.05 was used to identify areas of statistical significance. Chi-square is a test for significant differences between row and column variables. ANOVA is a test for significance between means.

The results are presented in five sections. The first section is organized according to the four areas of influence identified in the theory of student departure in commuter colleges and universities - entry characteristics, internal campus environment, the student's environment external to campus, and academic integration. The next three sections cover participant responses to individual survey questions and the final section covers civic engagement.

Entry Characteristics: Demographics

As with the engineering profession, significantly more of the survey participants were male (72.0%) than female (27.8%). Participating students from Newfoundland and Labrador duplicate this pattern with 70.5% male and 29.1% female respondents. The sample size of each cohort, traditional and transition, was equal at 47.6%. Most of the participants are in the first year (45.5%) or second year (41.8%) of university; however, 12.7% are in third year or above. Students indicating they were admitted under the direct entry from high school admission mode comprised 50.3% of the participants, followed by 37.3% entering from within the university, 5.5% from the bridging program, and 1.7% via the fast track mode. Fifteen (5.2%) of the respondents indicated other entry modes or declined to specify under which mode they entered (see Table 4.1).

Table 4.1 Student Academic Status - Term sequence, academic level, admission mode

	Frequency	Percent
Term Sequence		
Traditional cohort	139	47.6
Transition cohort	139	47.6
Not sure	14	4.8
Academic Level		
First-year student	133	45.5
Second-year student	122	41.8
Third-year student	27	9.2
Fourth-year student	6	2.1
Fifth-year student and above	4	1.4
Admission Mode		
Direct Entry from high school	147	50.3
Entry from within the University	109	37.3
Bridging Program	16	5.5
Other Entry	9	3.1
No answer	6	2.1
Fast Track	5	1.7

Table 4.2 contains a summary of participant communities of origin. Almost all of the participants were from Canada (91.2%), predominantly from the province of Newfoundland and Labrador (82.7%). There were 30 participants from other parts of Canada, which is the same as the number of participants from outside of Canada (8.5%). The recruitment of international students to Canadian universities and the recruitment of students from other parts of Canada are important for future national and provincial programs; however, for the purposes of this study, the rest of this thesis focuses on the response of the students from the province of Newfoundland and Labrador. Examination

of the responses from participants from other parts of Canada and other countries is deferred to a future study.

Table 4.2 Community of origin - All participants

Community of origin	Frequency	Percent
No answer	1	0.3
Newfoundland and Labrador	292	82.7
A province in Canada other than Newfoundland and Labrador	30	8.5
United States	3	0.8
A country other than Canada or the United States	27	7.6
Total	353	100.0

For purposes of this study, population centers were grouped in the following categories - rural 999 or less; semi-rural between 1,000 and 9,999 inclusive; semi-urban between 10,000 and 24,999 inclusive; and urban 25,000 or more (see Table 4.3). The inclusion of semi-rural and semi-urban categories was an attempt to gain greater insight beyond that which is available when only rural and urban categories are used. According to the 2006 Canadian Census (Statistics Canada, 2007), the city of St. John's and vicinity is the only area that fits the urban criterion and accounts for 29.9% of the province's population. The rural criterion encompasses 42.2% of the population. Of the remaining population, 19.4% reside in semi-rural communities that include Gander, Labrador City, Carbonear, Happy Valley-Goose Bay, and Stephenville, and 8.4% reside in semi-urban communities of Corner Brook, Grand Falls-Windsor, and Bay Roberts.

The largest number of participants (40.4%) came from an urban community. The second largest group, about two-thirds the size of the largest group (27.1%), came from semi-rural communities. There are slightly more participants from rural communities (16.4%) than are from semi-urban communities (15.1%). (See Table 4.3)

The profile of survey participants is not consistent with the distribution of the population of the province, which may be due to the way community size boundaries were determined. The population boundaries came from another research project and were convenient numbers for participants in this study to gauge the size of their home community. In light of this limitation, care should be taken when considering results reported by community size, particularly for the semi-rural and semi-urban groupings.

Table 4.3 NL community size by population

Size of Community	General population	NL participants	
	%	N	%
Rural: population < 999	42.2	48	16.4
Semi-Rural: population 1,000-9,999	19.4	79	27.1
Semi-Urban: population 10,000-24,999	8.4	44	15.1
Urban: population > 25,000	29.9	118	40.4
No answer		3	1.0
Total		292	

Entry Characteristics: Academic Preparedness

The data on academic preparedness gathered through the survey covered three areas - advanced or honours classes taken in high school, students' perceptions on the adequacy of their high school preparation, and grade point average.

When asked if a participant felt her or his high school coursework prepared them to be successful in an engineering curriculum, over half of all participants said yes (56.7%). Of the participants from Newfoundland and Labrador, more of the students said yes (52.1%) than said no (45.2%). Significant differences surface when the data were examined by gender. A greater percentage of women (63.4%) felt their high school preparation was adequate than did men (49.8%). No significant differences surfaced when further examining gender results either by term sequence or by community.

Table 4.4 summarizes the advanced or honours courses participants took during high school. Approximately a quarter of the participants took advanced or honours courses and the course cited the most was computer science (38.4%). Strong foundations in mathematics, physics and chemistry are essential for engineering studies. Over a quarter of the survey participants indicated they took calculus in high school, an advantage over students who did not take calculus or pre-calculus in high school. Similarly, approximately 20% took physics and chemistry courses in high school.

Participants could disclose their cumulative grade point average from the most recent academic term; however, the results were inconsistent. The information was provided using different numeric scales, which made it difficult to define a common scale. Consequently, grade point average is not included in this analysis.

Table 4.4 Advanced or honours high school courses taken

Course	Frequency	Percent
Computer science	112	38.4
Geometry	96	32.9
History	93	31.8
Biology	89	30.5
Calculus	83	28.4
English	76	26.0
Physics	64	21.9
Algebra	64	21.9
Chemistry	58	19.9
Pre-calculus	29	9.9

Entry Characteristics: Confidence

In general, students responding to the survey were confident that they will earn a degree (see Table 4.5, Table 4.6 and Table 4.7). Most of the participants from the province of Newfoundland and Labrador (86.3%) were either very confident (41.1%) or fairly confident (45.2%) they would earn any university degree. Slightly fewer (74.3%) were very confident (31.5%) or fairly confident (42.8%) of earning a degree in engineering. No significant differences were found when these data were examined by term sequence or gender.

Table 4.5 Confidence in earning a degree

Level of confidence	Engineering degree		Any degree	
	Freq	%	Freq	%
I am very confident that I will complete an engineering degree at this institution	92	31.5	120	41.1
I am fairly confident (greater than 50%) that I will complete an engineering degree at this institution	125	42.8	132	45.2
There is about a 50% chance that I will complete an engineering degree at this institution	39	13.4	27	9.3
Not very confident; it is highly likely I will not complete an engineering degree at this institution	20	6.8	6	2.1
Other or no answer	16	5.5	7	2.4

Freq=Frequency

Table 4.6 Confidence in earning an engineering degree - Frequency of distribution by term sequence and gender

	TC		XC		M		F	
	Freq	%	Freq	%	Freq	%	Freq	%
I am very confident that I will complete an engineering degree at this institution	18	12.9	17	12.2	11	5.3	13	15.3
I am fairly confident (greater than 50%) that I will complete an engineering degree at this institution	13	9.4	7	5	6	2.9	9	10.6
There is about a 50% chance that I will complete an engineering degree at this institution	59	42.4	60	43.2	26	12.6	35	41.2
Not very confident; it is highly likely I will not complete an engineering degree at this institution	44	31.7	45	32.4	90	43.7	26	30.6
Other or no answer	2	1.4	7	5	66	32	2	2.4

Freq =Frequency. TC=Traditional cohort. XC=Transition cohort. M=Male. F=Female

Table 4.7 Confidence in earning any degree - Frequency of distribution by term sequence and gender

	TC		XC		M		F	
	Freq	%	Freq	%	Freq	%	Freq	%
I am very confident that I will complete an engineering degree at this institution	15	10.8	10	7.2	18	8.7	9	10.6
I am fairly confident (greater than 50%) that I will complete an engineering degree at this institution	1	0.7	4	2.9	3	1.5	3	3.5
There is about a 50% chance that I will complete an engineering degree at this institution	59	42.4	68	48.9	91	44.2	41	48.2
Not very confident; it is highly likely I will not complete an engineering degree at this institution	60	43.2	54	38.8	87	42.2	32	37.6
Other or no answer	2	1.4	3	2.2	5	2.4	-	0.0

Freq=Frequency. TC=Traditional cohort. XC=Transition cohort. M=Male. F=Female

Entry Characteristics: Areas of Personal Importance

The survey provided 22 objectives and asked students to indicate the personal importance of each objective on a four-point Likert scale where 1 was essential, 2 was very important, 3 was somewhat important, and 4 was not important. The results are summarized in Table 4.8. Three areas stood out as essential - being very well off financially (39.0%), raising a family (36.6%), and helping others who are in difficulty (23.4%). When the participants who ranked these areas as very important is included, the percentages jump to 80.4%, 75.6%, and 68.9% respectively.

Table 4.8 Areas of personal importance by percent

Ref	Area	N	E	VI	SI	NI
G	Being very well off financially	290	39.0	41.4	17.9	1.7
E	Raising a family	287	36.6	39.0	16.7	7.7
H	Helping others who are in difficulty	290	23.4	45.5	27.2	3.8
C	Obtaining recognition from my colleagues for contributions to my special field	287	10.8	45.6	35.9	7.7
B	Becoming an authority in my field	290	12.1	39.0	41.0	7.9
T	Improving my understanding of other countries and cultures	290	10.3	33.1	40.3	16.2
F	Having administrative responsibility for the work of others	289	8.0.	36.0	40.8	15.2
I	Making a theoretical contribution to science	290	10.0	26.2	44.1	19.7
M	Becoming involved in programs to clean up the environment	290	9.3.	26.6	43.1	21.0
L	Becoming successful in a business of my own	290	13.4	23.4	35.9	27.2
N	Developing a meaningful philosophy of life	289	12.1	24.9	33.9	29.1
P	Helping to promote racial understanding	290	8.6	24.8	39.0	27.6
Q	Keeping up to date with political affairs	290	8.3	21.0	42.1	28.6
O	Participating in a community action program	288	3.8	20.1	48.6	27.4
U	Participating in an organization like Canada World Youth, Katimavic, Engineers without Borders, or the Peace Corps	290	7.6	15.9	42.1	34.5
R	Becoming a community leader	289	7.6	15.9	41.5	34.9
V	Engaging with members of my own racial/ethnic group	288	6.9	14.6	34.0	44.4
S	Integrating spirituality in my life	289	8.3	14.2	22.8	54.7
D	Influencing the political structure	289	5.9	10.0	37.7	46.4
K	Creating artistic works	290	2.8	9.0	22.8	65.5
A	Becoming accomplished in one of the performing arts	290	3.1	6.6	16.9	73.4
J	Writing original works	289	3.5	6.2	14.9	75.4

N=Total Frequency. E=Essential. VI=Very important. SI=Somewhat important. NI=Not important

Internal Campus Environment

Table 4.9 lists the extracurricular engineering activities provided in the survey and includes a summary of how often survey respondents participated in each activity. Most survey participants were not involved in extracurricular engineering activities, a finding which can be expected of students who are new to university life. Four activities were cited by more than 10% of the participants from Newfoundland and Labrador - activities sponsored by a department or major (27.1%), co-op placement or professional internship (16.4%), activities that serve community (13.7%), and an engineering society (13.4%).

Table 4.9 Engineering activities - Amount of involvement during term by percent

Ref	Activity (N=292)	NI	1-2	1-2	>5	Total
E	Activities (social or academic) sponsored by your department or major	71.9	19.9	4.8	2.4	27.1
H	Co-op placement or Professional Internship position	82.2	12.7	2.7	1.0	16.4
I	Activities that serve community (e.g. Engineers Without Borders, Habitat For Humanity, Tetra Society)	85.3	9.2	0.3	4.1	13.7
B	An engineering student society (e.g. Engineering Undergraduate Society)	85.6	11.6	0.3	1.4	13.4
F	Design competition teams (e.g. Formula MUN, Concrete Canoe Team)	91.8	4.5	0.3	2.4	7.2
G	Undergraduate research experiences	95.5	2.4	0.0	0.3	2.7
C	A professional or student group for women or minority engineers (e.g. WISE)	97.3	1.0	0.0	0.7	1.7
D	Activities sponsored by Women in Science and Engineering or Women in Engineering Program (e.g. CWSEA sponsored activity)	96.9	1.7	0.0	0.0	1.7
A	A professional society	98.3	0.3	0.0	0.0	0.3
J	Activities sponsored by Minority / Multicultural Engineering Program	98.3	0.3	0.0	0.0	0.3

NI=Not involved

External Campus Environment

Parental or guardian support of a student's choice to study engineering was generally high. Almost all respondents - 87.3% of all the participants and 89.0% of the participants from Newfoundland and Labrador - indicated that their parents or guardians were very supportive of their decision to choose engineering. No survey participants reported parental or guardian disagreement with their decision.

Involvement in athletics and the need to work can detract student attention away from studies. Among all survey participants, 20.7% participated in university athletic activities. Fewer participants from Newfoundland and Labrador participated in university athletic activities (16.1%).

Among participants from Newfoundland and Labrador, 38% worked during the academic year. The bulk of the students worked between 5 and 15 hours per week, and approximately four times more students worked off-campus than worked on-campus (see Table 4.10).

