AC 2011-1257: THE EVOLUTION OF A FIRST YEAR ENGINEERING TRANSFER PROGRAM: 1995 - 2010

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The Evolution of a First Year Engineering Transfer Program: 1995 – 2010

Abstract

There is a substantial amount of thought and insight that goes into the development and success of a one year engineering transfer program. As our program has grown from 33 students to over 200 students in 15 years, there have been considerable "growing pains" associated with this process. As a result, the program has evolved. This article speaks to the history and development of a one year engineering transfer program that prepares students to complete a Bachelor of Science in Engineering (B.Sc.) degree at a university that is located in the same city. During this time, our institution has also evolved from a community college to a university, which has had a huge impact on the engineering program as well.

The experience gained through this evolutionary period could be useful to other institutions that are currently going through similar growth. There are many facets of our program (bootcamp) that have been incorporated into other engineering programs, and likewise our program has adopted educational activities that are similar to other institutions. In all cases these changes were made to enhance the engineering education of students and ultimately lead to the successful completion of an engineering degree. The ultimate goal: the success of our students.

This article will focus on many of the educational activities that have been developed over the last fifteen years at our institution, and how we tried to measure their success. In some cases we have continued and enhanced many of the activities, and in some cases we have discontinued or modified them. These activities include a one week bootcamp, extra engineering tutorials, development of an engineering club to facilitate tours, engineering/math student assessment exams, and a Student Night as well as a variety of other additional activities that go towards enhancing the student experience. All of these activities constitute what might be called the "engineering educational experience", which is paramount to learning improvement.

In addition, there will be some discussion regarding the articulation process with our receiving transfer institution. It is essential for the success of the program to develop a strong rapport, with constant feedback regarding student achievement after transfer takes place. It is also essential to maintain close relationships with faculty at the transfer institution regarding course curricula so that the education of the students can have a strong sense of continuity after transfer takes place. It is extremely important to foster a cooperative rather than competitive relationship with the transfer institution. The author will briefly discuss the forums used to achieve these goals.

In summary, the purpose of this analysis is to provide a summary of the development of a one year transfer program in what was once a small community college. The synthesis and discussion of the evolutionary process can provide information which may enhance the engineering educational experience at other institutions. In the last several years, there has been a concerted effort to increase the availability as well as improve the opportunities for an engineering education.

Overview of the Program

The Bachelor of Science in Engineering Transfer program (Engineering program) is a one-year university transfer program at Grant MacEwan University (MacEwan) in Edmonton, Alberta, Canada. Students in the program take courses that are compatible with those courses offered in first year engineering at the University of Alberta (U of A) which is also in Edmonton. Almost all of the students in MacEwan's Engineering program transfer to Year Two Engineering at the U of A. Some students have gone on to pursue engineering degrees at other institutions in Canada, although this is rather atypical. The program has been in operation for over fifteen years. Currently, close to 85% of the students that successfully transfer to the U of A, go on to complete engineering degrees and enter the engineering profession. The U of A offers four year Bachelor of Science degrees in various disciplines of engineering as well as five year co-op degrees (with work experience). Details of the engineering program at the U of A can be found on the Faculty of Engineering website[1].

Historical Perspective of the Region

To provide some context in terms of the size of the institutions (MacEwan and U of A) and their student enrolments, information was obtained from the history of Edmonton website which gives the following data regarding the population for Edmonton during the time period 1995 - 2010:

"Edmonton's population growth, which had slowed through the 1980s and 1990s, resumed with the strong growth of the northern Alberta oil industry in the late 1990s. The city population topped 750,000 in 2008, and the Edmonton region population exceeded one million in the same year"[2]. The engineering expansions at MacEwan coincided with the strong growth in Edmonton's population in the late 1990's. The student enrolments for both the U of A and MacEwan for 1995 and 2010 are provided in Table 1. Currently MacEwan students comprise almost 10% of the second year engineering students at the U of A.

Table 1 - Enrolment statistics for MacEwan and University of Alberta: 1995 & 2010

Year	MacEwan	MacEwan Engineering	% Engineering / Institution Enrolment	U of A	U of A Engineering	% Engineering /Institution Enrolment
1995	~9,000 students	33 students	0.4	~25,000 (undergraduate students)	~ 2,500 students	10
2010	~17,000 students	212 students	1.2	~31,000 (undergraduate students)	~ 4,000 students	12.9

This growth combined with international interest in the program precipitated much of the expansion in the program during its development. During the same time period, MacEwan evolved from a community college to a university, becoming a university in September, 2009.

Historical Background of the Program

The Engineering program at MacEwan was established in 1995. The first classes for the program began in the fall of 1995; straddling the 1995/1996 academic year. The program was established to make first-year engineering studies more accessible in Alberta and, in particular, to increase the opportunities for high school students in Northern Alberta to obtain Bachelor of Science degrees in Engineering. The initial program proposal came about as a result of an overall expansion within the Faculty of Engineering at the University of Alberta (U of A) in a collaborative effort between the U of A and MacEwan. The U of A Faculty of Engineering guaranteed a position in Year Two of their engineering program for all successful Year One engineering students at MacEwan, provided they achieved a minimum academic standing (2.0/4.0) and successful achievement (greater than C- or 1.7/4.0) in a minimum number of courses (30 credits). This guaranteed transfer arrangement began with the original contingent of 33 full-time equivalent students (FLEs) (40 registered students), and continued as the program expanded to 92 FLEs (120 students) in 1999; to 110 FLEs (144 students) in 2008 and; to 164 FLEs (216 students) in 2009. It should be noted that these numbers are admission quotas. It can be seen, later, that the quotas are not completely filled each year.

Table 2a) shows the number of students that were admitted to the Engineering Program at MacEwan in the fall of each academic year from 1999 - 2010, and the number of applications each year (where available). Admission statistics are also provided showing the overall admission averages of the individual students' averages for all of the admitted students based on the courses required for admission (admission details provided in the next section). In addition, the overall averages in the core subjects themselves are also presented. The data for pre-1999 is quite scarce due to a change in the way in which student records were handled. What is available is given in Table 2b).

The number of engineering applications has nearly doubled since 1999, while the enrolment has increased by 6.5 times compared to 1995, yet the overall average admission average for all students has remained relatively stable between 77- 81%. This overall admissions average is used to gauge the academic profile of the student group each year. It is used an internal program indicator. One can see that each time an expansion occurred it took several years to reach the expected student quota. Currently, the program is filling 212/216 spots.

