

reports

Enrollment Survey

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University Engineering Enrollment Survey: A Summary of the Findings

Prepared by Michael Campbell Robinson Consulting Inc.



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Software Human Resource Council
Conseil des ressources humaines du logiciel

University Engineering Enrollment Survey

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I Introduction

■ Purpose of the survey

In November/December 2004, the Software Human Resource Council (SHRC) carried out an on-line survey of Canadian universities across the country. Part of “The Canadian IT Labour Market Initiative,” the survey was conducted in response to requests from Canadian universities to measure enrollment levels and trends in computer science and engineering programs at the university level. This report presents the key findings from the survey.

■ Survey approach

The survey was distributed electronically to 51 universities (see Appendix A) identified as providing degree programs – at the undergraduate and graduate levels – in any of the following disciplines:

- Computer engineering
- Computer science
- Electrical engineering
- Software engineering
- Mechanical engineering
- Chemical engineering
- Civil engineering

In most cases, the survey was addressed to the dean of the relevant faculty, with a request to forward the survey to another member of the university staff, if appropriate. Respondents were asked to provide actual enrollment statistics (total enrollment, female enrollment and enrollment of foreign students) for the academic years 2002-03 to 2004-05, inclusive, and projected enrollment figures for 2005-06 and 2006-07. In addition, a series of qualitative questions were designed to gather respondents’ views concerning the key factors contributing to recent and projected enrollment levels, as well as their suggestions on what steps might be taken to assist in the enrollment challenges faced by universities.

To maximize the response rate, the research team followed up the e-mail distribution with a phone call to each recipient. Prospective participants were encouraged to respond and invited to ask any questions about the survey. Those who had not responded by the cut-off date received a second phone call reminder.

A total of 17 universities responded – with some schools providing input from several different respondents representing relevant faculties/disciplines. A list of responding universities is provided in Appendix C.

■ How the results will be used

The data is a critical component in developing SHRC’s understanding of the current and future human resource supply and demand issues faced by the IT industry. The Council – together with the Information Technology Association of Canada (ITAC) – will use the information to develop strategies to address the emerging issues from both a university and an industry perspective. The results will be distributed to participating institutions and posted on the SHRC Web site (www.SHRC.ca).

II Key Findings

1. Recent Enrollment Trends

■ Enrollment figures

As shown in Table A, below, total enrollment – including undergraduate and graduate students – remained stable overall among responding universities during the period 2002-03 to 2004-05, decreasing less than 1%. At the same time, the total number of foreign students enrolled in engineering and computer science programs at either level increased 19%, while female enrollment dropped by 14%.

With respect to *undergraduate programs* (Table B), total enrollment for the same period remained relatively stable, with only a 2% decrease overall among the universities responding to the survey. Notably, while the number of foreign students enrolled in undergraduate programs also remained stable during that time, enrollment of women decreased by 18%.

At the *graduate level* (Table B), overall enrollment rose by 9%, while the number of foreign students rose by more than 40% and the number of female students rose only 4%.

In Individual Disciplines:

Some of the notable enrollment findings for individual disciplines are presented below. For a discipline-by-discipline summary of the findings, please see Appendix C.

- total enrollment gains were highest in graduate-level computer engineering programs (+26%), undergraduate software engineering programs (+28%), undergraduate civil engineering (+23%) and graduate chemical engineering (+25%)
- total enrollment losses were greatest in undergraduate computer science and computer science with a specialization programs (-13% and -15% respectively), graduate computer science with specialization (-30%) and undergraduate computer engineering (-19%)
- the number of female students rose significantly in undergraduate computer science (+47%) and graduate computer engineering (+28%),
- the number of female students fell most dramatically in undergraduate electrical engineering (-78%), both undergraduate and graduate computer science with a specialization (-41%) and undergraduate computer engineering (-33%)

Table A:

Actual Enrollment – All Disciplines			
Academic Year	Total Enrollment	Foreign Students	Female Students
2002 – 2003	40362	3004	8818
2003 – 2004	41059	3577	7439
2004 – 2005	40425	3585	7579
% Change 2002 – 04:	<1%	19%	-14%

Table B:

Actual Enrollment – All Disciplines						
Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 – 2003	32914	1587	7113	7448	1417	1705
2003 – 2004	32946	1764	5584	8113	1813	1855
2004 – 2005	32314	1605	5814	8111	1980	1765
% Change 2002 - 04:	-2%	1%	-18%	9%	40%	4%

- the highest enrollment gains among foreign students were in graduate software engineering (+267%), graduate electrical engineering with a specialty (+150%), undergraduate and graduate computer science with a specialization (+47% and +141%, respectively) and graduate computer engineering (+44%)
- enrollment of foreign students fell most significantly in undergraduate programs – electrical engineering (-23%), computer engineering (-17%) and civil engineering (-16%)

In Computing Disciplines

Table C below shows the trends when results for computer engineering, computer science and software engineering are combined. In comparison, Table D shows the results for the remaining programs surveyed (i.e., electrical engineering, mechanical engineering, chemical engineering and civil engineering). The findings show an overall reduction in actual enrollment in computing disciplines of -11% from 2002/03 – 2004/05 and an increase of +8% for other engineering disciplines over the same period. Enrollment of foreign students is up for both groups, while enrollment of female students rose 6% in computing disciplines and fell significantly (-22%) in other engineering disciplines.