Table 4.10 Hours worked during academic year

	Off-campus (n=89)		On-campus (n=22)	
	Frequency	Percent	Frequency	Percent
Less than 5 hours	27	30.3	7	31.8
6-10 hours	28	31.5	9	40.9
11-15 hours	20	22.5	5	22.7
16 - 20 hours	8	9.0	1	4.5
More than 20	6	6.7	0	0.0

Academic Integration

Recall that academic integration consists of structural and normative dimensions (Seidman, 2005). Structural dimensions refer to the meeting of explicit standards of the university, and normative dimensions refer to an individual's identification with the standards and customs of the academic system. For this section, academic integration covers the categories of academic involvement and response to academic problems.

Academic Integration: Academic Involvement

The survey provided a list of 14 academic or academic preparation activities and asked participants to indicate all the activities in which they engaged during the last academic term. Overall results are included in Table 4.11.

Cited by the almost three-quarters of the participants was attendance at an exam review session (74.1%). Between approximately one-half and two-thirds of the participants cited activities that involved interaction with other students, faculty or staff - sought help from other engineering students (61.4%), participated in formal or informal study groups (57.2%), visited a professor or graduate assistant during office hours (50.7%), and attended engineering orientation prior to beginning classes (47.9%).

Significant differences were found in all three major groupings (summarized in Table 4.12). For term sequence, six factors were significant, and in all cases more students from the traditional cohort cited the activity than from the transition cohort. Further, all factors had a confidence level between 0 and 0.002.

With regard to gender, three areas show significant differences: called or emailed parents or others close friends about class or school difficulties, scheduled an appointment with a professor or graduate assistant outside of his or her office hours, and visited a professor or graduate assistant in her or his office hours. In all cases, more women cited involvement than men.

Significant differences by community size were found in two areas. Far fewer participants from semi-urban areas said they received tutoring than did participants from rural, semi-rural, or urban areas. Many more participants from rural areas said they scheduled appointments with a professor or graduate assistant outside of his or her office hours than did participants from the other areas.

Table 4.11 Academic involvement - Frequency distribution for NL overall and by term sequence and gender

		NL		TC		XC		M		F	
Ref	Activity	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
C	Attended review sessions before exams	215	74.1	80	57.6	64	46	93	45.1	54	63.5
K	Sought help from other engineering students when I experienced difficulties in classes	178	61.4	56	40.3	53	38.1	73	35.4	40	47.1
H	Participated in formal or informal study groups	166	57.2	2	1.4	1	0.7	3	1.5	-	-
L	Visited a professor and / or graduate assistant in her or his office hours	147	50.7	116	83.5	94	67.6	151	73.3	63	74.1
A	Attended engineering orientation prior to beginning classes	139	47.9	28	20.1	-	-	18	8.7	11	12.9
D	Called or emailed parents or others close friends about difficulties I was experiencing in classes or school	113	39.0	108	77.7	67	48.2	129	62.6	48	56.5
I	Received tutoring for courses where I was experiencing difficulty	80	27.6	-	-	139	100	1	0.5	2	2.4
J	Scheduled an appointment with a professor and / or graduate assistant outside of his or her office hours	77	26.6	8	5.8	10	7.2	14	6.8	4	4.7
M	Visited or emailed an adviser or advising center	75	25.9	3	2.2	1	0.7	5	2.4	-	-
N	Visited the Career Center or Co-op Office to seek assistance with job search (e.g. permanent, internship or co-op)	29	10.0	106	76.3	30	21.6	97	47.1	41	48.2
E	Got advice from a mentor in a formal mentoring program	18	6.2	44	31.7	32	23	48	23.3	29	34.1
B	Attended summer program designed to prepare me to begin the engineering curriculum	5	1.7	23	16.5	48	34.5	56	27.2	19	22.4
F	Lived in honours or other non-engineering special interest dorm	3	1.0	32	23	45	32.4	58	28.2	22	25.9
G	Participated in engineering-focused living arrangement (e.g. dorm, engineering fraternity)	3	1.0	95	68.3	69	49.6	116	56.3	49	57.6

Freq=Frequency. NL=Newfoundland and Labrador. TC=Traditional cohort. XC=Transition cohort. M=Male. F=Female

Table 4.12 Academic involvement - Differences by term sequence, gender, and community size

Ref	Academic Activity	Sig	Subgroup	Freq	Percent
			Term Sequence		
A	Attended engineering orientation prior to beginning classes	.000**	TC	117	74.5
			XC	42	23.5
C	Attended review sessions before exams	.001**	TC	127	80.9
			XC	115	64.2
H	Participated in formal or informal study groups	.002*	TC	107	68.2
			XC	92	51.4
K	Sought help from other engineering students when I experienced difficulties in classes	.000**	TC	117	74.5
			XC	89	49.7
M	Visited or emailed an adviser or advising center	.001†	TC	27	17.2
			XC	60	33.5
N	Visited the Career Center or Co-op Office to seek assistance with job search (e.g. permanent, internship or co-op)	.000†	TC	32	20.4
			XC	4	2.2
			Gender		
D	Called or emailed parents or others close friends about difficulties I was experiencing in classes or school	.025	M	92	36.4
			F	48	49.5
L	Visited a professor and / or graduate assistant in her or his office hours	.003*	M	112	44.3
			F	60	61.9
J	Scheduled an appointment with a professor and / or graduate assistant outside of his or her office hours	.028	M	57	22.5
			F	33	34.0
			Community Size		
J	Scheduled an appointment with a professor and / or graduate assistant outside of his or her office hours	.005**	R	22	44.9
			SR	25	27.2
			SU	10	18.2
			U	32	21.2
I	Received tutoring for courses where I was experiencing difficulty	.017	R	16	32.7
			SR	24	26.1
			SU	5	9.1
			U	44	29.1

Two-sided Pearson Chi-square. *p<0.01. **p≤.001. †=Fisher's Exact
M=Male. F=Female. R=Rural. SR=Semi-rural. SR=Semi-urban. U=Urban. TC=Traditional cohort. XC=Transition cohort

Academic Integration: Response to Academic Problems

In order to determine how students handled academic problems, the survey presented a predefined list of 15 action and asked participants to rank the top three actions they took when faced with an academic problem in engineering. Overall results are summarized in Table 4.13.

At least two-thirds of the participants cited two actions: spend more time studying (71.4%), and talk to other students and/or friends (69.5%). One action was cited by 46.2% of the participants: do something relaxing or social.

Less than 25% of respondents cited actions that each indicated consultation with others outside their immediate peer group: talk to a faculty member (22.8%), seek academic help at a tutoring center (20.9%), form or join a student study group (19.1%), and talk to my parents or siblings (15.8%). Interestingly, more students said they did nothing (8.4%) than would talk with engineering personnel assigned to advising (5.3%).

Table 4.13 Response to academic problem in engineering by percent

Ref	Action	n	Highest	Second	Third	Total
F	Spend more time studying	280	32.5	24.3	14.6	71.4
J	Talk to other students and/or friends	279	33.3	26.5	9.7	69.5
A	Do something social or something that relaxes me (e.g. exercise, read a novel)	279	10.0	11.1	25.1	46.2
E	Seek academic help at a tutoring center	277	5.4	6.9	8.7	20.9
G	Talk to a faculty member	285	3.5	8.1	11.2	22.8
B	Form or join a student study group	283	3.9	7.1	8.1	19.1
K	Talk to my parents or siblings	284	3.5	7.0	5.3	15.8
D	Nothing	285	1.8	0.7	6.0	8.4
I	Talk to engineering adviser and/or advising staff	284	2.1	1.1	2.1	5.3
M	Visit the Academic Advising Centre	285	0.0	1.1	0.7	1.8
C	I never feel this way	285	1.4	0.4	0.7	2.5
H	Talk to a mentor	286	0.0	0.3	0.3	0.7
L	Visit the International Student Advising Office	286	0.0	0.3	0.0	0.3
N	Visit the office of the Chair for Women in Science and Engineering (CWSEA)	286	0.0	0.0	0.0	0.0
O	Other	290	1.0	0.7	0.3	2.1

Reasons for Choosing to Major in Engineering

A list of 12 predefined reasons for choosing engineering was provided in the survey. Participants were asked to select from the list the reasons they initially chose to study engineering (see Table 4.14). More than 60% of the participants cited three reasons for choosing engineering - good at math or science (81.8%), wanted to be able to get a well-paying job after graduation (69.5%), and like to solve problems (64.0%).

A second tier of responses was reported by between 25% and 60% of the survey participants. The second tier included the following items - like the design work that engineers do (58.6%); parent, other relative or friend is an engineer (35.6%); a parent, sibling or other relative recommended it (29.8%); and attracted by the challenge of a difficult curriculum (27.4%).

Other reasons offered by survey participants included dissatisfaction with previous job/career/area of study, previous experience with engineering-related area, and an interest is a specific area (e.g. boats, robots, and aerospace).

An examination of the reasons for choosing engineering revealed significant differences by gender and community size. No significant difference was found by term sequence. The results are summarized in Table 4.15.

When examining the data by gender, more women (91.8%) than men (77.5%) identified being good at math or science as a reason for choosing engineering. In addition, more men (64.6%) than women (43.5%) said they liked the design work that engineers do.

Examination of the data by community size also revealed a significant difference in two categories - good at math or science, and a parent, sibling or other relative recommended it. Participants from semi-urban areas (93.2%) cited being good at math or science the most, while participants from urban areas (72.9%) cited this reason the least. Participants from rural and semi-rural were in the middle with approximately 85% in each group citing the reason. Twice as many participants from semi-rural and semi-urban areas (approximately 40% each) said they had a parent, sibling or other relative who recommended engineering than from than from rural and urban areas (approximately 20% each).

Table 4.14 Reasons for Choosing Engineering - Frequency distribution by NL participants, term sequence, and gender

Ref	Reason	NL		TC		XC		M		F	
	N=292	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
B	Good at math or science	239	81.8	113	81.3	118	84.9	160	77.7	78	91.8
J	Wanted to be able to get a well-paying job after I graduate	203	69.5	106	76.3	92	66.2	146	70.9	56	65.9
D	Like to solve problems	187	64.0	92	66.2	85	61.2	133	64.6	53	62.4
E	Like the design work that engineers do	171	58.6	86	61.9	76	54.7	133	64.6	37	43.5
G	Parent, other relative or friend is an engineer	104	35.6	44	31.7	53	38.1	75	36.4	28	32.9
H	Parent, sibling or other relative recommended it	87	29.8	43	30.9	38	27.3	61	29.6	26	30.6
A	Attracted by the challenge of a difficult curriculum	80	27.4	38	27.3	39	28.1	50	24.3	29	34.1
C	High school adviser or teacher recommended it	43	14.7	18	12.9	24	17.3	31	15.0	11	12.9
K	Wanted to use engineering solutions to address social problems	24	8.2	14	10.1	10	7.2	17	8.3	7	8.2
F	Participated in engineering camp or workshop that influenced me	22	7.5	12	8.6	9	6.5	13	6.3	9	10.6
M	Other	20	6.8	10	7.2	8	5.8	15	7.3	5	5.9
I	Received or anticipated possibility of good college scholarship	11	3.8	8	5.8	2	1.4	9	4.4	2	2.4
L	Not Sure	8	2.7	5	3.6	3	2.2	7	3.4	1	1.2

Freq=Frequency. NL=Newfoundland and Labrador. TC=Traditional cohort. XC=Transition cohort. M=Male. F=Female.

Table 4.15 Reason for choosing engineering - Differences by gender and community size

Ref	Reason	sig	Subgroup	Freq	%
			Gender		
B	Good at math or science	.005*	M	160	77.7
			F	78	91.8
E	Like the design work that engineers do	.001**	M	133	64.6
			F	37	43.5
			Community Size		
B	Good at math or science	.01*	R	41	85.4
			SR	68	86.1
			SU	41	93.2
			U	86	72.9
H	Parent, sibling or other relative recommended it	0.01*	R	10	20.8
			SR	31	39.2
			SU	18	40.9
			U	26	22.0

Two-sided Pearson Chi-square. *p<.01. **p≤.001.
Freq=Frequency. M=Male. F=Female. R=Rural. SR=Semi-rural. SU=Semi-urban. U=Urban

Self-identified Persistence Factors

Participants were given two opportunities to identify specific reasons for their persistence in engineering. The first allowed participants to select from a predefined list of 13 factors by ranking each item as to whether the factor had no influence, small influence, moderate influence, or significant influence on their persistence in engineering education (see Table 4.16). The second was an open-ended question that asked participants to describe the one biggest factor that helped them to persist in the study of engineering.

The top three factors were cited as a moderate or significant influence by more than 70% of the participants - personal abilities/talents "fit" the requirements in engineering (80.0%), confidence in succeeding in engineering future classes (77.9%), and satisfactory performance on my grades in engineering (70.6%). Between 50% and 70% of the participants also cited positive interactions with other engineering students (64.5%); good teaching by engineering faculty, instructors, or graduate assistants (62.4%); ability to find satisfactory co-op placements and/or internships (54.5%); and friendly climate in engineering classes (54.5%) as moderate or significant influences. Fewer than 50% of the students cited the remaining factors as moderate or significant influences.

Significant differences were found in all major groupings and results are summarized in Table 4.17. Approximately twice as many participants from the transition cohort as from the traditional cohort cited each of two reasons as of significant or moderate influence - sufficient opportunities for financial aid or scholarships, and positive experiences in design teams or other collaborative learning experiences in engineering. Additionally, more from the transition cohort cited good teaching as a significant or moderate influence than did from the traditional cohort. As for the last reason, ability to find a satisfactory co-op placement or internship, more from the traditional cohort (83.5%) than from the transition cohort (69.8%) cited the reason as a significant, moderate or small influence.