The majority of the students have better grades in the math and science areas, and the weakest grades typically in the English courses. The lowest acceptable grade in English is 50%. The Science averages shown in the tables do not include the English grade.

Table 2a) Admissions data for 1st Year Engineering at MacEwan for 1999-2010

FALL	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Applications	315	305	330	293	462	394	394	437	478	496	535	584
Total Accepted:	109	113	116	119	120	123	122	120	120	142	212	212
Admission Average:	77	76.9	77.6	76.7	79.5	78.6	79.7	79.5	81.1	80.6	79.3	79
Admission Range:	66-93	65-89	70-92	66-90	67-95	65-95	70-92	70-97	71-93	75-93	67-96	71-92
Science Average:	79	78.4	79.3	78.4	81.1	80.4	82	80.9	83.1	82.6	81.2	81.1
Physics Average:	78	77.6	78.7	78.4	80.9	79.9	81	79.7	82.1	78.9	78.8	78.1
Math 30 Average:	80.9	80.8	80.7	80.1	83	82	84	82.9	83.1	81.1	83.0	83.1
Math 31 Average:	78.7	77.6	79.3	77.6	81	80	81	80	83.1	82.1	82.7	81.7
Chem 30 Average:	78	77	78	77	80	79	82	81	84.3	80	80.4	81.4
English 30 Average:	68	70	70	69	73	72	71	73	72.8	71.5	68.0	71
English 30 Range:	50-89	50-90	52-90	50-92	50-96	50-95	53-94	50-92	50-92	54-93	52-99	52-91

Table 2b) Admissions data for 1st Year Engineering at MacEwan pre-1999

Year	1995	1996	1997	1998
# Students Admitted	33	37	41	36

Admission Requirements for Engineering at MacEwan

Students are admitted to engineering at MacEwan based on their averages in the five high school courses (core subjects) summarized in Table 3. The demographics of the students based on their high school averages are presented in Figure 1 for the years 1998 – 2007. This profile closely resembles a normal distribution with the average around 78%. This average confirms the data presented earlier in Table 2a) where the overall high school admission average for each year is in the range of 77% – 81%. Since the U of A uses a cutoff average of 80%, it is expected that the demographic profile of their students is slightly different than MacEwan's, although one would still expect a similar shape to the profile. Access to this data is not available.

In the Alberta school system, courses required for entrance to the program are the highest academic level courses taught in the public school system (except for the academic enrichment programs). The students' marks are based on a combination of work done throughout the school

year (term work), and a final diploma exam, where each contribution is equally weighted. For Math 31 (calculus), there is currently no diploma exam. The admission to the program is competitive; to attract those students with the highest academic achievement. The minimum or cutoff average to enter engineering at MacEwan is currently set at 75%. The cutoff average for engineering at the U of A is set at 80% and sometimes higher, depending on the number of students that apply. Since our institution (MacEwan) is in the same city as the U of A, the institutions share the same student application pool. To date both institutions have been able to fulfill and even exceed admission expectations. Also to date the engineering program at MacEwan has been able to maintain the same admission standards without compromising the academic profile of the student group.

Table 3: Admission Requirements: Core Subjects

Chemistry 30	English 30-1	Pure Math 30 (Algebra)	Math 31 (Calculus)	Physics 30

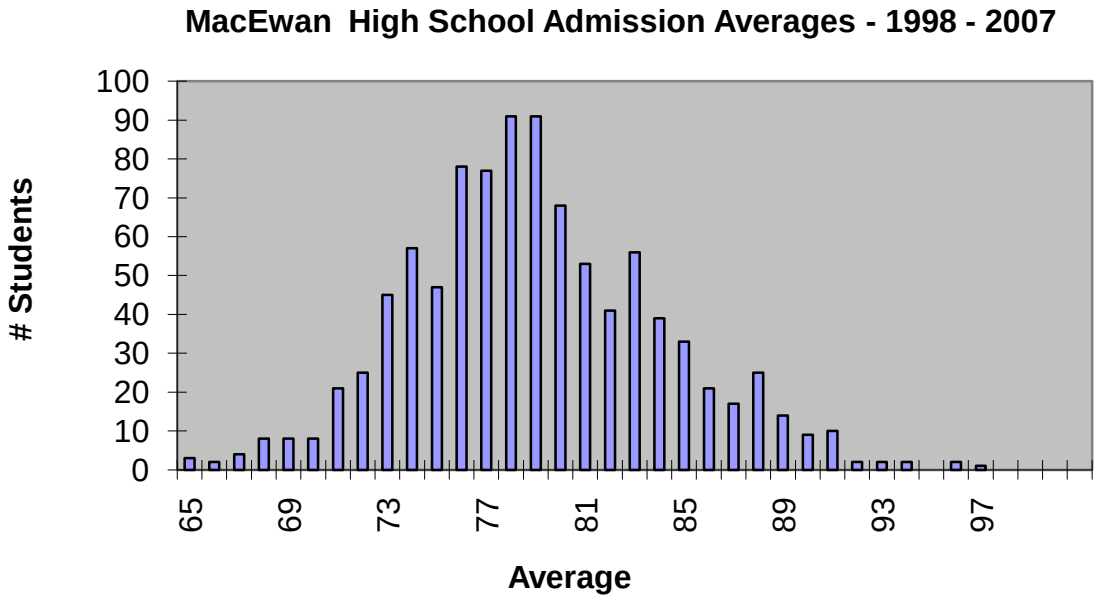


Figure 1 – Histogram of High School Admissions Averages 1998 – 2007 for MacEwan Engineering Students

A chart of the individual high school admission averages versus first year GPAs for each student in the program between1999 and 2006 is shown in Figure 2. Throughout the life of the program, a tremendous amount of data has been collected and examined to the benefit of the operation of the program. The type of information presented in Figure 2 (scatter plot) is very useful in setting and evaluating the admission requirements. When the admission standards were first set in 1995, the cutoff average was set at 65%. However, because the program became increasingly competitive (doubling of applications over a ten year period), this average was driven up to 75%. Analysis of program admission statistics in Figure 2 indicates that the success rate of the students

with high school averages between 65% and 75% is not extremely good. The data in Figure 2 is very scattered, however, when the data is fitted with a linear trend line (shown as a solid line in the figure), it becomes clear that using an admission cutoff of 75% leads to a reasonable expectation for success and transferability, since the trend line GPA at 75% is greater than 2.0, which corresponds to a letter grade of C. This information is used only as a "rule of thumb" to set engineering admissions, rather than as a predictor of academic performance. Clearly, from the figure, it can be seen that there are many students in the 70-75% category that are successful (> 2.0 GPA) in the program. This is not what the trend line alone would predict. The program was established to increase accessibility to engineering education. To this end, it has and continues to meet this goal. Table 4 indicates that, overall, approximately 60% of the students successfully transfer to the U of A. Those that are unable to transfer can redirect their education in other areas at MacEwan or elsewhere.