■ Contributing factors

Respondents identified a variety of factors as contributors to recent enrolment trends in engineering and computer sciences in universities. Among the key factors/trends cited for *declining* enrolment levels were:

- a decline in overall university enrolment

Table C:

Actual Enrollment in Computer Engineering, Computer Science and Software Engineering

Academic Year	Total Enrollment	Foreign Students	Female Students
2002 - 2003	17290	1009	2485
2003 - 2004	16873	1188	2333
2004 - 2005	15427	1179	2622
% Change:	-11%	17%	6%

Table D:

Actual Enrollment in "Other" Disciplines

Academic Year	Total Enrollment	Foreign Students	Female Students
2002 - 2003	23072	1995	6333
2003 - 2004	24186	2389	5106
2004 - 2005	24998	2406	4957
% Change:	8%	21%	-22%

- declining participation by women (who may see greater opportunities in life and physical sciences, particularly health-related areas)
 - negative attitudes among students (and their parents) that have resulted from the slowing market in new technologies
 - dot-com crash
 - recent employment trends and public perceptions of job opportunities
 - poor public image of the engineering profession (i.e., engineers are viewed as technicians rather than professionals)
 - high school curriculum changes that do not encourage an emphasis on math and sciences
 - competition from faculties of health science for top students (as a result of the media's disproportionate emphasis on health care issues)
 - competition from biotechnology engineering programs
 - the overall costs of a university education (of which tuition is only a small part)
 - the impact of the job market on co-op programs
 - changes in scholarship and housing policies
 - the high degree of difficulty associated with these programs
- Among the factors identified as major contributors to *increasing* enrolment in university engineering and computer science programs were:
- growing interest in computer/electrical/industrial engineering
 - increasing enrolment by women and foreign students
 - increasing CEGEP admissions for major feeder schools (English)
 - for civil engineering – the current market and increased recruitment efforts

- increasing provincial government funding to computer science and engineering schools
- Ontario government education initiatives such as ATOP
- double cohort from high school
- scholarship and financial assistance programs by government and universities

2. Projected Enrollment Trends

■ Enrollment figures

Because of the low response rate from universities on projected enrollment levels for 2005/06 and 2006/07, it is difficult to draw meaningful conclusions. However, an examination of total enrollment data from all institutions providing both recent and projected enrollment statistics indicates an anticipated 10% increase in overall enrollment from 2002/03 to 2006/07, with an almost negligible decrease in women's enrollment and an increase of 47% in foreign students over the same period. An analysis of the projected enrollment figures for 2006/07 relative to current levels (i.e., 2004/05) shows an expected increase of 7% in overall enrollment, with increases of 48% and 13%, respectively, anticipated for foreign and female students over the next two years (Table E).

An analysis of data from all universities providing recent and projected enrollment data showed a rise in enrollment in the following disciplines over the five-year period under study:

- Computer science (+26%)
- Chemical engineering (+16%)
- Civil engineering (+29%)
- Software engineering (+41%)
- Mechanical engineering (+12%)
- Electrical engineering (+14%)
- Electrical engineering with specialization (+10%)

Table E:

Enrollment – Actual and Projected for All Disciplines

Academic Year	Total Enrollment	Foreign Students	Female Students
2002 - 2003	24568	921	3062
2003 - 2004	25354	1283	3039
2004 - 2005	25295	1532	2719
2005 - 2006	26114	1891	2822
2006 - 2007	26953	2275	3066
% Change 2002 - 2006:	10%	147%	<1%
% Change 2004 - 2006:	7%	48%	13%

Table F:

Enrollment – Actual and Projected in Computer Engineering, Computer Science and Software Engineering

Academic Year	Total Enrollment	Foreign Students	Female Students
2002 - 2003	8322	191	654
2003 - 2004	8252	232	673
2004 - 2005	8349	280	639
2005 - 2006	8850	313	867
2006 - 2007	6495	315	639
% Change:	-22%	65%	-2%

A drop in enrollment was projected for the following disciplines:

- Computer science with specialization (-21%)
- Computer engineering (-15%)

Projected enrollment for computing disciplines vs. other engineering disciplines

Table F shows the projected enrollment figures when the findings for computer science, computer engineering and software engineering are combined, while Table G sets out the projections for other engineering disciplines (note: these tables only include the findings for institutions that provided enrollment figures for all five years). The findings show a 15% projected increase over the five-year period under study in

“other” engineering disciplines compared to a substantial decline (-22%) in computing disciplines (the drop in computing disciplines is expected to occur in 2006-2007). As well, a substantially greater increase is predicted in the number of foreign students in “other” engineering disciplines than in computing disciplines (146% and 65%, respectively).