In terms of gender, significant difference was found in four areas - sufficient opportunities for financial aid or scholarships, engineering faculty or staff show an interest in me, satisfactory performance on grades in engineering, and confidence in succeeding in future engineering classes. In all cases, more women cited each factor as important (small, moderate or significant) than did men.

When examined by community size, a significant difference in predefined persistence factors was found with respect to financial aid or scholarship. Approximately twice as many participants from rural areas cited sufficient opportunities for financial aid or scholarship as a reason for persistence than did participants from urban, semi-urban, or semi-rural areas. Additionally, more than half of the participants from urban and semi-urban areas considered this factor not important.

Table 4.16 Self-identified persistence factors by percent

Ref	Factors	NI	SM	MI	SI	MI+SI
J	My personal abilities/talents "fit" the requirements in engineering	5.2	14.8	41.0	39.0	80.0
K	Confidence in succeeding in engineering future classes	5.9	16.3	40.1	37.7	77.9
E	Satisfactory performance on my grades in engineering	6.6	22.8	41.5	29.1	70.6
L	Positive interactions with other engineering students	11.0	24.5	37.9	26.6	64.5
G	Good teaching by engineering faculty, instructors, or graduate assistants	9.3	28.3	40.3	22.1	62.4
I	Ability to find satisfactory Co-op placements and/or internships	22.0	23.4	26.6	28.0	54.5
D	Friendly climate in engineering classes	14.8	30.7	39.3	15.2	54.5
F	Faculty help me understand what practicing engineers do	21.8	33.9	30.4	13.8	44.3
C	Reasonable workload of the engineering classes	26.0	31.5	33.6	9.0	42.6
M	Positive experiences in design teams or other collaborative learning experiences in engineering	29.2	29.9	28.5	12.5	41.0
H	Effective academic advising by engineering faculty or advisors	34.3	34.9	24.2	6.6	30.8
A	Sufficient opportunities for financial aid or scholarships	45.9	27.6	16.9	9.7	26.6
B	Engineering faculty/departmental personnel show an interest in me	50.0	30.3	16.9	2.8	19.7

NI=No influence. SM=Small influence. MI=Moderate influence. SI=Significant influence

Table 4.17 Self-identified persistence factors - Differences by term sequence, gender, and community size

Ref	Reasons for persistence	Source	df	Mean Square	F	Sig
		Term sequence				
A	Sufficient opportunities for financial aid or scholarships	Between Groups	1	14.37	14.835	0**
		Within Groups	275	0.969		
M	Positive experiences in design teams or other collaborative learning experiences in engineering	Between Groups	1	25.989	26.784	0**
		Within Groups	276	0.97		
G	Good teaching by engineering faculty, instructors, or graduate assistants	Between Groups	1	3.683	4.388	.037
		Within Groups	276	0.839		
I	Ability to find satisfactory Co-op placements and/or internships	Between Groups	1	5.194	3.988	.047
		Within Groups	276	1.303		
		Gender				
A	Sufficient opportunities for financial aid or scholarships	Between Groups	1	4.215	4.226	.041
		Within Groups	287	0.997		
B	Engineering faculty/departmental personnel show an interest in me	Between Groups	1	4.829	6.979	.009*
		Within Groups	287	0.692		
E	Satisfactory performance on my grades in engineering	Between Groups	1	5.67	6.704	.01*
		Within Groups	289	0.846		
K	Confidence in succeeding in engineering future classes	Within Groups	289	1.356	5.299	.022
		Between Groups	1	4.497		
		Community size				
A	Sufficient opportunities for financial aid or scholarships	Between Groups	3	3.276	3.323	.02
		Within Groups	283	0.986		

One-way ANOVA. *p<0.01. **p ≤ 0.001

Plans After Graduation

Participants were asked to select among nine predefined options regarding their options after graduation (see Table 4.18). Participants could also indicate other options beyond the list provided in the survey.

One option, selected by 71.6% of the participants, and stood out clearly as the top option - work in industry after graduation. Between approximately 20% and 30% of the participants selected the second cluster of options - participate in a business start up or start my own business (26.0%), work in government lab or agency (19.5%), and go on to graduate school (18.5%). A similar number (18.2%) were undecided on what to do after graduation. Less than 5% of the survey participants cited the remaining options.

Significant differences were found with respect to term sequence and gender (see Table 4.19). More students from the traditional cohort than from the transition cohort planned to work in industry after graduation. Almost twice as many women (27.1%) than men (16.0%) planned to work in a government lab or agency. The reverse was true for those planning to start their own business or participate in a start up after graduation with almost twice as many men (29.6%) than women (17.6%) citing the intent.

Table 4.18 Plans after graduation - Frequency distribution by term sequence and gender

		All NL		TC		XC		M		F	
Ref	Plans (N=292)	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
A	Work in industry	209	71.6%	111	79.9	88	63.3	150	72.8	58	68.2
G	Participate in a business start up or start my own business	76	26.0%	32	23	42	30.2	61	29.6	15	17.6
B	Work in government lab or agency	57	19.5%	28	20.1	28	20.1	33	16	23	27.1
C	Go on to graduate school	54	18.5%	26	18.7	27	19.4	33	16	21	24.7
I	Undecided	53	18.2%	21	15.1	29	20.9	34	16.5	19	22.4
D	Go on to professional school (e.g. medicine, law)	12	4.1%	7	5	4	2.9	8	3.9	4	4.7
E	Teach at the college or university level	11	3.8%	8	5.8	3	2.2	8	3.9	3	3.5
H	Enter (or re-enter) the military	11	3.8%	5	3.6	6	4.3	11	5.3	0	0
J	Other	10	3.4%	5	3.6	4	2.9	7	3.4	3	3.5
F	Teach in K-12 schools	3	1.0%	1	0.7	2	1.4	2	1	1	1.2

Freq =Frequency. Two-sided Pearson Chi-square. *p<.01. TC=Traditional cohort. XC=Transition cohort. M=Male. F=Female.

Table 4.19 Plans after graduation - Differences by term sequence and gender

Ref	Plans after graduation	Sig	Group	Frequency	Percent
	Term Sequence				
A	Work in industry	.002*	TC	111	79.9
			XC	88	63.3
	Gender				
B	Work in government lab or agency	.03	M	33	16.0
			F	23	27.1
G	Participate in a business start up or start my own business	.035	M	61	29.6
			F	15	17.6

Civic Engagement Results

As previously noted, for purposes of this research civic engagement is defined as "individual and collective actions designed to address issues of public concern" (American Psychological Association, 2007, Definition of Civic Engagement section, para. 1). This survey included five items related to civic engagement in order to answer the research question: To what extent are first-year students civically engaged? The first survey item was taken from a list of predefined reasons from which a participant could select as a reason for choosing engineering. That reason - wanted to use engineering solutions to address social problems - was selected by 10.2% of all participants (see Table 4.20). Of those, 6.8% were from Newfoundland and Labrador, and 3.4% were from outside of the province. No significant difference was found when the data were examined by term sequence, gender, or community size. The remaining questions were intended to quantify actual participation, gauge the level of student interest, and uncover possible connections between an engineering degree and community needs.

In the survey, participants were asked to list community or civic activities in which they were involved over the last three years. Additionally, respondents were asked to indicate whether they were a participant, volunteer, or organizer in order to gauge the level of participation. Sax (2004) found that in general, student commitment to civic responsibilities such as helping others in difficulty, participating in community action, and influencing social values or the political structure, increases during university, but after university, the gains disappeared. She also found that engineering students were less likely to develop a commitment to social activism. This question intended to determine a baseline of participation for engineering students at this University and the results are summarized in Table 4.20. The reported numbers are approximate numbers because some of the descriptions of the activities that were provided by survey participants were difficult to categorize. This limitation is discussed later.

Approximately 48.1% of all survey participants (170 out of 353) indicated that they were involved in community or civic activities as a participant, volunteer or organizer over the last three years, which for the study group is mostly during high school. Of those, 106 students reported taking part as a participant in approximately 163 events, 149 were volunteers in approximately 201 events, and 66 were organizers in approximately 73 events. Approximately 50.3% of participants from Newfoundland and Labrador (147 out of 292) indicated that they participated in community or civic activities. Of those, 93 students reported taking part as a participant in approximately 143 events, 132 were volunteers in approximately 175 events, and 59 were organizers in approximately 64 events. Fewer (37.7%) of the participants from outside of province indicated that they were involved in community or civic activities. Additionally, 13.7% of participants responded positively when asked to what extent they were involved in engineering activities that serve community such as Engineers without Borders.

The second part was taken from the YFCY survey (Higher Education Research Institute, 2006). The question listed 22 objectives and asked students to indicate the personal importance of each objective on a four point Likert scale where 1 was essential, 2 was very important, 3 was somewhat important, and 4 was not important. Among the 22 areas of potential importance, 10 areas are related to civic engagement and the remaining objectives are related to the profession, the arts, and self. This question was included in order to gain insight into what students considered personally important outside of engineering. Table 4.21 lists the areas related to civic engagement and includes a summary of the results from participants from Newfoundland and Labrador. As previously noted, helping others who are in difficulty ranked third in importance, and only 3.8% considered the area not important. While the remaining areas were considered essential by less than about 10%, between 10% and 33% of the participants considered the area very important.

The third part was an open-ended question that asked participants how a bachelor degree in engineering could be helpful to their community of origin or anticipated community. By reframing the question in a community context, this question intended to draw out connections between engineering study and any local needs that a participant could already have in mind. In general, participants were not able to envision a connection beyond the obvious ties to employment, which can be expected of students in their first year of university because their breadth of experience is typically narrow. Some comments were notable and are covered in the next chapter.

Results from an examination of these ten areas by term sequence is summarized in Table 4.22 Significant differences by term sequence occur in one area - improving personal understanding of other countries and cultures - where more traditional cohort participants consider this area essential, very important, or somewhat important, than did transition cohort participants.

Table 4.20 Civic Engagement - Two indicators

	NL Participants			All Participants		
	N	%		N	%	
Wanted to use engineering solutions to address social problems	24	6.8		36	10.2	
Community or civic activities involved in within the last three year	N	%	Activities	N	%	Activities
Participant	93	31.8%	143	106	30.0%	163
Volunteer	132	45.2%	175	149	42.2%	201
Organizer	59	20.2%	64	66	18.7%	73

Note: Individual involvement in #22 could include more than one category so the total frequencies will not equal the number of survey participants.

Table 4.21 Civic engagement - Areas of personal importance by percent

Ref	Area of personal importance (N=292)	E	VI	SI	NI	E+VI / E+VI+SI
H	Helping others who are in difficulty	23.4	45.5	27.2	3.8	69.0/96.2
T	Improving my understanding of other countries and cultures	10.3	33.1	40.3	16.2	43.4/83.8
M	Becoming involved in programs to clean up the environment	9.3	26.6	43.1	21.0	35.9/79.0
P	Helping to promote racial understanding	8.6	24.8	39.0	27.6	33.4/72.4
Q	Keeping up to date with political affairs	8.3	21.0	42.1	28.6	29.3/71.4
O	Participating in a community action program	3.8	20.1	48.6	27.4	24.0/72.6
R	Becoming a community leader	7.6	15.9	41.5	34.9	23.5/65.1
U	Participating in an organization like Canada World Youth, Katimavic, Engineers without Borders, or the Peace Corps	7.6	15.9	42.1	34.5	23.4/65.5
V	Engaging with members of my own racial/ethnic group	6.9	14.6	34.0	44.4	21.5/55.6
D	Influencing the political structure	5.9	10.0	37.7	46.4	15.9/53.6

E = Essential. VI = Very important. SI = Somewhat important. NI=Not important

Table 4.22 Civic engagement - Differences and frequencies by term sequence

Significant differences

Area of difference		Sum of Squares	df	Mean Square	F	Sig.
Improving my understanding of other countries and cultures	Between Groups	9.339	1	9.339	12.797	0**
	Within Groups	199.951	274	0.73		

One-way ANOVA. **p<0.001

Frequencies

		Traditional cohort			Transition cohort		
		N	V%	C%	N	V%	C%
Improving my understanding of other countries and cultures	E	19	13.9	13.9	9	6.5	6.5
	VI	53	38.7	52.6	41	29.5	36
	SI	52	38	90.5	58	41.7	77.7
	NI	13	9.5	100	31	22.3	100

N=Frequency. V%=Valid percent. C%=Cumulative percent. E=Essential. VI=Very important. SI= Somewhat important. NI=Not important

The results from an examination of these ten areas by community size are summarized in Table 4.23 and Table 4.24. Two of the areas - participating in a community action program and becoming a community leader - show significant differences. More participants from rural and semi-rural communities felt it was essential, very important, or somewhat important to participate in a community action program. In terms of becoming a community leader, more participants from rural communities felt it was essential or very important than from urban and semi-urban communities. Twice as many participants from urban and semi-urban communities than from rural and semi-rural areas felt both areas were not important.