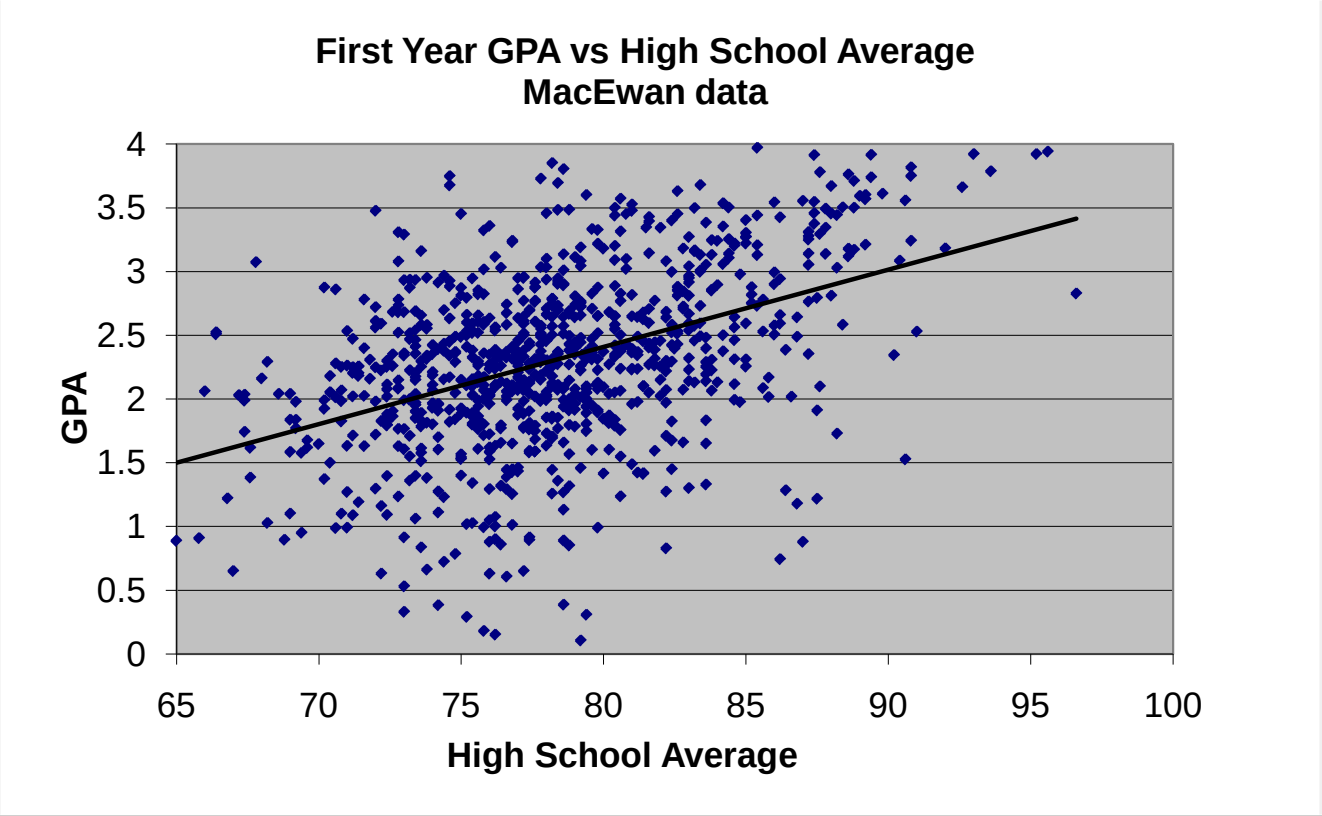


Figure 2 - MacEwan Engineering Student High School Admission Averages versus First Year Grade Point Average (GPA) 1999 - 2006[1]

[1] GPAs at MacEwan have used the 4.0 point scale since the beginning of the program.

Table 4– Number of Engineering Students Transferring to University of Alberta (Engineering - Year Two) from MacEwan (Year indicates Fall Term) 1995 - 2000[2]

Year	1995	1996	1997	1998	1999	2000	2001
#Transferred to 2nd Year U of A	2	19	24	24	21	58	75
Admitted to 1st Year MacEwan	33	37	41	36	109	113	116
% 1st year transferred	--	57.6	64.9	58.5	58.3	53.2	66.3

Year	2002	2003	2004	2005	2006	2007	2008	2009
#Transferred to 2nd Year U of A	76	68	73	65	58	70	76	81
Admitted to 1st Year MacEwan	119	120	123	122	120	120	142	212
% 1st year transferred	65.5	57.0	60.8	52.8	47.5	58.3	63.3	57.0

Program Performance

The performance of the engineering program at MacEwan is monitored internally and externally using a set of key performance indicators. In both cases, the program annually receives a "report card" highlighting the set of key performance indicators (indicative of goals and expectations), and whether or not the program was able to achieve these goals. A sample of an internal "report card" for MacEwan's engineering program (2010) is shown in Figures 3 and 4. Program ratings, in general, range from "A" to "D", with numerical performance scores (5.0 – 10.0) associated with the performance as well. The results for the engineering program for this example are extremely positive, as the program has been rated as an "A" or 9.2/10.0. Figure 4 shows a detailed breakdown of the number of applications and enrolment data, historical satisfaction ratings and transfer rate. The satisfaction ratings tend to fluctuate from year to year, but tend to remain around 90%. The transfer rates are not meaningful for our program as this is a measure of transfer within the institution only. MacEwan's engineering program has been rated as an "A" for the past four years, having obtained the highest grade in the institution since 2005. The internal report card relies on surveys, estimates of cost, admissions information and various other factors to determine program performance. None of the cost information is presented here as it was deemed confidential.