■ Contributing factors

Commenting on the factors/conditions that affected their projections of *increased* enrollment figures for the upcoming two years (i.e., 2005-06 and 2006-07), respondents identified the following:

- positive publicity

Table G:

Enrollment – Actual and Projected in “Other” Disciplines

Undergraduate + Graduate			
Academic Year	Total Enrollment	Foreign Students	Female Students
2002 - 2003	16412	616	2016
2003 - 2004	17373	870	2092
2004 - 2005	17869	1038	1969
2005 - 2006	18251	1267	2033
2006 - 2007	18947	1513	2093
% Change:	15%	146%	4%

- increased recruitment/awareness-raising activities/efforts on behalf of the universities
- markets – e.g., demand by the petroleum industry for graduates of selected disciplines (mechanical engineering, chemical engineering, geological engineering)
- new programs (e.g., mechatronics, biomedica eng., computing major program)

Respondents cited the following factors as contributing to their estimates of *declines* in enrollment:

- limitations imposed by quotas and physical facilities
- trends of decreased enrollment in computer science across Canada
- changing attitudes supporting a more multidisciplinary approach (vs. a technology-driven program)

In addition, several factors were put forward as affecting projections, but were not identified as affecting enrollment either positively or negatively:

- markets
- niche recruitment
- gender and the ethnic diversity of applicants

3. A Case Study

A closer examination of the enrollment data provided by one Canadian university with a large faculty of engineering demonstrate the following:

From 2002-03 to 2006-07 (i.e., including recent and projected enrollment), enrollment is expected to increase in most of the programs for which projections are provided. More specifically, enrollment is expected to:

- decline by 2% in undergraduate computer engineering and increase by 32% in the graduate program
- rise by 5% in undergraduate electrical engineering
- increase by 142% in undergraduate software engineering
- increase by 5% in undergraduate mechanical engineering and rise 34% in the graduate program
- rise by 36% in undergraduate chemical engineering and 20% in the graduate program
- increase by 9% in graduate civil engineering and remain stable in the undergraduate program
- increase by 290% in undergraduate mechatronics engineering

- increase by 2% in undergraduate systems design engineering and by 4% in the graduate program

Other findings of note:

- in all cases in which projections are provided, the number of foreign students is expected to increase – in some cases, by up to 400%
- in all but one case in which projections were provided, the number of female students is expected to rise, although not as significantly as the number of foreign students

4. Taking action

Respondents were asked what, if any, steps should be taken – by governments, the private sector, universities or their associations and secondary schools – to maintain/increase/decrease enrollment in Canadian engineering programs. A summary of responses is provided below.

■ By the federal government

Among the suggested activities for the federal government were:

- encourage programs through increased/adequate/stable funding
- provide grants, bursaries and renewable scholarships
- offer interest-free loans (beyond graduation)
- promote programs through publicity
- emphasize the importance of highly qualified personnel
- simplify the process for student visa applications
- maintain political stability
- increase the number of summer co-op employment opportunities

■ By provincial governments

Respondents urged that provincial governments support enrollment in engineering programs by:

- providing increased funding (for programming and infrastructure)
- offering grants, government bursaries, renewable scholarships
- providing interest-free loans/improving loan remission programs
- recognizing the distinctive differences between technical colleges and university programs
- recognize and promote the role of engineering professions in creating wealth for the province
- promoting an international image

■ By the private sector

Actions appropriately undertaken by the private sector included:

- contributing to scholarship and research programs
- providing financial and in-kind support to activities on- and off-campus (e.g., draw prize donations, events, mentoring opportunities)
- lobbying governments
- partnering with engineering schools to provide students with hands-on experience (i.e., through internship/employment programs)
- taking a “long view” of engineering education and recognizing the potential benefits to the sector

■ By universities

With respect to universities role in enhancing enrollment in engineering programs, respondents suggested the following activities:

- recruit aggressively/promote professional programs aggressively to the larger community
- provide programs that meet industry demands
- expand research and academic facilities
- offer assistance to ensure that students complete programs successfully

■ By secondary schools

According to respondents, secondary schools have an important role to play in enhancing enrollment in universities – for example, they should:

- host in-class visits by recruiters
- promote programs
- encourage female participation in technology programs
- stress mathematics skills and other prerequisites for engineering and science programs
- encourage top students to pursue a university education
- offer career counseling and advertise engineering programs; improve the quality and competency of guidance counselors
- offer bridge programs to ease students’ transition from high school to university
- make a sincere effort to understand the professions and have professional engineers give presentations on “what an engineer does”