Table 4.23 Civic engagement - Differences by community size

Ref	Area of engagement		Sum of Squares	df	Mean Square	F	Sig.
O	Participating in a community action program	Between Groups	5.92	3	1.973	3.204	0.024
		Within Groups	173.04	281	0.616		
R	Becoming a community leader	Between Groups	10.48	3	3.492	4.431	0.005
		Within Groups	222.24	282	0.788		

One-way ANOVA. p<0.05

Table 4.24 Civic engagement - Frequencies by community size

Ref	Area of engagement		Rural			Semi-rural			Semi-urban			Urban		
			N	V%	C%	N	V%	C%	N	V%	C%	n	V%	C%
O	Participating in a community action program	E	2	4.2	4.2	1	1.3	1.3	1	2.3	2.3	7	6.1	6.1
		VI	15	31.2	35.4	17	21.8	23.1	8	18.2	20.5	18	15.7	21.7
		SI	24	50	85.4	47	60.3	83.3	15	34.1	54.5	53	46.1	67.8
		NI	7	14.6	100	13	16.7	100	20	45.5	100	37	32.2	100
R	Becoming a community leader	E	6	12.5	12.5	6	7.6	7.6	0	0	0	10	8.7	8.7
		VI	9	18.8	31.2	13	16.5	24.1	6	13.6	13.6	18	15.7	24.3
		SI	25	52.1	83.3	38	48.1	72.2	15	34.1	47.7	41	35.7	60
		NI	8	16.7	100	22	27.8	100	23	52.3	100	46	40	100

N=Frequency. V%=Valid percent. C%=Cumulative percent. E=Essential. VI=Very important. SI=Somewhat important. NI=Not important

An examination of these 10 areas by gender shows significant differences in six areas (Table 4.25) - helping others who are in difficulty, improving my understanding of other countries and cultures, helping to promote racial understanding, participating in a community action program, becoming a community leader, and participating in an organization like Engineers Without Borders. In all cases, more women than men cited each area as essential or of significant importance. In contrast, more men than women cited each area as not important (Table 4.26).

Table 4.25 Civic engagement - Differences by gender

Ref	Area of engagement		Sum of Squares	df	Mean Square	F	Sig.
H	Helping others who are in difficulty	Between Groups	3.959	1	3.959	6.226	0.013
		Within Groups	182.498	287	0.636		
T	Improving my understanding of other countries and cultures	Between Groups	8.24	1	8.24	11.082	0.001
		Within Groups	213.4	287	0.744		
P	Helping to promote racial understanding	Between Groups	7.599	1	7.599	9.202	0.003
		Within Groups	237.003	287	0.826		
O	Participating in a community action program	Between Groups	3.139	1	3.139	5.03	0.026
		Within Groups	177.857	285	0.624		
R	Becoming a community leader	Between Groups	5.557	1	5.557	6.939	0.009
		Within Groups	229.023	286	0.801		
U	Participating in an organization like Canada World Youth, Katimavic, Engineers without Borders, or the Peace Corps	Between Groups	13.678	1	13.678	17.921	0
		Within Groups	219.042	287	0.763		

One-way ANOVA. $p<0.03$

Table 4.26 Civic engagement - Frequencies by gender

Ref	Area of engagement		Male Freq	Male V%	Male C%	Female Freq	Female V%	Female C%
H	Helping others who are in difficulty	E	45	22.1	22.1	23	27.1	27.1
		VI	86	42.2	64.2	46	54.1	81.2
		SI	63	30.9	95.1	15	17.6	98.8
		NI	10	4.9	100	1	1.2	100
P	Helping to promote racial understanding	E	13	6.4	6.4	12	14.1	14.1
		VI	49	24	30.4	23	27.1	41.2
		SI	76	37.3	67.6	37	43.5	84.7
		NI	66	32.4	100	13	15.3	100
T	Improving my understanding of other countries and cultures	E	20	9.8	9.8	10	11.8	11.8
		VI	56	27.5	37.3	39	45.9	57.6
		SI	86	42.2	79.4	31	36.5	94.1
		NI	42	20.6	100	5	5.9	100
U	Participating in an organization like Canada World Youth, Katimavic, Engineers without Borders, or the Peace Corps	E	12	5.9	5.9	10	11.8	11.8
		VI	26	12.7	18.6	20	23.5	35.3
		SI	81	39.7	58.3	41	48.2	83.5
		NI	85	41.7	100	14	16.5	100
O	Participating in a community action program	E	8	4	4	3	3.5	3.5
		VI	36	17.8	21.8	22	25.9	29.4
		SI	93	46	67.8	46	54.1	83.5
		NI	65	32.2	100	14	16.5	100
R	Becoming a community leader	E	15	7.4	7.4	7	8.2	8.2
		VI	27	13.3	20.7	19	22.4	30.6
		SI	78	38.4	59.1	41	48.2	78.8
		NI	83	40.9	100	18	21.2	100

Freq=Frequency. V%=Valid percent. C%=Cumulative percent. E=Essential. VI=Very important. SI=Somewhat important. NI=Not important

Chapter 5: Analysis of the Results

Reasons for Persistence

The first objective of this study was to investigate reasons engineering students self-identify for why they persist from year one to year two. In the research process, comparisons between this study's cohort of first-year engineering students and engineering students in other Canadian universities were sought. The AWE SLES tool was originally selected as a basis for this study in part because 22 other Canadian universities had subscribed to the AWE service. The hope was that research results from other Canadian engineering programs would be available for comparison. Unfortunately, AWE organizers do not expect to see such comprehensive research findings until at least the summer of 2008. A large study conducted at the University of Calgary, however, does report findings that are appropriate for comparison. That study was conducted in the fall of 1998 and included approximately 2,000 undergraduate students in six major degree programs. The findings presented a descriptive profile of engineering majors and discussed factors influencing their decisions to major in engineering (Cannon et al., 2006).

This analysis is organized according to the four areas of influence identified in the theory of student departure in commuter colleges and universities - entry characteristics, internal campus environment, the student's environment external to campus, and academic integration - and highlights significant differences by term sequence, gender, and community size.

Entry Characteristics

The majority (82.7%) of participating first-year engineering students were from the province of Newfoundland and Labrador, which can be expected of a province with only one university. Overall, in 2005 78.7% of all students at Memorial University were from Newfoundland and Labrador (Centre for Institutional Analysis and Planning, 2005a), and 59.5% of all students selected Memorial University because of its convenience or location (Centre for Institutional Analysis and Planning, 2005b). Of the students from Newfoundland and Labrador participating in this study, 40% were from the urban area encompassed by St. John's and vicinity. Of the remaining students, almost half live in communities with populations between 1,000 and 9,999. The remaining students are split between rural communities of less than 999 and semi-urban communities of populations between 10,000 and 24,999 that encompass Corner Brook, Grand Falls-Windsor, and Bay Roberts.

In terms of gender, more men (71%) than women (29%) participated in the survey. At Memorial University, 21% of engineering undergraduates are female and 79% are male (Centre for Institutional Analysis and Planning, 2007). Nationally women comprise 17.5% of the engineering undergraduates in Canada (Engineers Canada, 2006) and 17.2% in the United States (National Science Foundation, 2006b).

The study group is evenly divided between traditional and transition cohorts. About half of the students entered the engineering program directly from high school, and over one-third entered from within the university.

Approximately one quarter of the students took advanced placement or honours courses in high school. Over half of the respondents felt that their high school preparation was adequate for engineering study, a finding which corresponds with results reported by CIAP (2005b). Written comments from engineering student respondents are consistent with this bimodal distribution of attitudes.

Confidence is not in short supply in this study group. Almost all (86%) of the respondents were confident they would receive *any* Memorial University degree. About three-quarters were confident that their degree would be in engineering. This widespread feeling of confidence was reflected in the written comments with regard to specific participant reasons for persistence.

Participants were fairly consistent as to why they chose to study engineering. Almost 80% cited being good at math or science while almost 70% said they wanted to be able to get a well-paying job after graduation or liked to solve problems. These results are not surprising and reflect positively on traditional efforts, such as information posted to the engineering website, that promote the engineering profession to students. Between 25% and 60% of the survey participants cited a second tier of reasons that are consistent with a deeper understanding of engineering often associated with personal experience or contact with someone knowledgeable of profession: I like the design work that engineers do; parent, other relative or friend is an engineer; a parent, sibling or other relative recommended it; and attracted by the challenge of a difficult curriculum.

Respondents were very clear on what they would do after graduation, and over 70% said that they planned to work in industry. A little over a quarter of respondents planned to participate in a business start up or start a business, followed to a lesser extent by those planning to work in a government lab or agency, or go on to graduate school. Interestingly, only 18% were unsure. In comparison, 79.3% of all first-year students at Memorial University said they chose their area of study based on interest and aptitude while only 5.8% chose their area of study based on career opportunities (Centre for Institutional Analysis and Planning, 2005b).

Participants were given two ways to identify specific reasons for why they persist in engineering study. The first was a predefined list of reasons and the second was an open-ended question. Comments gathered from the open-ended question reflected the top selections by participants from the predefined list: personal fit, confidence, and good grades. Other themes surfacing from participant comments included appreciation for the positive attributes of a career in engineering such as financial reward, prestige, employment security, and career flexibility. In addition, participants mentioned intellectual stimulation, and a long time desire or passion for engineering, as well as a fear of failure or feeling that too much was already invested to change. Table 5.1 includes verbatim statements that illustrate these points.

Table 5.1 Sample of first-year student comments on reasons for persistence

A good interesting job! End of story!
Academically I'd be completely screwed if I switched degrees; I'd have wasted 2 years of my life and thousands of dollars and be left with a handful of transferable courses.
Always wanted to be an engineer
Belief that I can get this degree and move on into other academic interests such as economics and finance
Co-op job placements every second term so there is always a break/reward in the near future
Having my father as an electrical engineer
Money
I cannot afford to fail. It would be a waste of my mother's investment
I do not consider myself a "quitter" therefore as the courses get harder I will not give up. Also I have high aspirations for my future and I believe engineering can give me the future I want.
I feel my talents and abilities fit that of an engineer and I look forward to a profession which provides challenges and satisfaction on a daily basis.
I want to become an engineer to have a well-paying job and a good (respectable) lifestyle
My biggest factor would be because I enjoy thinking about a process and seeing how it can be done easier, more efficient or a different way
Program fits my personality and I am good a math/sciences and I like it. I know it will be a very rewarding career and I will like going to work every day. I'm a problem solver. I don't want a boring job when I graduate.
That it may be one of the hardest degrees to obtain and I enjoy a challenge and the fact that it is by far the highest demanded degree in North America
The biggest factor is that I want to become an engineer, so I can design or modify items to make a difference in the world and make a good salary as I do
The possibility of a stable and well paid career after graduation.

Internal Campus Environment

Participant attitudes towards the internal campus environment were derived from an open-ended question that asked "What could the university or the faculty of engineering do to make the study of engineering more enjoyable or satisfying?" In all, 57% provided specific comments, 6% thought things were fine as is or mostly good, and 37% did not know or had no comment.

A number of students highlighted classroom logistics as an issue, specifically mentioning that the rooms were overcrowded. This is likely due to the double cohort of traditional and transition students entering engineering in the fall semester 2007. This should not be an issue when the class size returns to a single cohort in the fall semester 2008. Other themes included teaching quality especially English as a second language of professors and teaching assistants, hands on learning, formal opportunities for assistance such as better help centers, and better academic and career guidance. Table 5.2 provides a sample of first-year student comments.

Table 5.2 Sample of first-year student recommendations to faculty

Nothing. Its school. I'm here to study
Become hands-on in earlier terms. Many people enjoy the hands-on aspect of engineering but have to wait through a year and a half of lectures before making a nut and bolt in the design labs
Form an engineering help center where we can go to get academic help from people other than the profs and TAs. Provide a quiet study area, much like the library with their study booths.
Make more references to applicability of course material; Make the course seem interesting;
More charitable activities that we perform as a faculty (i.e. build a H4H home, raise money for school park/playground, etc)
More help centers. Usually, if you have a problem, you have to sort it out yourself or go to the professor who has odd hours.
More profs who speak English well enough for us to understand; We can't understand the speech of many ESL profs
Profs should explain where things come from more effectively; Make the learning for students more enjoyable, not just reading off the projectors
Some courses/labs are very poorly organized and the onus is completely on the student to find extra resources to understand topics that are poorly covered.
Teachers that communicate the material well.
There could be more ways for students to meet and get to know other engineering students. On the other hand, this is the 1st term
They could get different lecture halls so that we don't have to be in the same room for 4 hours Mon, Wed, Fri. I think the walk to a different room would be refreshing and would help students stay awake.
Work closely with student body to determine problems

External Campus Environment

Participants benefit from external support in a number of ways that collectively bode well for engineering student persistence. First, familial support of their decisions to pursue a course of study in engineer was positive for the vast majority of this study group (95.2%). That support is reinforced by the lack of any reported negative response from families. Cannon et al. (2006) examined family support of first-year engineering students at the University of Calgary in much greater detail. The researchers found that at the University of Calgary, 2% of mothers and 27% of fathers were engineers, and that there were no significant gender differences with regard to students whose mothers were engineers. Over half (51%) of all students reported that their fathers were a positive influence and encouraged them to pursue engineering, and no significant difference based on gender of the student was found. One third of female students (34%) said their fathers were engineers. Positive influence and encouragement from their mother was cited by more female students (40%) than male students (32%). There were no gender differences found when the engineer was a relative other than a parent (29%).

Second, external demands on student time that could take student attention away from study do not appear to be excessive. There is sufficient financial support available so that two-thirds of the respondents do not work during the school term. This is consistent with the CIAP study that shows that only 30% of first-year students at Memorial University worked during the school term. Additionally, participation in university athletics, potentially another large time sink, is a factor for only 15% of the participants.

Finally, over one-third of participants have a relative or friend that is an engineer. Assuming the role models are positive ones, access to convenient role models should reinforce student persistence.

Academic Integration

The definition of academic integration consists of two parts - structural elements associated with explicit university requirements, and student identification with normative structure of the academic system (Seidman, 2005). For the former, grades are the final quantitative measure of performance, and unfortunately inconsistent data from the survey preclude comment. For the latter, this study provided data under the categories of academic involvement, academic actions, and engineering activities.