In addition to the report cards that are issued each year, there is another separate process for program evaluation at MacEwan, which provides additional information for the growth and evolution of the program. The program evaluation process itself is a formal process that takes place every five years. Internal and external stakeholders (U of A) are invited to take part in the process to provide feedback for improvement. A detailed report is provided at the end of this process as well as follow-up meetings and discussions. This process is extremely useful as a

[2] The % 1st year transferred uses the 2nd year # transferred divided by the previous year admitted to MacEwan.

measure of program success. Many of the educational initiatives discussed later in this paper precipitated from this program evaluation.

The expansion of the Engineering Program in 1999 came about as a result of the continued demand for engineering studies, and because of the successful implementation of the first year engineering program at MacEwan between 1995 and 1999. The external key performance indicators were the measure of this success. The success of the MacEwan engineering students at the University of Alberta has been monitored by both the University of Alberta and MacEwan throughout the life of the program: on the basis of academic performance of MacEwan students in the second year of their program at the U of A. This constitutes the external annual review of the program. The GPAs of the students in their first year at MacEwan are compared to their GPAs in their second year at the U of A. Tables 5a) and 5b) give a comparison of the first year grade point averages (GPAs) of all of the students from MacEwan with averages in their second year GPAs at the University of Alberta. These statistics confirm that the performance of MacEwan engineering students is consistent with standards set by the Faculty of Engineering at the U of A. The U of A is an accredited engineering program.

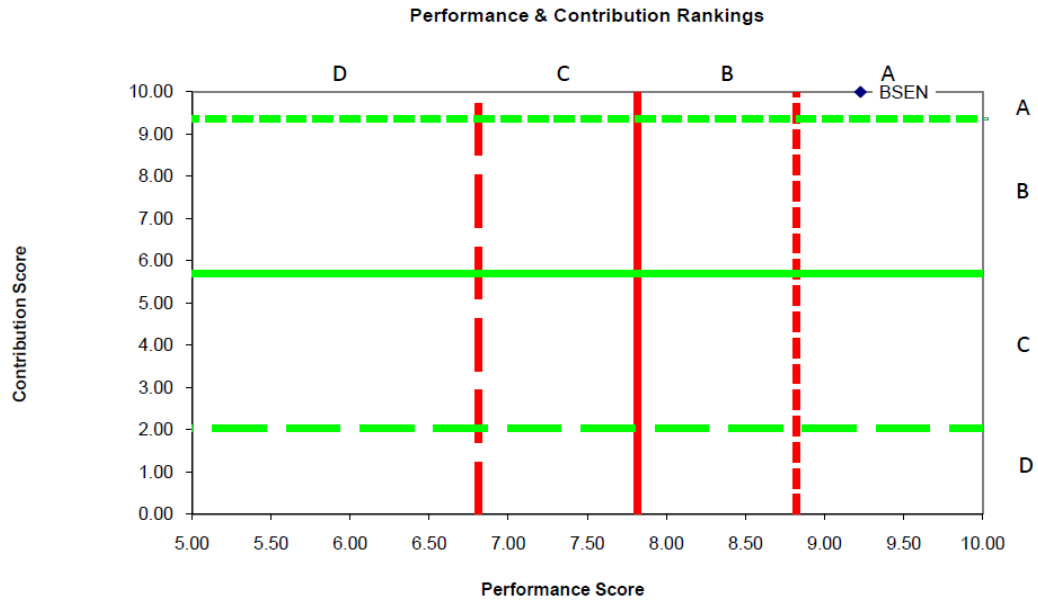
The table also shows, for comparison, the academic performance of those students that completed first year engineering at the U of A compared to their second year performance. The first monitored year (1996) indicated that the students from MacEwan were not doing quite as well as their U of A counterparts. The drop in GPA was -0.5/9.0 compared to -0.1/9.0 for U of A students, so some adjustments were made to the program to improve the academic performance of MacEwan students, and examine the averages of the students for possible grade inflation. Typically, the overall average of the GPAs of MacEwan students is substantially lower than those at the U of A (2.6 compared to 2.9). However, this is consistent with the academic profile of the students that is based on their high school averages in the courses required for admission. The U of A does not admit students with high school averages less than 80%, while there are numerous students admitted to MacEwan with high school averages less than 80%. Consequently, the academic profile of the engineering student body at MacEwan is different than that at the U of A. As such, then, the engineering students at MacEwan must be educated in a way to prepare them for the second year at the U of A so that they will be able to perform to the same academic standards as their U of A counterparts.

Graduation statistics provided by the U of A are presented in Table 6. As the program has been evolving, the graduation rate has been steadily improving. Care should be taken in interpreting these results, since it is quite difficult to track graduation rates accurately. They are quite fluid because many students do not complete their programs in a four year period, and may even graduate in the middle of the academic year. For this reason, the statistics that have been provided are averaged over a three year period. Prior to 2000, the number of students that transferred was very small (<25). After that year, the program had expanded, thereby increasing the number of students transferring. This larger population is probably more representative of the current situation regarding transfer. It is clear, however, in a general sense that the success rate of MacEwan students is not quite as high as the U of A. This is likely due to the difference in the academic profile of the students that are admitted to the engineering program at MacEwan. This has already been discussed: U of A has a cutoff of 80% to enter their first year engineering program, while MacEwan's cutoff average is 75% . The success of MacEwan's engineering

program is reviewed annually by the U of A. Each year a formal letter it sent to MacEwan and all of the other transfer institutions in Alberta regarding student success as well as curriculum compatibility. Currently there are seven transfer institutions and two receiving institutions.