Appendixes

Appendix A: List of Universities Contacted

Acadia University
University of Alberta
Athabasca University
Bishop's University
Brandon University
University of British Columbia
Brock University
University of Calgary
Carleton University
Concordia University
Dalhousie University
University of Guelph
The King's University College
Lakehead University
Laurentian University of Sudbury
Université Laval
University of Lethbridge

Malaspina University-College
University of Manitoba
McGill University
McMaster University
Memorial University of Newfoundland
Université de Moncton
Mount Allison University
University of New Brunswick
Nipissing University
University of Northern British Columbia
Okanagan University College
University of Ottawa
École Polytechnique de Montréal
University of Prince Edward Island
Queen's University
University of Regina
St. Francis Xavier University
Saint Mary's University

University of Saskatchewan
Université de Sherbrooke
Simon Fraser University
University of Toronto
Trent University
Trinity Western University
University of Victoria
University of Waterloo
The University of Western Ontario
Wilfrid Laurier University
University of Windsor
York University
University College of the Cariboo
Université de Montréal
Université de Québec École de technologie supérieure

Appendix B: List of Universities Responding

Brandon University
Concordia University
Mount Allison University
Okanagan University College
Queen's University

Saint Mary's University
Simon Fraser University
St. Francis Xavier University
Université de Montréal
Université de Sherbrooke
Université Laval
University of British Columbia
University of Calgary

University of Prince Edward Island
University of Saskatchewan
University of Waterloo
The University of Western Ontario

Appendix C: Summary Data by Discipline

a) Computer Engineering

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	3784	218	410	352	99	58
2003 - 2004	3450	207	365	402	112	79
2004 - 2005	3079	178	273	442	143	74
% Change:	-19%	-18%	-33%	26%	44%	28%

b) Computer Science

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	9333	370	1035	1122	146	265
2003 - 2004	9061	425	939	1218	188	311
2004 - 2005	8166	359	1481	1240	190	300
% Change:	-13%	-3%	43%	11%	30%	13%

c) Computer Science Spec

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	1059	92	291	846	41	288
2003 - 2004	1035	123	249	754	74	231
2004 - 2005	904	135	171	595	99	169
% Change:	-15%	47%	-41%	-30%	141%	-41%

d) Electrical Engineering

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	2980	286	1894	847	205	176
2003 - 2004	2912	292	448	924	241	194
2004 - 2005	2885	219	417	920	240	186
% Change:	-3%	-23%	-78%	9%	17%	6%

e) Electrical Engineering Spec

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	980	76	220	681	72	156
2003 - 2004	957	102	203	771	139	162
2004 - 2005	868	91	174	731	180	149
% Change:	-11%	20%	-21%	7%	150%	-4%

f) Software Engineering

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	736	37	125	58	6	13
2003 - 2004	893	43	145	60	16	14
2004 - 2005	940	53	142	61	22	12
% Change:	28%	43%	14%	5%	267%	-8%

g) Mechanical Engineering

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	4987	118	768	1130	260	185
2003 - 2004	5172	139	742	1211	332	212
2004 - 2005	5392	164	680	1228	323	196
% Change:	8%	39%	-11%	9%	24%	6%

h) Chemical Engineering

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	1867	46	775	427	152	137
2003 - 2004	1915	61	766	527	184	154
2004 - 2005	2088	73	750	534	186	154
% Change:	12%	59%	-3%	25%	22%	12%

i) Civil Engineering

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	2525	116	602	990	196	208
2003 - 2004	2794	122	675	1070	232	227
2004 - 2005	3111	98	738	1056	247	237
% Change:	23%	-16%	23%	7%	26%	14%

j), k), etc) Other: (Includes all “other” categories)

Enrollment – Actual or Projected

Academic Year	Undergraduate			Graduate		
	Total Enrollment	Foreign Students	Female Students	Total Enrollment	Foreign Students	Female Students
2002 - 2003	4663	228	993	995	240	219
2003 - 2004	4757	250	1052	1176	295	271
2004 - 2005	4881	235	988	1304	350	288
% Change:	5%	3%	-1%	31%	46%	32%

The Software Human Resource Council is a non-profit sector council that works for IT (informatics) professionals throughout Canada. SHRC addresses human resource needs related to IT employment in Canada by working with partners from industry, government and education.

Our programs and projects focus on:

- Labour market intelligence
- Skills definition and development (including the Occupational Skills Profile Model)
- Career awareness
- Career development

For more information contact:

Software Human Resource Council
30 Metcalfe Street, Suite 400
Ottawa, Ontario
K1P 5L4

Tel: (613) 237-8551
Fax: (613) 230-3490

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Canada

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