In terms of academic involvement, the majority of participants sought association first with their student peer group and second with a professor or graduate assistant. To a lesser extent, they consulted parents or other friends. When faced with the need for action in response to academic problems, the dominant responses were to study harder, consult with other students and friends, and find a way to relax. This behaviour is consistent with CIAP findings on students at Memorial University in general. A look at the minority responses shows that more participants would do nothing than would consult advising staff, a situation that should warrant closer investigation. Lastly, participants were not involved in engineering activities to any great extent. When participants were involved in engineering activities, it was primarily in those activities sponsored at the department or major level. To lesser extent, participants were active in work experience; activities that serve community such as Engineers without Borders, Habitat for Humanity, and the Tetra Society; and professional societies like the IEEE or ASME.

Significant Differences by Term Sequence

This study sought to uncover significant differences between students in the traditional and transition cohorts that could potentially affect student persistence and therefore retention in a negative way. Significant differences between the traditional and transition cohorts surfaced in 11 factors that fell under three survey categories - plans after graduation, academic involvement, and predefined persistence reasons. In all but two factors, the significance was very strong ($p \leq .001$).

With respect to plans after graduation, more participants from the traditional cohort than from the transition cohort planned to work in industry after graduation. This finding is reasonable given that transition cohort students have one less year of university and may be keeping their options open. Six of the factors fall under the survey area of academic involvement. These areas are consistent with the response to complementary open-ended question. These areas also cover issues where interventions are possible, for example engineering orientation prior to beginning classes, exam review sessions, formal or informal study groups, and academic or career advising. The remaining factors fall under the survey category of predefined reasons for persistence. By a factor of 2 to 1, money to finance their education and team experience are more important for transition students. The new five-year program may have opened the door to a greater number of qualified students who view cost as a primary obstacle. To a lesser extent, good teaching and the ability to find a satisfactory co-op placement or internship were cited as reasons to persist by more participants from the traditional cohort than the transition cohort.

Significant Differences by Gender

The chronic underrepresentation of women in engineering motivates analysis of the data by gender. Throughout Canada, female undergraduate enrolment in engineering peaked at 20.7% in 2001 and then declined to 17.5% in 2005. At the provincial level, Alberta had the largest percentage (20.1%), followed by Newfoundland and Labrador (19.7), and Prince Edward Island (19.5%) (Engineers Canada, 2006). It is notable that, despite its small size, the province of Newfoundland and Labrador attracted more women to engineering than the national average.

While differences by term sequence are clustered in three survey categories, differences by gender range over five categories - adequacy of high school preparation, reasons for choosing engineering, plans after graduation, academic involvement, and predefined persistence reasons. In general, these categories are consistent with previously published results to engineering and gender.

In the area of academic preparedness, more women felt their high school preparation was adequate and that their ability in math and science was good than men. Specifically, 63.4% of women and 49.8% of men felt their high school preparation was adequate. More women (91.8%) than men (77.5%) identified being good at math or science as a reason for choosing engineering Additionally, more men (64.6%) than women (43.5%) said they liked the design work that engineers do.

Significant differences were found in three areas of academic involvement - called or emailed parents or others close friends about class or school difficulties, scheduled an appointment with a professor or graduate assistant outside of his or her office hours, and visited a professor or graduate assistant in her or his office hours. In all cases, more women cited involvement than men.

Like their male counterparts, the vast majority of women planned to enter industry. As another option, however, almost twice as many women than men planned to work in a government lab or agency. The reverse was true for those planning to start their own business or participate in a start up after graduation with almost twice as many men than women citing that intent.

In the survey category of predefined persistence factors, a significant difference was found in four areas when examined by gender: sufficient opportunities for financial aid or scholarships, engineering faculty or staff show an interest in me, satisfactory performance on grades in engineering, and confidence in succeeding in future engineering classes. In all cases, more women cited each factor as of small, moderate or significant importance than did men.

Significant Differences by Community Size

Analysis of the survey results by community size revealed significant differences in three areas. First, in the area of academic involvement more students from rural and semi-rural areas scheduled appointments with professors or teaching assistants and received tutoring. More effective management of time on campus is a reasonable response for students who must commute some time or distance to attend university classes.

Second, in terms of self-identified persistence factors, opportunities for financial aid or scholarships were important to many more students from rural areas than from the other three areas. This perspective is consistent with the added expense facing students whose families do not live in the same area as the university.

Lastly, the reasons cited for choosing engineering showed that urban students considered themselves good at math and science in lower numbers than rural, semi-rural, and semi-urban students. Additionally, more semi-rural and semi-urban participants indicated that a relative recommended engineering study than did rural and urban participants. It is not possible to draw any conclusions from this data, however, the data does surface mixed results that support the need for better definition of the population boundaries that includes at least three categories of community size.

Engineering Retention at Memorial University

This study hypothesized that without intervention, Memorial University could see attrition rates similar to that which are common to universities in the United States, specifically, 30% to 60% over the first two years of an engineering program (Besterfield-Sacre et al., 1997; Budny et al., 1997; Richardson & Dantzler, 2002). Recall that no comparable reports on Canadian engineering student retention rates were found during the literature review and that the United States numbers are assumed to apply.

Prior to the change from a six-year to a five-year program, enrolments over the first two years of the engineering program at Memorial University revealed attrition rates in the 7% to 45% range. This is already within the lower to middle end of the generalized US range; however, admission to many engineering programs in the United States coincides with the first year of university. These engineering rates at Memorial University coincide with the second year of university, and complete synchronicity to the first year will not occur until the fall semester 2008. A look at academic performance at Memorial University shows failure rates of 8.6% for all first-year students (new matriculates), 15.3% pre-engineering students (traditional cohort), and 2.1% for engineering students overall (Centre for Institutional Analysis and Planning, 2005a). It is difficult to draw comparisons from these reports because failure rates reported by CIAP assume simple criteria of a minimum overall grade average of 50% while the engineering program requirements for promotion are more complex.

Without more detailed data and information, it is impossible to predict the extent to which first-year students are at risk of attrition. It can be said that first-year engineering students at Memorial University are much like their counterparts in other schools, and that there is no clear evidence that the Memorial University engineering experience will be substantially different. The students in this study identified a number of areas of improvement that are worth consideration. In addition, this study has identified a number of significant differences based on student cohort, gender, and to a lesser extent on community size. Known interventions can minimize the potential negative impact; however, the resources at Memorial University are finite, so questions arise as to what criteria apply when considering what changes are worth implementing. Recall that initial and subsequent institutional commitment influence student persistence (Astin & Oseguera, 2005; Bean, 2005; Braxton & Hirschy, 2005; Braxton & Lee, 2005; Cabrera et al., 2005; Hagedorn, 2005; Nora et al., 2005). The full consideration of student recommendations for improving the internal engineering environment could positively influence the institution, which in turn could positively influence student persistence through increased student involvement.

In the case of Memorial University, the engineering program is currently operating at capacity, meaning that the number of traditional and transition cohort students is greater than the number of committed seats for Term 3, which is the point when both cohorts merge. If all students in both cohorts persist to Term 3, the allotment of seats would be insufficient; however, the lack of seats could lessen when the first-year class returns to a single cohort. If generalized retention rates are repeated at Memorial University, then the cost of lost opportunity could be large. Such are the strengths and weakness of being the province's only university.

Civic Engagement Analysis

The second objective of this study was to examine what areas of civic engagement were of interest to first-year engineering students and to gauge to what level students were involved. In order to answer this question, five items that were related to civic engagement were included that surfaced five observations worth noting.

First, civic engagement is important to this cohort. Helping others who are in difficulty ranked high in importance and that was second only to financial well being and raising a family. Over half of the survey participants considered each of the remaining nine items associated with civic engagement to be essential, very important, or somewhat important. Approximately 15% of respondents consider influencing the political structure important. In the United States, overall student interest in the political process increased to 32.9% in 2003 from at an all-time low of 28% in the United States in 2000 (Rooney, 2003).

Second, civic engagement is important to this cohort; however, action is more likely to be taken by women and participants from outside urban areas. Of 10 items related to civic engagement, six areas showed significant differences by gender and in all cases, more women than men cited each area as essential or of significant importance. In contrast, two to three times more men than women cited each area as not important. Two notable areas of civic engagement - participating in a community action program and becoming a community leader - were cited by more female, rural, and semi-rural students as essential, very important or somewhat important than their male, urban, and semi-urban counterparts.

Third, the first-year class of engineering students entering in 2007 is experienced in civic and community activities. Within the last three years approximately half of all respondents participated in civic or community activities. Of those, approximately half served as volunteers and about 20% served as organizers. In numbers, that translates to an experienced volunteer staff of 132 and 59 organizers.

Fourth, there is a small core of individuals who wants to focus on solving social problems. While only in their first year, 6.8% or 24 respondents already know they want to use engineering principles to solve social problems. That number is more than the number wanting to teach at university or go on to a professional school like business or law.

Finally, students were asked to describe how their bachelor degree in engineering could bring benefit to their community of origin or anticipated community. There were many responses and, in general, the comments centered on conventional views related to individual employment opportunities, economic expansion, and public works projects. One student indicated a broader appreciation for the societal benefits - "the world has many problems without acceptable solutions, e.g. environmental, economic, social" - as well as an understanding of the potential limitations of engineering education - "(the) university turn(s) out the wrong types of engineers without a strong sense of the world". The quotes included in Table 5.3 are representative of the major themes noted in comments from the first-year students.

Table 5.3 Sample of first-year student statements on the benefit of a bachelor degree to home community

A bachelor degree would allow me to get a good job and be able to give back financially to my community. And my knowledge of engineering could be used by the community on new projects they may have or are considering. I could promote engineering to the young people/students in my community
A bachelor's degree in engineering could be useful to St. John's as it could potentially bring jobs if a new company is made, or through design recognition could put St. John's on the map so to say. It could also make the overall environment safer, or bring more modern technologies which can make life easier.
A degree in engineering enables us to solve problems. The world has many problems without acceptable solutions, e.g. environmental, economic, social. However my opinion is that university turn out the wrong types of engineers without a strong sense of the world. This appears to be changing which is promising. We need engineers who can solve world problems.
As an educated and respected person with resources to be able to help, I could use my leadership ability to organize community programs
Become an active & positive member of my community, perhaps with the financial ability to assist those in need. It will also provide me with the ability to create/design ways to improve the quality of life for people in my community and abroad.
Engineers help to improve the world, so if I can start at home, and make NL a better place, I will strive to do so
Firstly, with a growing oil and gas industry, NFLD will require engineers to continue projects and continue to grow economically. As well engineers play a large role in the implementations of environmental protection projects, essential to many worksite in today's society. As well, engineers are responsible for the well being of citizens within a community, both to province essentials of life in a convenient manner and sustain these essentials.
If (EE) I would stay and probably get involved with projects like lower Churchill, else (computer engineer) I would need to move to a higher technological hub away from NFLD.
In Windsor, ON the economy is failing. It will be important to bring in new ideas to keep the economy alive.
It will allow me to earn enough to be a benefit to the financial side of the community, the skills to be a technical asset, and the maturity to be socially responsible.
I don't know. Who can say for certain? I've always believed that how helpful you are to society depends less on what your job is and more on what you do on a personal level for you community. There are lots of people with less education than a degree that have made a significant impact on the world/my community.
I don't believe me getting a bachelor degree in engineering will be helpful to my community of origin or anticipated community

Chapter 6: Summary, Recommendations, & Limitations of the Research

This study was not a statistical analysis of historical data on engineering student academic performance. This research intended to profile a first-year engineering class, to gauge how interested that cohort was in areas of civic engagement, and to propose a framework to allow civic interests to gain visibility in the engineering program on par with industry, government, and research. The hope was that emerging themes would inform interventions that would in turn enrich the pool of engineering students through diversification and expand student understanding of the career potential of an engineering bachelor degree.

The study group consisted of a unique combination of two first-year engineering student cohorts admitted to engineering in 2007. The first cohort had at least one year of university experience that satisfied a pre-engineering requirement for students enrolling before 2007. The second cohort consisted of students entering directly from high school, the admission mode for students who enrol starting in 2008.

In essence, this study found that first-year engineering students fit the profile of other students at Memorial University and that they are also much like other engineering students in North America. The study found no compelling evidence that either study cohort would perform differently than previous engineering cohorts at Memorial University. Significant differences between the two cohorts in the area of academic involvement were found that could, however, influence student persistence. Interventions in those areas could minimize any negative influence.

The study also found that first-year engineering students were interested in areas of civic engagement and had prior personal experience as participants, volunteers, and organizers in civic and community activities. Twenty-four students from Newfoundland and Labrador indicated explicitly that they wanted to use engineering to address social problems. In general, more female and rural students consider civic engagement of personal importance than with their male and non-rural counterparts. Of 10 items related to civic engagement, female students considered six items essential or of significant importance, whereas more male students cited each as not important. For the specific areas of participating in a community action program and becoming a community leader more female, rural and semi-rural students considered these areas of overall importance than male and non-rural students.

In so far as engineering can be viewed as a culture unto itself, engineering's limited growth could be more a result of cultural limitations that narrowly define what engineers are rather than individual deficits. Civic engagement is a valuable approach that not only draws upon individual interests and commitments, but also situates civic needs on par with industry, government, and education, and can expand why students choose engineering and who benefits. Civic engagement through experiential education can also serve as an environment for students to develop the higher order skills that are highly desired by the profession and employers.

The next step is to complete an analysis of student responses to the three open-ended questions and follow-up interviews may be needed in order to bring clarity to some of the original comments. Each of the open-ended questions was asked in isolation;

however, maximum value toward identifying meaningful interventions lies in considering the responses together. Once that analysis is complete, specific recommendations can be made to the Faculty.