Program Performance Report 2010

BSc Engineering (Transfer)



Performance Measure	*Raw Performance*	*Maximum Performance Target*	*Program Score*	*University Average*	*Program Rank*
Student Demand *(07/08 – 09/10)*	4.6:1	5:1	9.3	5.8	A
Enrolment *(07/08 – 09/10)*	111.1%	110%	10.0	8.6	A
Completion Rate *(02/03 – 07/08, dep. on program type)*	n/a	85% cert. 75% dip. 70% app. deg.	n/a	8.2	n/a
Overall Satisfaction *(04/05 – 08/09, dep. on program type)*	88.9%	100%	8.9	8.2	B
Employment Rate OR Transfer Rate *(Employ: 04/05-08/09; Transfer: 03/04-07/08)*	78.9%	(varies by field) 90%	8.8	8.8 8.4	B
Performance Total			9.2	7.8	A

Figure 3 - MacEwan Engineering Program Internal Report Card – Part I

BSc Engineering (Transfer) Data Summary: 2004 - 05 to 2009 - 10

Performance Report Criteria

Applications Report

BSc Engineering (Transfer)	2004 - 05	2005 - 06	2006 - 07	2007 - 08	2008 - 09	2009 - 10
Quota:	92.00	92.00	92.00	92.00	92.00	164.00
Applications:	394.00	394.00	439.00	480.00	496.00	537.00
Program Ratio:	4.28	4.28	4.77	5.22	5.39	3.27
Faculty/School Average Ratio:	3.39	3.41	2.87	2.93	2.96	3.80
University Average Ratio:	3.08	3.19	2.88	2.93	3.14	3.52

Enrolment Report

BSc Engineering (Transfer)	2004 - 05	2005 - 06	2006 - 07	2007 - 08	2008 - 09	2009 - 10
Plan FLE:	92.00	92.00	92.00	92.00	92.00	164.00
Total FLE:	95.71	89.94	95.63	91.30	117.65	177.75
% of Plan:	104.03%	97.76%	103.95%	99.24%	127.88%	108.38%
Unclassified FLE:	0.00	0.00	0.00	0.00	0.00	0.00

No Data Available For Completion

Satisfaction Report (% fully satisfied)

BSc Engineering (Transfer)		2005 - 06	2007 - 08
Overall Quality	Program	85.00%	96.43%
	Faculty/School	89.83%	90.48%
	University	88.88%	90.97%
Quality of Instruction	Program	87.00%	96.43%
	Faculty/School	85.83%	86.63%
	University	82.27%	83.68%
Relevance of Courses	Program	85.00%	96.43%
	Faculty/School	83.39%	83.49%
	University	82.69%	83.87%

Employment/Transfer Report

BSc Engineering (Transfer)	2005 - 06	2007 - 08
Transfer Same:	63.50%	82.14%
Transfer Different:	13.50%	7.14%
Faculty/School Transfer Same Avg:	35.47%	54.64%
University Transfer Same Avg:	45.21%	64.08%

Figure 4- MacEwan Engineering Program Internal Report Card - Part II

Table 5a) – Comparison of GPAs (9.0 point scale) of MacEwan engineering students to U of A students (Year indicates Fall Term at U of A) for period 1996 – 2002[3]

Year	1996	1997	1998	1999	2000	2001	2002
MacEwan Year One GPA	6.1	6.2	6.3	6.3	6.4	6.0	6.2
MacEwan Year Two GPA at U of A	5.6	6.0	6.0	5.8	6.0	5.6	6.1
Change	-0.5	-0.2	-0.3	-0.5	-0.4	-0.4	-0.1
U of A Year One GPA	6.5	6.6	6.6	6.6	6.7	6.7	6.6
U of A Year Two GPA	6.4	6.4	6.5	6.5	6.6	6.6	6.7
Change	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	0.1

Table 5b) – Comparison of GPAs (4.0 point scale) of MacEwan engineering students to U of A students (Year indicates Fall Term at U of A) for period 2004– 2009

Year	2004	2005	2006	2007	2008	2009
MacEwan Year One GPA	2.6	2.8	2.6	2.7	2.8	2.7
MacEwan Year Two GPA at U of A	2.6	2.6	2.5	2.6	2.6	2.6
Change	0.0	-0.2	-0.1	-0.1	-0.2	-0.1
U of A Year One GPA	2.9	2.9	2.9	2.9	2.9	3.0
U of A Year Two GPA	3.0	2.7	2.9	2.9	2.9	2.9
Change	0.1	-0.2	0.0	0.0	0.0	-0.1

[3] Note: Data was not available for 2003 due to the change in performance scale at U of A (9.0 to 4.0 point).

Table 6 – Comparison of Graduation Statistics between MacEwan and U of A Students 2000 - 2006

MacEwan 2nd Year Average Enrolment	U of A 2nd Year Average Enrolment	Years Averaged	Average Number Graduating MacEwan	Average Number Graduating U of A	MacEwan Graduation Rate in %	U of A Graduation Rate in %
23	413	2000 to 2003	17	352	74	85
34	422	2001 to 2004	22	380	65	90
49	431	2002 to 2005	43	404	88	94
64	406	2003 to 2006	54	381	84	94

Typically the transfer students apply to Year Two at the U of A or University of Calgary This paper does not address details of the other transfer institutions, nor that of the U of C, however, there is a regular exchange of information amongst all of the institutions in Alberta involved in engineering education. Representatives of each transfer institution meet with representatives of the U of A and U of C to form what is referred to as an "Articulation committee". This group gets together annually to discuss matters that are pertinent to the development of a cohesive set of standards for the engineering educational process. The U of A and U of C set the transfer guidelines and establish standards for curriculum. This articulation process has been extremely helpful in guiding the development and evolution of the program.

Engineering Curriculum at MacEwan & Transferability

The curriculum for the Engineering program at MacEwan is strongly defined by the curriculum in first year engineering at the University of Alberta. Since engineering programs in general are accredited, the curriculum must be consistent with the collaborative university program which is accredited (University of Alberta). A summary of the first year engineering courses for MacEwan is provided in Table 7. These courses are virtually identical to those at the U of A, except for minor differences in course numbers, and the amount of course instructional hours.

All of the courses offered by the Engineering program at MacEwan are transferable (if successfully completed) to Year Two at the University of Alberta. Typically, students in the program will complete 40 credits and must achieve a minimum grade point average of 2.0/4.0. There is a guaranteed transfer arrangement with the University of Alberta, whereby those students that successfully complete 30 credits with a minimum grade point average of 2.0/4.0 will be offered admission to Year Two engineering at the University of Alberta. Some of these

courses would be transferable to a general Bachelor of Science degree, if the student did not pursue engineering. Many of the engineering courses have course equivalencies that are transferable to other institutions in Alberta.