Recommendations

As previously mentioned, retention is an institutional issue. So far, existing recruitment practices are able to fill the available seats in the engineering program at Memorial University, but is full enrolment good enough or simply a starting point? This question is especially important in light of declining populations in rural areas in Newfoundland and Labrador, changing demographics where today's students are considered to be very different from previous generations, the recent restructuring of the engineering program from six years to five, and changes in the global environment and economy. The question is difficult to answer without sufficient data to identify areas of success that are worth keeping as well as areas of improvement that need intervention or areas of little or no value that can be eliminated.

> Recommendation 1: Establish a formal program in the Faculty, with granularity to the individual student level, to track and analyze overall student progression.

Professional disciplines like engineering, business, and medicine, assert a great deal of influence on the programs that educate future practitioners, especially in a co-op programs where 50% of a student's university career can be away from the university. That influence on a university student's development is largely unexamined. To understand what this means to engineering student persistence, and by extension to overall engineering student retention, requires closer examination of the engineering profession in terms of the profession's ability and effort to attract students. Additionally, faculty support and involvement is necessary for interventions to be most effective. It may be difficult, however, to convince engineering faculty of the value of intervention without speaking in the language of the engineer. Findings based on the new engineering education research paradigm in the United States and theoretical frameworks that consider the influence of employers, such as the Transmission Line Model, hold promise as ways to align and coordinate the objectives of the university, students, and future employers.

> Recommendation 2: Develop strategies that equate persistence and retention with continuous quality improvement and that communicate goals and objectives to engineering student, faculty, and staff as well as potential engineering employers.

The province of Newfoundland and Labrador is sufficiently small that Memorial University and technical colleges such as the College of the North Atlantic must recruit from the same pool of students. Coordinated efforts could yield better results than independent efforts. Future research design should consider the findings and recommendation of two early studies by Kirby & Sharpe (2001) and Sharpe & Spain (1993). Coordination of effort with the Centre for Institutional Analysis and Planning would improve data quality and provide a vehicle to better address overall institutional goals, which could then align better with provincial objectives.

> Recommendation 3: Future research should take into consideration the recommendations from previous research done in the province as well as from more recent findings based on the new engineering education research paradigm in the United States.

There are a wide assortment of programs, activities, and interventions that attempt to address engineering student enrolments and retention, yet, despite all the effort, overall enrolment and retention rates are essentially unchanged. Many of those recruitment and intervention programs follow the deficit model, a model that is better suited for duplicating existing norms than for uncovering meaningful alternatives. This study shows that, like other university students, first-year engineering students care about areas of civic engagement, especially female students and students from rural areas. Rather than let that engineering student interest in civic engagement wane, interest in civic engagement should be nurtured to increase the effectiveness of experiential education and to provide a new lens through which to view the value of an engineering education. Through a civic engagement lens it also becomes possible to identify new ways in which to bring unique value directly back to communities in the province rather than as secondary or tertiary benefits of professional employment in business or industry.

> Recommendation 4: Wherever possible, incorporate civic engagement from a Canadian perspective as a context for experiential education that enables engineering students to see viable career paths in the area of public benefit. Specific exposure should be given to the views and experience of female and rural engineering students with respect to civic engagement.

While individual universities may have studied retention issues internally, the apparent lack of published papers that specifically address engineering student retention in Canada is puzzling given the great number of such papers originating in the United States. Why does student retention in engineering programs not garner greater attention? While Canada and the United States have many similarities, it may naïve to rely so heavily on the American experience when it comes to engineering education interventions. Canada can benefit, however, from the increased quality of engineering *education* research coming from the United States. Potential starting points should include the work of the NSERC Chairs for Women in Science and Engineering in Canada and the Assessing Women and Men in Engineering Project in the United States. Additionally, the newly launched Canada ASEE website promises to become a convenient portal for sharing Canadian knowledge and perspectives (Canada ASEE, 2008).

> Recommendation 5: Work to engage engineering education researchers at other universities to create a knowledge base populated with Canadian data, information, and analyses.

Limitations of the Research

This study attempted to gather insight based on the size of a participant's home community. The categories of semi-rural and semi-urban were added to the more commonly used categories of rural and urban, and the boundaries used to delineate the sizes were primarily convenient. A respondent may not have known the exact population of her or his home community so data associated with this category should be considered approximate. Future investigation could benefit from more precise definition such as the use of a predefined list of communities based on clear criteria.

The survey asked participants to list community or civic activities in which they were involved over the last three years, and to indicate whether they were a participant, volunteer, or organizer. The variety of responses made it difficult to identify the type of activity so the results should be considered approximate. Further research in this area should consider using a predefined list of activities or consider definitions offered by civic engagement organizations such as Campus Compact in the United States.

Lastly, this study is not a retrospective of historical data. This study is cross-sectional and provides only a baseline of information from one class at one point in time. A proper retention study requires longitudinal data.

Conclusion

> *If Canada is to excel in the global knowledge based economy, we have to call up all of our strengths to build and maintain a strong, entrepreneurial science culture that maximizes all of our human resources (Carty, 2004, p. 3).*

As the above statement by Arthur J. Carty (2004), Canada's former National Science Advisor indicates, Canada must call on all its human resources to excel in a knowledge based economy. That call, however, must not be limited to technical skills but should also include understanding of context that serves to ground judgement on which issues and problems are prioritized for consideration. The ability to establish well-informed priorities is especially important given that our dependence on technology is permanent and that the supply of skilled engineers is not likely to increase significantly in the foreseeable future. Engineering programs and the students who choose that course are well prepared for the training of engineering skill. What is missing from the program is student comprehension of how the unique ability of engineers can make a direct difference on their home communities and to people they know.

The students in this study are as prepared as previous classes to successfully pursue engineering; however, they will ultimately face a world very different from the world faced by their predecessors. Soon, Newfoundland and Labrador will become a *have* province and with increased wealth comes the need to properly manage the wealth so that all residents benefit. It is essential that today's engineering student become knowledgeable about the needs of their local communities as well as the needs of industry and business so they can help to make decisions that maximize positive benefits and minimize negative effects to community. The first-year students are already interested in civic engagement, have an idea what it means to be involved, and have indicated what areas are of personal importance. Future engineering program enhancements should capitalize on that emerging commitment to civic engagement to enrich the leadership potential of its graduates.

References

American Psychological Association. (2007). Civic engagement and service-learning. Retrieved December 18, 2007, from http://www.apa.org/ed/slce/civicengagement.html

American Society for Engineering Education. (2006a). Special Report: The national engineering education research colloquies. *Journal of Engineering Education, 95*(4), 257-256.

American Society for Engineering Education. (2006b). Special Report: The research agenda for the new discipline of engineering education. *Journal of Engineering Education, 95*(4), 259-261.

Anita Borg Institute for Women and Technology. (2006). Past Project Archive: Virtual Development Center. Retrieved June 18, 2008, from http://anitaborg.org/initiatives/special-projects/past-projects-archive/vdc/

Assessing Women and Men in Engineering Project. (2005). AWE Research Overviews: Self-efficacy and women in engineering. Retrieved November 11, 2006, from https://www.engr.psu.edu/awe/secured/director/lit_overview/selfefficacy/SelfEfficacy_03_07_05.pdf

Assessing Women and Men in Engineering Project. (n.d.-a). AWE Instruments: Students leaving engineering survey (SLES). Retrieved October 16, 2007, from https://www.engr.psu.edu/awe/secured/director/Instruments/exit.aspx

Assessing Women and Men in Engineering Project. (n.d.-b). AWE Instruments: Students persisting in engineering survey (SPES). Retrieved October 16, 2007, from https://www.engr.psu.edu/awe/secured/director/Instruments/persisters.aspx

Assessing Women and Men in Engineering Project. (n.d.-c). AWE Purpose and History. Retrieved October 23, 2008, from http://www.engr.psu.edu/awe/misc/about.aspx

Association for Experiential Education. (2008). What is experiential education? Retrieved July 18, 2008, from http://www.aee.org/customer/pages.php?pageid=47

Astin, A. (1993). *What matters in college? Four critical years revisited.* San Francisco: Jossey-Bass.

Astin, A., & Oseguera, L. (2005). Pre-college and institutional influences on degree attainment. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 245-276). Westport, CN: Praeger Publishers.

Baillie, C. (2007, June 24-27, 2007). *Distinguished lecturer: Building the impossible.* Paper presented at the 2007 ASEE Annual Conference & Exposition, Honolulu, Hawaii.

Barney, D. (2007). One nation under Google: Citizenship in a technological republic [Electronic Version]. *Hart House Lectures*. Retrieved September 11, 2007, from http://www.harthouselecture.ca/.

Bean, J. P. (1980). Dropouts and turnover: The synthesis and test of a causal model of student attrition. *Research in Higher Education, 12*(2), 291-320.

Bean, J. P. (1983). The application of a model of turnover in work organizations to the student attrition process. *Review of Higher Education, 6*(2), 129-148.

Bean, J. P. (2005). Nine themes of college student retention. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 215-243). Westport, Connnecticut: Praeger Publishers.

Berger, J. B., & Lyon, S. C. (2005). Past to present: A historical look at retention. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 1-29). Westport, Connecticut: Praeger Publishers.

Besterfield-Sacre, M., Atman, C. J., & Shuman, L. J. (1997). Characteristics of freshman engineering students: Models for determining student attrition in engineering. *Journal of Engineering Education, 86*(2), 139-149.

Borrego, M. (2007). Conceptual difficulties experienced by trained engineers learning educational research methods. *Journal of Engineering Education, 96*(2), 91-102.

Borrego, M., & Newswander, L. K. (2008). Characteristics of successful cross-disciplinary engineering education collaboration. *Journal of Engineering Education, 97*(2), 123-134.

Braxton, J. M., & Hirschy, A. S. (2005). Theoretical development in the study of college student departure. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 61-87). Westport, Connecticut: Praeger Publishers.

Braxton, J. M., & Lee, S. D. (2005). Toward reliable knowledge about college. In A. Seidman (Ed.), *College Student Retention: Formula for student success* (pp. 107-128). Westport, Connnecticut: Praeger Publishers.

Broido, E. M. (2004). Understanding diversity in millennial students. *New Directions For Student Services, Summer 2004*(106), 73-85.

Bryant, L. M. (1999). *Paths students take: Fall 1998 attrition survey* St. John's, NL: Memorial University of Newfoundland.

Budny, D., Bjedov, G., & LeBold, W. (1997). *Assess of the impact of the freshman engineering courses.* Paper presented at the 27th Annual Frontiers in Education Conference, Pittsburgh, PA.

Burtner, J. (2004). *Critical-to-quality factors associated with engineering student persistence: The influence of freshman attitudes.* Paper presented at the 34th ASEE/IEEE Frontiers in Education Conference, Savannah, GA.

Busch-Vishniac, I. J., & Jarosz, J. P. (2004). Can diversity in the undergraduate engineering population be enhanced through curricular change? *Journal of Women and Minorities in Science and Engineering, 10*(3), 255-281.

Business Roundtable. (2005). *Tapping America's potential: The education for innovation initiative*. Washington, DC: Business Roundtable.

Cabrera, A. F., Burkum, K. R., & La Nasa, S. M. (2005). Pathways to a four-year degree. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 155-214). Westport, CN: Praeger Publishers.

Campus Compact. (n.d.). Get informed. Retrieved October 16, 2007, 2007, from http://www.actionforchange.org/getinformed/civic-engagement.html

Canada ASEE. (2008). Website for Canadian membership in ASEE. Retrieved July 22, 2008, from http://www.aseecanada.ca/

Canadian Academy of Engineering. (1999). Evolution of engineering education in Canada [Electronic Version]. Retrieved July 20, 2008, from http://www.acad-eng-gen.ca/publis/e/Evolution_a.1.cfm.

Cannon, M. E., Wallace, J. E., & Haines, V. A. (2006). *Academic choices of engineering undergraduates*. Paper presented at the CCWEST Conference for the Advancement of Women in Engineering, Science and Technology, St. John's, NL.

Carty, A. J. (2004). Opening remarks: Spotlight on women in science, technology and trades. Unpublished speech presented at the Senior Women in Science 4th Roundtable Breakfast on November 4, 2004. Office of the National Science Advisor.

Centre for Institutional Analysis and Planning. (2005a). *Academic performance profile, Memorial University, Fall 2005*. St. John's, NL: Memorial University of Newfoundland and Labrador.

Centre for Institutional Analysis and Planning. (2005b). *The first year experience of new students at Memorial University*. St. John's, NL: Memorial University of Newfoundland.

Centre for Institutional Analysis and Planning. (2007). *Fact Book 2007* (No. 030-033-11-07-300). St. John's, NL: Memorial University of Newfoundland.

Centre for Institutional Analysis and Planning. (2008). Fact Book. Retrieved April 23, 2008, from http://www.mun.ca/ciap/fact_book.php

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). New York, NY: RoutledgeFalmer.

Congressional Commission on the Advancement of Women and Minorities in Science. (2000). *Land of plenty: Diversity as America's competitive edge in science, engineering and technology* (No. cawmset0409). Washington, D.C.: National Science Foundation.

Denzin, K., & Lincoln, Y. S. (Eds.). (1998). *Strategies of qualitative inquiry* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Emerson, C. J. (2006). Increasing women in SETT: The Business Case [Electronic Version]. Canadian Coalition of Women in Science, Engineering, Trades and Technology. Retrieved August 3, 2007, from http://www.ccwestt.org/Portals/0/winsett/The%20Business%20Case%20for%20Increasing%20Women%20in%20SETT%20June%2006%20Final.pdf.

Engineers Canada. (2006). *Canadian engineers for tomorrow: Trends in engineering enrolment and degrees awarded 2001 to 2005*. Retrieved September 19, 2007, from http://www.engineercanada.com/e/prog_publications_2_1.cfm.

Faculty of Engineering and Applied Science. (2007). B. Eng. admissions process, Fall 2007. Retrieved October 1, 2007, from http://www.engr.mun.ca/policies/admissions07.php

Felder, R. M., Felder, G. N., Mauney, M., Hamrin, C. E., Jr, & Dietz, E. J. (1995). A longitudinal study of engineering student performance & retention: III. Gender Differences in Student Performance and Attitudes. *Journal of Engineering Education 84*(2), 151-163.

Felder, R. M., Forrest, K. D., Baker-Ward, L., Dietz, E. J., & Mohr, P. H. (1993). A longitudinal study of engineering student performance & retention: I. Success and failure in the introductory course. *Journal of Engineering Education, 82*(1), 15-21.

Foor, C. E., Walden, S. E., & Trytten, D. A. (2007). "I wish that I belonged more in this whole engineering group:" Achieving individual diversity. *Journal of Engineering Education, 96*(2), 103-115.

Frehill, L. M., Fabio, N. M. D., Hill, S. T., Traeger, K., & Buono, J. (2008). Women in engineering: A review of the 2007 literature. *SWE Magazine, 54,* 34-70.

French, B. F., Immekus, J. C., & Oakes, W. (2003). *A structural model of engineering students success and persistence.* Paper presented at the 33rd ASEE/IEEE Frontiers in Education Conference, Boulder, Colorado.

Gibbons, M. T. (2006). *Engineering by the numbers* (Report). Washington, D.C.: American Society for Engineering Education. Retrieved September 17, 2007, from http://www.asee.org/publications/profiles/index.cfm#Online_Profiles.

Hagedorn, L. S. (2005). How to define retention: A new look at an old problem. In A. Seidman (Ed.), *College Student Retention* (pp. 89-105). Westport, CT: Praeger Publishers.

Higher Education Research Institute. (2006). CIRP freshman survey: The survey instrument. Retrieved October 16, 2007, from http://www.gseis.ucla.edu/heri/cirp_survey.html

Hutchinson, M. A., Follman, D. K., Sumpter, M., & Bodner, G. M. (2006). Factors influencing the self-efficacy beliefs of first-year engineering students. *Journal of Engineering Education, 95*(1), 39-47.

Jamieson, L. H. (2007). *Main plenary: Experiencing engineering.* Paper presented at the 2007 Annual American Society for Engineering Education Conference and Exposition, Honolulu, HI.

Johnson, M. J., & Sheppard, S. D. (2004). Relationships between engineering student and faculty demographics and stakeholders working to affect change. *Journal of Engineering Education, 93*(2), 139-151.

Kirby, D., & Sharpe, D. (2001). Student attrition from Newfoundland and Labrador's public college. *Alberta Journal of Educational Research, 47*(4), 353-368.

Li, Q., McCoach, D. B., Swaminathan, H., & Tsang, J. (2008). Development of an instrument to measure perspectives of engineering education among college students. *Journal of Engineering Education, 97*(1), 47-56.

Lyons, S., Duxbury, L., & Higgins, C. (2005, May 28-31, 2005). *An empirical assessment of generational differences in work-related values.* Paper presented at the Administrative Sciences Association Canada Conference 2005, Toronto, ON.

Marra, R., Bogue, B., Shen, D., & Rodgers, K. (2007). *Those that leave – Assessing why students leave engineering.* Paper presented at the American Society for Engineering Education Conference 2007, Honolulu, HI.

Marra, R., Bogue, B. B., Rodgers, K., & Shen, D. (2007). *Self-efficacy of women engineering students – Three years of data at U.S. institutions.* Paper presented at the American Society for Engineering Education Conference 2007, Honolulu, HI.

Memorial University of Newfoundland. (2008). Memorial University Calendar [Electronic Version]. Retrieved July 15, 2008, from http://www.mun.ca/regoff/calendar.php.

Montano, G. (2007). Program plan: Technology and democracy. Unpublished manuscript. Memorial University of Newfoundland.

NAS. (2006). Generation Y: The millennials ready or not, here they come [Electronic Version]. *NAS Insights*. Retrieved July 21, 200, from http://www.nasrecruitment.com/talenttips/NASinsights/GenerationY.pdf.

National Academy of Engineering. (2004). *The engineer of 2020: Visions of engineering in the new century*. Washington, D.C.: National Academy of Engineering.

National Academy of Engineering. (2005). *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*. Washington, D.C.: National Academy of Engineering.

National Science Foundation. (2006a). *Science and Engineering Indicators 2006: Chapter 2, Higher Education in Science and Engineering*. Retrieved September 17, 2007, from http://www.nsf.gov/statistics/seind06/c2/c2h.htm.

National Science Foundation. (2006b). *TABLE B-10. Undergraduate enrollment in engineering programs, by sex, race/ethnicity, and citizenship: 2005*. Retrieved July 10, 2008, from http://www.nsf.gov/statistics/wmpd/underrl.htm.

Nora, A., Barlow, E., & Crisp, G. (2005). Student persistence and degree attainment beyond first year in college. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 129-153). Westport, CN: Praeger Publishers.

Osmond, M. (2006). Memorial's engineering program gets overhaul [Electronic Version]. *Gazette*, *39*. Retrieved October 1, 2007, from http://www.mun.ca/marcomm/gazette/issues/vol39no1/newspage1.php.

Papadopoulos, G. (2006). Engineering Field Must Have Diversity [Electronic Version]. *CNET News.com.* Retrieved August 3, 2007, from http://news.com.com/Engineering+field+must+have+diversity/2010-1022_3-6122825.html.

Pearson, G., & Young, A. T. (Eds.). (2002). *Technically Speaking: Why all Americans need to know more about technology*. Washington, D.C.: National Academy Press.

Pieronek, C., McWilliams, L. H., Silliman, S. E., Uhran, J. J., Gunty, M. L., & Graf, C. A. (2005). *Beyond the Numbers: A Deeper Look into the Retention of Female Engineering Students.* Paper presented at the 2005 WEPAN/NAMEPA Joint Conference, Las Vegas, NV.

Pieronek, C., Uhran, J. J., McWilliams, L. H., & Silliman, S. E. (2004). *A Demographic Characterization of First-Year Engineering Students.* Paper presented at the 2004 ASEE Annual Conference and Exposition, Salt Lake City, UT.

Prensky, M. (2001). Digital Natives, Digital Immigrants [Electronic Version]. Retrieved October 25, 2008, from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf.

Pritchard, J., & Baillie, C. (2006). How can engineering education contribute to a sustainable future? *European Journal of Engineering Education, 31*(5), 555-565.

Raill, S., & Hollander, E. (2006). How campuses can create engaged citizens: The student view. *Journal of College and Character, 7*(1), 1-7.

Richardson, J., & Dantzler, J. (2002). *Effect of a freshman engineering program on retention and academic performance.* Paper presented at the 32nd ASEE/IEEE Frontiers in Education Conference, Boston, MA.

Rooney, M. (2003). Freshmen show rising political awareness and changing social views. *Chronicle of Higher Education, 49*(21), A35-A38.

Sarkar, G. (1993). *SIAST Retention Study: Factors Affecting Retention of First-Year Students in a Canadian Technical Institute of Applied Science and Technology.* Paper presented at the Canadian Institutional Researchers and Planners Conference. Retrieved October 17, 2007, from http://www.cirpa-acpri.ca/images/proceed1993/sarkar/sarkar.html.

Sax, L. J. (2004). Citizenship development and the American college student. *New Directions for Institutional Research, 2004*(122), 65-80.

Seidman, A. (2005). *College student retention: Formula for student success*. Westport, CN: Praeger Publishers.

Seymour, E., & Hewitt, H. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Sharpe, D. B., & Spain, W. H. (1993). *Student attrition and retention in the post-secondary education and training system in Newfoundland and Labrador*. St. John's, NL: Memorial University of Newfoundland.

Statistics Canada. (2007). Population and dwelling counts. Retrieved March 30, 2008, from http://www12.statcan.ca/english/census06/data/popdwell/Table.cfm?T=802&SR=1&S=0&O=A&RPP=9999&PR=10&CMA=0

Tan, D. L. (2002). *Majors in science, technology, engineering, and mathematics: Gender and ethnic differences in persistence and graduation*. Paper presented at the 42nd Annual Association for Institutional Research Forum. Retrieved July 20, 2008, from http://www.ou.edu/education/csar/literature/tan_paper3.pdf.

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research, 45*, 89-125.

Watson, K., & Froyd, J. (2007). Diversifying the U.S. Engineering Workforce: A New Model. *Journal of Engineering Education, 96*(1), 19-32.

Williams, R. (2003). Education for the Profession Formerly Known as Engineering [Electronic Version]. *The Chronicle of Higher Education, 49*, B12. Retrieved September 17, 2007, from http://chronicle.com/weekly/v49/i20/20b01201.htm

Wilson, M. E. (2004). Teaching, learning, and millenial students. *New Directions for Student Services, 106*(Summer 2004), 59-71.

Wulf, W. A. (2002). The importance of diversity in engineering. In *Managing diversity: Managing the workforce of the future*. Washington, D.C.: National Academy Press.

Appendix

Appendix 1 Ethics Review Approval

MEMORIAL UNIVERSITY

Interdisciplinary Committee on
Ethics in Human Research (ICEHR)

Office of Research
St. John's, NL Canada A1C 5S7
Tel: 709 737 8368 Fax: 709 737 4612
www.mun.ca

December 10, 2007

ICEHR No. 2007/08-037-ED

Ms. Gloria Montano
Faculty of Education
Memorial University of Newfoundland

Dear Ms. Montano:

Thank you for the revised copy of the documents addressing the issues raised by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) concerning your research proposal *"A study on how civic engagement can become a part of engineering student retention"*.

We are happy to confirm our earlier approval of your proposal. If you intend to make changes during the course of the project which may give rise to ethical concerns, please forward a description of these changes to the ICEHR Co-ordinator, Mrs. Eleanor Butler, at ebutler@mun.ca for the Committee's consideration.

The *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans* (TCPS) requires that you submit an annual status report on your project to ICEHR, should the research carry on beyond *December 2008*. Also, to comply with the TCPS, please notify us when research on this project concludes.

We wish you success with your research.

Yours sincerely,

Lawrence F. Felt

Lawrence F. Felt, Ph.D.
Chair, Interdisciplinary Committee on
Ethics in Human Research

LF/bl

copy: Supervisor – Mr. Robert Shea, Faculty of Education

Appendix 2 Request for Support from the Dean's Office

December 11, 2007

Dear Dr. Gosine,

During our earlier meetings, we discussed possible research topics for my work towards a master's of education in post-secondary studies. The result is a research proposal entitled *A Study on How Civic Engagement Can Become a Part of Engineering Student Retention.* In conducting this research, I hope to provide information and recommendations that could improve and enhance the educational experience in engineering at Memorial University.

This study is in support of my long-standing interest in improving engineering education and student retention. In summary, the study has three objectives:

1. to examine what variables engineering students self identify as reasons they persist in engineering
2. to examine what areas of civic engagement appeal to students in an effort to identify areas of local relevance that could inspire academic improvements
3. to apply the results from the first two objectives to develop a practical model for engineering student retention based on a new transmission line model offered by engineering educators

Attached is an abbreviated version of the full proposal that I hope you are willing to support. If so, would you please send an email message regarding your support by December 17, 2007?

Following receipt of your message of support, I will contact the appropriate instructors to request access to students during regular class time. Please note that completion of the first-year student survey is planned for January 14 to February 1, 2008.

If you would like more clarification, I would be happy to meet at a suitable time.

This study has the approval of the Interdisciplinary Committee on Ethics in Human Research at Memorial University (ICEHR No. 2007/08-037-ED).

Sincerely,
Gloria Montano

Office: ED 3011A
gloria.montano@mun.ca
754-7646

cc: John Quaicoe
Rob Shea

attachments:
Master's Thesis Overview for Engineering
Engineering Student Persistence and Interest Survey

Appendix 3 Request for Support from Course Faculty

January 10, 2008

Dear Professor Bruce-Lockhart,

My name is Gloria Montano and I am a graduate student in the Faculty of Education working towards a master's of education in post-secondary studies. As part of my thesis research, I am requesting access to your section of ENGI 2420 Structured Programming in order to solicit student participation.

During the 20+ years that I spent as an engineer in the high tech sector, I developed a long-standing interest in improving engineering education and student retention. My thesis topic, entitled *A Study on How Civic Engagement Can Become a Part of Engineering Student Retention*, has three objectives:

- to examine why engineering students persist in engineering and uncover any differences in the persistence of students admitted into the engineering program under different criteria
- to examine what areas of civic engagement appeal to the first-year students in an effort to identify areas of local relevance that could inspire academic improvements
- to apply the results from the first two objectives to develop a practical model for engineering student retention for possible use at Memorial University

In conducting this research, I hope to provide recommendations to the faculty that could improve and enhance the educational experience in engineering at Memorial University.

This study has the approval of the Interdisciplinary Committee on Ethics in Human Research at Memorial University and the support of the Dean's office.

In order to ensure students that their participation will not affect their grade, you may not be in the room when students are completing the survey. Ideally, explanation of the study and completion of the survey would occur during a regular meeting of the class and take about 20 minutes -- about five minutes to explain and distribute the survey and about 15 minutes to complete the survey. Should this amount of time be excessive, I would happily discuss alternatives. Students will deposit surveys in a secure box that I will make available at the same time the surveys are distributed.

Assuming that you support this effort, would you please email the information requested below to gloria.montano@mun.ca by January 17, 2008?

- Section number
- Available dates. The idea dates would fall between January 14, 2008 and February 25, 2008.
- Starting times and the amount of time allocated

Thank you for your attention. If you have any questions, I may be reached at gloria.montano@mun.ca or 754-7646.