Table 7– First Year Engineering Courses at MacEwan

First Term (1st Year)	**LSEH (Hours per term)**	**Credits**
ENGG 100 – Introduction to the Engineering Profession I	15.0	1.0
ENGG 130 – Engineering Mechanics I (Statics)	75.0	4.0
PHYS 130 – Wave Motion, Optics and Sound	63.0	3.8
MATH 100 – Calculus I	71.0	4.0
ENGL 199 – Essentials of Writing for Engineering Students	45.0	3.0
CHME 103 – Introductory University Chemistry I	78.0	4.3
Second Term (1st Year)	**LSEH (Hours per term)**	**Credits**
ENGG 101 – Introduction to the Engineering Profession II	15.0	1.0
ENPH 131 – Mechanics (Dynamics)	78.0	4.3
ENCP 100 - Computer Programming for Engineers	81.0	3.8
MATH 101 – Calculus II	58.0	3.5
MATH 102 – Applied Linear Algebra	58.0	3.5
CHME 105 – Introductory University Chemistry II	78.0	3.8

One of the growing pains associated with the expansion of the program in the last fifteen years, is the growth in the size of the lecture components of the classes and increased contact hours with students. The lectures have grown from 33 students to 72 students during that time period. The lab and seminar class sizes have remained the same due to constraints in the physical size limitations of the laboratories. Though the curriculum itself has remained the same, the delivery of the curriculum has changed as well. In many instances faculty are making use of new technologies such as MasterEngineering©[3] and MasteringPhysics©[4] to supplement the delivery of course material.

Program Objectives

Setting the objectives for MacEwan's engineering program is strongly driven by the processes that have been summarized in this article thus far. One of the main objectives of the program is to ensure that students from our engineering program are successful in Year Two at the U of A (short term goal). In the long term, the goal is to prepare these students to go on to complete their studies in engineering and become productive engineers in the profession. To this end, the program offers extra tutorials, a boot camp introductory week prior to the start of classes, and

strong instructor interactions with the students. It is also extremely important that the students that transfer to Year Two maintain at least the same level of academic achievement that was obtained in Year One in our Engineering program. This leads to a second objective of the program; to maintain academic standards that are consistent with first year engineering at the University of Alberta, and in a more general sense, Canadian standards. There is a strong commitment to teaching by the instructors at MacEwan, since the focus of the institution prior to 2009 was predominately teaching. They strive to prepare the first year engineering students to take their place in Year Two at the U of A. The third objective of the program is to provide seamless transfer to the receiving institution.

The change in MacEwan's institutional mandate from community college to university coincided with the growth of the engineering program and this gave rise to many "growing pains" for the program itself. Competition for resources across the institution has led to changes in the way in which the program has been delivered. As a part of the program evaluation process, the overall instructional profile for the engineering program was examined for the period 1998 to 2006. Table 8 shows this history of the instructional category of instructors teaching the engineering courses during this period. The categories are "Full time", "Sessional" and "Term". At MacEwan the sessional and term instructors are hired into contract based positions which may or may not exist from year to year. Term instructors usually teach for eight months of the year. It is this aspect of this changing profile that provides a challenge to maintain consistency in the program. In 2006, only 60% of the instruction in engineering was done by full time instructors, whereas in 1998, this number was 100%. Since this data was collected before the engineering expansion took place, and also prior to the institution becoming a university, it is probable that this challenge continues to exist to date.

Table 8 – Percentage of Instructor Type Teaching in the Engineering Program by Term and Year from 1998 – 2006[4]

Term/Year	Full time	Sessional	Term	Grand Total	%FullTime	%Sessional	%Term
Fall/1998	417			417	100	0	0
Fall/1999	825		216	1041	79	0	21
Fall/2000	807		198	1005	80	0	20
Fall/2001	807	90	162	1059	76	8	15
Fall/2002	861	165	339	1365	63	12	25
Fall/2003	795	225	345	1365	58	16	25
Fall/2004	585	30	405	1020	57	3	40
Fall/2005	588		537	1125	52	0	48
Winter/1999	474		36	510	93	0	7
Winter/2000	1059			1059	100	0	0
Winter/2001	792		240	1032	77	0	23
Winter/2002	1005	60	18	1083	93	6	2
Winter/2003	1017	105	96	1218	83	9	8
Winter/2004	690	105	393	1188	58	9	33
Winter/2005	729	90	354	1173	62	8	30
Winter/2006	594	15	396	1005	59	1	39

[4] Units of measurement for teaching loads are LSEH (a form of instructional hours).

Educational Activities

Many of the educational activities at MacEwan were established according to the program objectives in a cause and "perceived"effect relationship. The causal aspect of this relationship is driven by the key performance indicators, and the "perceived" effect tends to be a qualitative analysis of the outcomes of the activities. In most cases a direct measure of the success of an activity is not possible, since the entire academic experience is governed by many different parameters: some that can be controlled and measured, and others that cannot. Grade point averages, and admissions averages can be examined statistically, as well as student numbers, but there are many non quantifiable parameters that contribute to the entire educational experience which cannot be measured. In most cases, activities are initiated to improve the educational experience, hoping that this in turn will improve academic performance. A summary of educational activities that have been tried or are ongoing is presented below. Each activity is identified with a rationale for its development along with a perceived perception of its success or lack of success.

- **BootCamp -** Bootcamp (a series of remedial sessions shown in Figure 5) for MacEwan engineering students was established in 1999 as a result of the performance assessment done by the U of A prior to this date. Even though the students performed within the acceptable limits (-0.5/9.0 which corresponds to -0.22/4.0), steps were still taken to improve the academic performance of MacEwan students to further ensure the future success of the program. Since the average drop in MacEwan GPAs (see Tables 5a) and 5b)) between 2004 and 2009 was -0.12/4.0, (an improvement from the previous data), the bootcamp activity was perceived to be a success. Each year, satisfaction surveys indicated that the students fully supported this educational activity with a satisfaction rating typically of 4.5/5. The bootcamp concept has been adopted by two other transfer institutions in Alberta in a fashion similar to the template provided in Figure 5. The template has been provided to show a breakdown of what is covered during this activity.