Sincerely,
Gloria Montano

Appendix 4 Explanation of Interview and Consent Form

CONSENT FORM

I, ________________________________, ________________

(name)
(student ID)

☐consent ☐do not consent to participate in this research project, *A Study On How Civic Engagement Can Become a Part of Engineering Student Retention.*

____________________________ ____________________

Signature Date

EXPLANATION OF STUDY

<u>Who am I?</u> My name is Gloria Montano and I am an electrical engineer with over 20 years of experience in high tech companies located in the Silicon Valley. I am also a graduate student at MUN working towards a master's of education and I am requesting your participation in my thesis research project.

<u>The research</u> This research project, entitled *A Study on How Civic Engagement Can Become a Part of Engineering Student Retention*, reflects my long-standing interest in improving engineering student retention through community involvement.

This research requires a survey of students to identify reasons that students persist in engineering and to identify student interest in areas of civic engagement. In conducting this research, I hope to provide recommendations to the faculty that could improve and enhance the educational experience in engineering at Memorial University.

<u>Important points to know</u>

- This survey is confidential and your privacy protected. As the researcher, only I will see the raw data and my written thesis report will not include any names or other identifying information. All data will be stored for a period of five years in a secure file, or encrypted if in electronic form.
- Participation is voluntary and does not affect your grade.
- You may choose to refrain from answering a particular question(s).
- The proposal for this research has been approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 737-8368.
- You may also contact my supervisor, Professor Robert Shea, at rshea@mun.ca or 737-6926.

<u>Instructions</u>

- The survey takes about 15 minutes to complete.
- Complete the consent form at the top of this page and the attached survey.
- Please write legibly and do not remove the staple or separate the sheets.
- Deposit your completed consent form and survey in the secure collection box located in this room.
- If you do not wish to participate, deposit your blank consent form and blank survey in the box as noted above.

Thank you for your attention. If you have any questions about this research, please contact me at gloria.montano@mun.ca or at 754-7646.

Sincerely, Gloria Montano

Appendix 5 Engineering Student Persistence and Interest Survey

(Version 200702)

Your major as of today:

- ☐ Engineering
- ☐ Civil Engineering
- ☐ Computer Engineering
- ☐ Computer Science
- ☐ Electrical Engineering
- ☐ Ocean & Naval Architectural Engineering
- ☐ Other:

Sex:

☐ Male ☐ Female

Which best describes your community of origin?

- ☐ Rural: population < 999
- ☐ Semi-Rural: population 1,000-9,999
- ☐ Semi-Urban: population 10,000-24,999
- ☐ Urban: population > 25,000

Place of Origin:

- ☐ I am from Newfoundland and Labrador
- ☐ I am from a province in Canada other than Newfoundland and Labrador
- ☐ I am from the United States
- ☐ I am from a country other than Canada or the United States

As of today, I am a:

- ☐ First-year student
- ☐ Second-year student
- ☐ Third-year student
- ☐ Fourth-year student
- ☐ Fifth-year student and above

I entered engineering under the following admission mode:

- ☐ Direct Entry from high school
- ☐ Fast Track
- ☐ Entry from within the University
- ☐ Bridging Program
- ☐ Other Entry: Please specify

I am following the course sequence specified for:

☐ Term 1/2 ☐ Transition Term A/B ☐ Not sure

ENGI 2420 - Are you taking this class for the first time?

☐ Yes ☐ No

1. Where were you immediately before your first semester/term at this institution? **(Check one)**

☐ High school
☐ 4-year college or university
☐ Working a full-time job
☐ 2-year college
☐ Military
☐ Working part-time job, no school
☐ Vocational / technical school
☐ Other:

1a. If you checked 2year college or 4-year college or university, tell us the name of the institution:

2. What was your cumulative grade point average at the end of the most recent academic semester/term? _____

3. When did you first enroll in Memorial University (month / year)? _____/ _____

4. Why did you initially decide to major in engineering? **(Check all that apply)**

☐ Attracted by the challenge of a difficult curriculum
☐ Good at math or science
☐ High school adviser or teacher recommended it
☐ Like to solve problems
☐ Like the design work that engineers do
☐ Participated in engineering camp or workshop that influenced me
☐ Parent, other relative or friend is an engineer
☐ Parent, sibling or other relative recommended it
☐ Received or anticipated possibility of good college scholarship
☐ Wanted to be able to get a well-paying job after I graduate
☐ Wanted to use engineering solutions to address social problems
☐ Not Sure
☐ Other:

5. Using the table to the right, check **Yes** or **No** to indicate if you completed any of these **honors** or **advanced courses** during high school.

	Honors/Advanced? Yes	No
Algebra	☐	☐
Biology	☐	☐
Computer science	☐	☐
Pre-calculus	☐	☐
Calculus	☐	☐
Chemistry	☐	☐
English	☐	☐
Geometry	☐	☐
History	☐	☐
Physics	☐	☐
Trigonometry	☐	☐

6. Do you feel your high school coursework adequately prepared you to be successful in an engineering curriculum?

☐ Yes ☐ No Please explain your response:

7. When you began your engineering degree, how confident were you that you would complete it? **(Check one)**

☐ Not very confident; I was already unsure of my plan to study engineering.
☐ I felt there was about a 50% chance that I would complete a degree in engineering.
☐ I was fairly confident that I would complete a degree in engineering.
☐ I was very confident that I would complete a degree in engineering.
☐ Other:____

8. At the present time, how confident are you that you will complete a degree (in any major) at this institution? **(Check one)**

☐ Not very confident; it is highly likely I will not complete an engineering degree at this institution
☐ There is about a 50% chance that I will complete an engineering degree at this institution
☐ I am fairly confident (greater than 50%) that I will complete an engineering degree at this institution
☐ I am very confident that I will complete an engineering degree at this institution
☐ Other:____

9. My plans for the future are to: **(Check all that apply)**

☐ Work in industry
☐ Work in government lab or agency
☐ Go on to graduate school
☐ Go on to professional school (e.g. medicine, law)
☐ Teach at the college or university level
☐ Teach in K-12 schools
☐ Participate in a business start up or start my own business
☐ Enter (or re-enter) the military
☐ Undecided
☐ Other: Please specify ____

10. The following is a list of engineering activities (co-curricular and academic). For each activity **indicate your level of involvement** during the most recent academic term (e.g. Fall 2007).

Activity	Not Involved	1-2 times term	3-5 times term	More than 5 times term
A professional society (e.g. IEEE, ASME, CSME, CSCE)	☐	☐	☐	☐
An engineering student society (e.g. Engineering Undergraduate Society)	☐	☐	☐	☐
A professional or student group for women or minority engineers (e.g. WISE)	☐	☐	☐	☐
Activities sponsored by Women in Science and Engineering or Women in Engineering Program (e.g. CWSEA sponsored activity)	☐	☐	☐	☐
Activities (social or academic) sponsored by your department or major	☐	☐	☐	☐
Design competition teams (e.g. Formula MUN, Concrete Canoe Team)	☐	☐	☐	☐
Undergraduate research experiences	☐	☐	☐	☐
Co-op placement or Professional Internship position	☐	☐	☐	☐
Activities that serve community (e.g. Engineers Without Borders, Habitat For Humanity, Tetra Society)	☐	☐	☐	☐
Activities sponsored by Minority / Multicultural Engineering Program	☐	☐	☐	☐

11. The following is a list of academic and/or academic preparation activities. **Check all the activities in which you engaged** during the last academic term (e.g. Fall 2007)

- ☐ Attended engineering orientation prior to beginning classes
- ☐ Attended summer program designed to prepare me to begin the engineering curriculum
- ☐ Attended review sessions before exams
- ☐ Called or emailed parents or others close friends about difficulties I was experiencing in classes or school
- ☐ Got advice from a mentor in a formal mentoring program
- ☐ Lived in honors or other non-engineering special interest dorm
- ☐ Participated in engineering-focused living arrangement (e.g. dorm, engineering fraternity)
- ☐ Participated in formal or informal study groups
- ☐ Received tutoring for courses where I was experiencing difficulty
- ☐ Scheduled an appointment with a professor and / or graduate assistant outside of his or her office hours
- ☐ Sought help from other engineering students when I experienced difficulties in classes
- ☐ Visited a professor and / or graduate assistant in her or his office hours
- ☐ Visited or emailed an adviser or advising center
- ☐ Visited the Career Center or Co-op Office to seek assistance with job search (e.g. permanent, internship or co-op)

12. Do you currently participate in any college / university athletic activities (intramural or official)? **(check one)**

☐ Yes ☐ No

13. Do you work during the academic year? **(check one)** ☐ Yes ☐ No

14. If you answered "yes" above, approximately how many hours per week are you employed?

	Less than 5 hours	6 - 10 hours	11 - 15 hours	16 - 20 hours	More than 20 hours
On-campus	☐	☐	☐	☐	☐
Off-campus	☐	☐	☐	☐	☐

15. When you have an academic problem in engineering, what do you do?
(Rank your top 3 choices where 1 = highest rank)

_____ Do something social or something that relaxes me (e.g. exercise, read a novel)
_____ Form or join a student study group
_____ I never feel this way
_____ Nothing
_____ Seek academic help at a tutoring center
_____ Spend more time studying
_____ Talk to a faculty member
_____ Talk to a mentor
_____ Talk to engineering adviser and/or advising staff
_____ Talk to other students and/or friends
_____ Talk to my parents or siblings
_____ Visit the International Student Advising Office
_____ Visit the Academic Advising Centre
_____ Visit the office of the Chair for Women in Science and Engineering (CWSEA)
_____ Other:____

16. The following are factors associated with you persisting in your engineering education. For each factor, **choose a column - ranging from No Influence to Significant Influence** - to indicate the degree to which that factor influences your persistence in engineering.

Factor in your persistence	No Influence	Small Influence	Moderate Influence	Significant Influence
Sufficient opportunities for financial aid or scholarships	☐	☐	☐	☐
Engineering faculty/departmental personnel show an interest in me	☐	☐	☐	☐
Reasonable workload of the engineering classes	☐	☐	☐	☐
Friendly climate in engineering classes	☐	☐	☐	☐
Satisfactory performance on my grades in engineering	☐	☐	☐	☐
Faculty help me understand what practicing engineers do	☐	☐	☐	☐
Good teaching by engineering faculty, instructors, or graduate assistants	☐	☐	☐	☐
Effective academic advising by engineering faculty or advisors	☐	☐	☐	☐
Ability to find satisfactory Co-op placements and/or internships	☐	☐	☐	☐
My personal abilities/talents "fit" the requirements in engineering	☐	☐	☐	☐
Confidence in succeeding in engineering future classes	☐	☐	☐	☐
Positive interactions with other engineering students	☐	☐	☐	☐
Positive experiences in design teams or other collaborative learning experiences in engineering	☐	☐	☐	☐

17. What is the **one biggest factor** that helps you persist in your study of engineering?

18. How supportive are your parents/guardians in your decision to study engineering? **(Check one)**

☐ Very supportive of my decision
☐ Somewhat supportive of my decision
☐ Did not have a preference in my decision
☐ Somewhat against my decision
☐ Firmly against my decision
☐ Did not discuss decision with them

19. What could the university or the faculty of engineering do to make the study of engineering more enjoyable or satisfying?

20. Indicate the importance to you personally of each of the following: **(Mark one for each item)**

	Essential Important	Very Important	Somewhat Important	Not Important
Becoming accomplished in one of the performing arts (acting, dancing, etc)	☐	☐	☐	☐
Becoming an authority in my field	☐	☐	☐	☐
Obtaining recognition from my colleagues for contributions to my special field	☐	☐	☐	☐
Influencing the political structure	☐	☐	☐	☐
Raising a family	☐	☐	☐	☐
Having administrative responsibility for the work of others	☐	☐	☐	☐
Being very well off financially	☐	☐	☐	☐
Helping others who are in difficulty	☐	☐	☐	☐
Making a theoretical contribution to science	☐	☐	☐	☐
Writing original works (poems, novels, short stories, etc)	☐	☐	☐	☐
Creating artistic works (paintings, sculpture, decorating, etc)	☐	☐	☐	☐
Becoming successful in a business of my own	☐	☐	☐	☐
Becoming involved in programs to clean up the environment	☐	☐	☐	☐
Developing a meaningful philosophy of life	☐	☐	☐	☐
Participating in a community action program	☐	☐	☐	☐
Helping to promote racial understanding	☐	☐	☐	☐
Keeping up to date with political affairs	☐	☐	☐	☐
Becoming a community leader	☐	☐	☐	☐
Integrating spirituality in my life	☐	☐	☐	☐
Improving my understanding of other countries and cultures	☐	☐	☐	☐
Participating in an organization like Canada World Youth, Katimavic, Engineers without Borders, or the Peace Corps	☐	☐	☐	☐
Engaging with members of my own racial/ethnic group	☐	☐	☐	☐

21. How can a bachelor's degree in engineering, be helpful to your community of origin or anticipated community?

22. What community or civic activities were you involved in within the last three years? Please indicate if you were a participant, volunteer, or organizer. Continue on back of paper if necessary.

Activity	Participant	Volunteer	Organizer
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

Follow up contact

In some cases, additional information may be needed to gain clarity on answers and comments. For example, additional detail or context to your response to open-ended questions such as #19 or #21 could improve my understanding of your intent.

If you are willing to be contacted, please provide your name and email address. Initial contact will be made through email and any subsequent interview would be limited to ½ -1 hour depending on how much you want to respond. Your participation will be kept confidential.

☐ Yes, please contact me
☐ No, do not contact me

Name ______________________ Email address ______________________

Thank you!