- **Math Advisory Exams –** Math Advisory exams were implemented because of a desire to assess the math skills of the engineering students at the beginning of their first year. The hope was that this could be used as a performance indicator to improve the academic performance of MacEwan students (both pre and post transfer). At the same time, the bootcamp concept was being developed. So, the Math Advisory exams were offered as a mandatory part of bootcamp. This was done to determine the mathematical skill level of the students entering MacEwan's engineering program and to provide program data to analyze. The results of this exam are also provided to the students almost immediately after they take the exam, so that they are aware of their math skill level compared to the academic expectations of the engineering math courses. Typically, on average the students score just over 50% on this exam. This is surprising to many of the students since they have high school averages 75% or better. The students' performances on this exam confirm the instructors' perceptions that the students do not have an "acceptable" skill level in mathematics to succeed in first year engineering. Each year after this exam, the students request math tutorials to improve their skills in this area.

FIGURE 5 - ENGINEERING BOOT CAMP SCHEDULE

TIME	8/31/09 MON		TIME	9/1/09 TUES				TIME	9/2/09 WED						TIME	9/3/09 COLLEGE ORIENTATION MOR THURS						TIME	9/4/09 FRI					
9:00 - 10:15 am	INTRODUCTION		*8:00 - 12:00 noon*	Library Intro	SRC	Time Mgmnt	Eng Assess Exam	*9:00- 10:20 am*	MATH3			ENGG2			*8:30 - 12:00 noon*	Registration						*9:00- 10:20 am*	CMPT1			MATH4		
	Math Advisory Exam		*8:00 - 8:50 am*	Group 1	Group 2	Group 3	Group 4		Groups			Groups											Groups			Groups		
				(54)	(54)	(54)	(54)		1 & 2			3 & 4											*A, B & C*			3 & 4		
	(216)		*9:00 - 9:50 am*	Group 2	Group 3	Group 4	Group 1		(108)			(108)											(108)			(108)		
10:15 - 10:30 am	BREAK			(54)	(54)	(54)	(54)	*10:20 - 10:30 am*	BREAK												*10:20 - 10:30 am*	BREAK					
10:30 - 12:00 noon	Guest Speakers		*10:00 - 10:50 am*	Group 3	Group 4	Group 1	Group 2	*10:30 - 12:00 noon*	ENGG2			MATH3											*10:30 - 12:00 noon*	MATH4			CMPT1		
				(54)	(54)	(54)	(54)		Groups			Groups												Groups			Groups		
			11:50 am	Group 4	Group 1	Group 2	Group 3		1 & 2			3 & 4												1 & 2			*D, E & F*		
	(216)			(54)	(54)	(54)	(54)		(108)			(108)												(108)			(108)		
Noon - 1:00	BREAK		*Noon - 1:00*	BREAK				*Noon - 1:00*	BREAK						*Noon - 1:00*	Orientation Luncheon (Clock Tower)						*Noon - 1:00*	BREAK					
1:00 - 2:30 pm	MATH1	ENGG1	*1:00 - 2:30 pm*	CHEM1		MATH2		*1:00 - 5:00 pm*	PHYS1			CHEM 2			*1:00 - 5:00 pm*	PHYS1			CHEM2			*1:00 - 5:00 pm*	PHYS1			CHEM2		
	Groups	Groups		Groups		Groups			Group			Group				Group			Group				Group			Group		
	1 & 2	3 & 4		1 & 2		3 & 4			220			222				221			220				222			221		
	(108)	(108)		(108)		(108)			(72)			(72)				(72)			(72)				(72)			(72)		
2:30 - 2:45 pm	Break	Break	*2:30 - 2:45 pm*	Break		Break			Break			Break				Break			Break				Break			Break		
2:45 - 4:15 pm	ENGG1	MATH1	*2:45 - 4:15 pm*	MATH2		CHEM1			Groups			Groups				Groups			Groups				Groups			Groups		
	Groups	Groups		Groups		Groups			55	56	57	61	62	63		58	59	60	55	56	57		61	62	63	58	59	60
	1 & 2	3 & 4		1 & 2		3 & 4																						
	(108)	(108)		(108)		(108)			(24)	(24)	(24)	(24)	(24)	(24)		(24)	(24)	(24)	(24)	(24)	(24)		(24)	(24)	(24)	(24)	(24)	(24)

- **Engineering Assessment Exam -** Since the Math Advisory exam had provided useful information for the program about the mathematical skill level of the engineering students, an engineering assessment exam was introduced during Bootcamp 2008. The Engineering Assessment exam, also mandatory, is based on the Force Concept Inventory exam[5] developed by Hestenes et al.[6] This exam is used to explore the students' understanding of engineering concepts, as well as obtain data that might prove useful to the program itself. The average on the engineering assessment exam for the past three years has been just under 55%. This average seems to be declining each year, although there is not enough data yet to substantiate this trend. Up until now the data has been used only by the students as self assessment. From the program perspective, the results are also used to gauge the skill level of the students. This year the test will be applied in a pre and post fashion to see how this information could be used to study the effectiveness of their first year learning experience.

- **Tutorials –** Tutorials in Math, Chemistry and Statics and Dynamics were initiated at the request of the students. Tutorials have been an ongoing initiative for at least the last ten years. Tutorials are a remedial activity, similar to that of bootcamp. However, bootcamp is a one- time intensive initiative at the beginning of the year, while tutorials typically are given weekly or as needed. In tutorials, students are provided with individual extra help as they need it, whereas bootcamp delivers remedial information in a lecture format. Both bootcamp and tutorials require additional support from teaching faculty to provide this extra service.

- **Student Night –** Student Night is an important event at MacEwan. This is a team building social event that recognizes students, and provides current students the opportunity to interact with former students. Former students become guest speakers at this annual event. They share their experiences at MacEwan and at the U of A, with the students that are currently enrolled in the program. It has been an extremely successful event in terms of establishing networking opportunities for MacEwan students. Through this event we are able to maintain contact with MacEwan engineering alumni, thereby fostering the reputation and success of the program. In 2010, forty former students attended the event. Student satisfaction with the program is clearly demonstrated in this event by the amount of participation that takes place each year.

- **Engineering Club –** An engineering club was established in the Fall 2009 to facilitate the arrangement of tours and define an engineering entity at the university. With the evolution to the increased size of the student body, it was no longer an option to tour all of the engineering students, as had been done in the past. Students formed the engineering club so that small groups could be organized go on a variety of "engineering tours". Several tours were organized, so the activity was deemed successful. However, it is difficult to scientifically quantify this success.

- **Student Program Advisory Committee (SPAC) –** SPAC is a committee of student representatives that meets twice a year with the Program Chair and Student Advisors. This committee is mandated by the institution, so it must be formed each year. It is difficult to measure its success, but the feedback provided through this group has provided many suggestions for educational activities and improvements to the program. This activity is perceived to be extremely useful and successful.

- **Participation in external projects/competition –** Several groups have participated in bridge building contests at the U of A and other external projects. It has been very difficult to measure the success of this activity. The student feedback on this type of activity is very positive. However, the students devote a tremendous amount of time to these activities and it is difficult to gauge whether or not this is detrimental to their grades. Examination of the literature regarding first year programs indicates that this activity is an essential part of an engineering education[10].

- **StrengthsQuest –** This educational activity is based on a personality assessment tool called StrengthsQuest that was developed by Gallup[8]. It came about as a result of participation of a faculty member in a leadership conference. There is a substantial amount of literature linking personality types of engineering students to their academic success[9]. At MacEwan, this tool was used as a reflective exercise for students in the introductory professional engineering courses (ENGG 100 and ENGG 101). At the same time data has been collected, starting in 2009, to determine a strengths profile for first year engineering students at MacEwan. The preliminary results are presented in Figure 6. This research is ongoing.

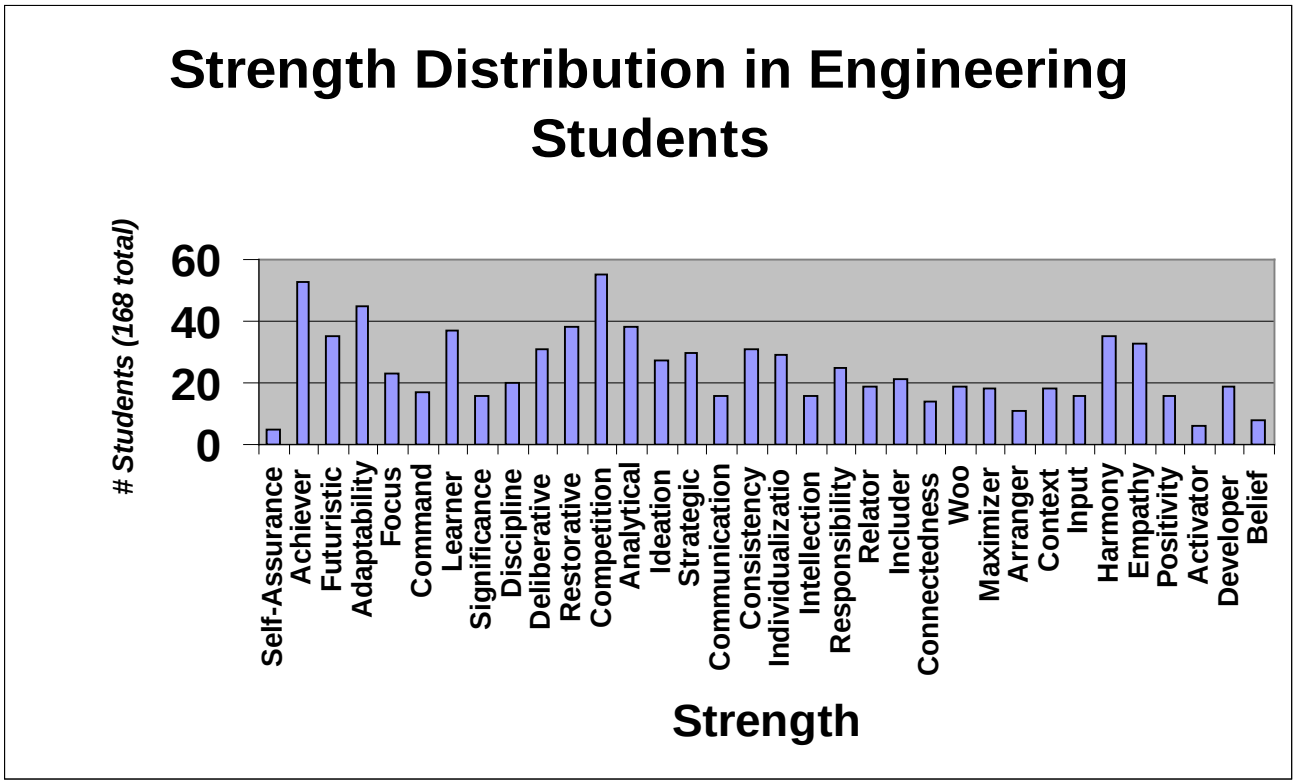


Figure 6 - StrengthsQuest Distribution for MacEwan Engineering Students First Term 2009

The response of the students was extremely positive. The research was initiated to determine whether or not first year engineering students had a "unique" strengths profile, and whether or not this could be used to improve the delivery of instructional material through a better understanding of the nature of the first year engineering student. It is very interesting that two of the top five strengths of the students are "Competition" and "Achiever".

Comparison with Other 1st Year Engineering Programs

In pursuit of information in writing this historical summary of the first year engineering program at MacEwan, a quick literature survey was conducted to get a sense of the nature of other first year engineering programs particularly in the US and Canada. A survey of first year engineering programs (predominately US) was presented at the 2005 ASEE Annual Conference[10]. Although this article doesn't speak to the measured success of the programs that responded to the survey, it certainly provides a "valuable reference for educators who are establishing, modifying, or evaluating first year programs". This article has confirmed many of the observations presented in the article such as: mathematical weaknesses in engineering students entering first year and the lack of readiness of students to study engineering. The study also confirmed the use of a standardized curriculum in first year. The review has indicated that the curriculum used at many of the institutions in the US is very similar to the curriculum outlined in Table 6 that is currently being delivered at MacEwan. Many of the educational activities described herein are used by many of the respondents to the surveys conducted by Brannan and Wankat.

Summary

This paper was written to be reflective as well as to summarize the focused attempts to quantify success and continued success in a first year engineering transfer program. If meeting key performance indicators is an acceptable measure of success, it is clear from this historical summary that MacEwan's engineering program has successfully satisfied its objectives in a "measurable" way through external and internal key performance indicators. It has satisfied these objectives through a definitive time period. At the same time, if student satisfaction is also crucial in this measure of success, again, MacEwan's engineering program has successfully satisfied its objectives. It is clear from the amount of research devoted to engineering pedagogy in general, that the success of engineering education is very multi faceted and the outcomes are really not so easily measured. Finally the question has to be asked: What really makes a first year engineering transfer program successful?

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