Report of the Academic Programme Review Committee
For the Department of Computer Science
Memorial University of Newfoundland

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November 7, 2002

Table of Contents

List of Tables

1.   Summary of the Review Procedure

Members of the Review Committee met with Dr. E. Simpson (Vice-President, Academic), Dr. C.R. Lucas (Dean of Science), and Dr. C. Jablonksi (Interim Dean of Graduate Studies) on the evening of October 2, 2002. This meeting provided an opportunity for discussion of general issues such as the place of the Computer Science Department within the University, and identification of specific issues that the Review Committee might usefully consider during its meetings with the Department.

Over the next two days the Review Committee members toured the departmental teaching and research facilities, and met with:

- faculty members as a group on two occasions focused on undergraduate issues, and graduate studies and research issues, respectively;
- two faculty members individually (at their request);
- undergraduate students, mostly in the 3rd and 4th years of the program;
- 1 departmental PhD student, and 1 MSc student from the Computational Science program;
- administrative staff;
- systems support staff;
- instructional assistants;
- the person who last held the position of Internship Co-ordinator (this position is now vacant);
- a group consisting of representatives of units having academic ties with the Department of Computer Sciences. The units represented were the School of Business, the Faculty of Engineering & Applied Science, and the departments of Economics, Geography, Mathematics & Statistics, and Physics & Physical Oceanography;
- the Interim Head of Computer Science, Professor Jane Foltz, on multiple occasions over the two days;
- the Dean of Science and Associate Dean of Science, Dr. Grant Gardner.

Our discussions with these individuals and groups augmented information contained in the Self-Assessment document that the Computer Science Department supplied to us.

We were disappointed that some faculty members did not provide copies of their CVs, and that some faculty members who were on campus did not participate in any of our meetings. A thorough and balanced review of the Department was made more difficult by this lack of participation.

Recommendation 1-1: *Every effort should be made to ensure that future Academic Review Committees receive at least a current CV from all faculty members in the unit being reviewed, and that these CVs be prepared according to some consistent guideline.*

2. Summary of Key Issues

This section of the report summarizes what we believe to be the most significant issues confronting the Computer Science Department. Although each of these issues is discussed in greater detail elsewhere in the report, we have brought them together into a separate section in order to emphasize their importance.

2.1 Poor Communication at all Levels

All members of the Computer Science Department who met with the Review Committee identified the search for a new Department Head as being the most pressing issue facing the Department. We agree that this is an extremely important issue that must be resolved speedily. However, we believe that this issue is not just a cause but also a symptom of other fundamental problems.

There appears to be a breakdown in communication amongst members of the Department, between the Department and other academic units of the University, and between the Department and more senior levels of the University Administration. Against this background of poor communication, the absence of a permanent Head has become a focal point for all manner of dissatisfaction, and an easy excuse for lack of personal commitment to departmental improvement. Mistrust, rumours and cynicism flourish in the absence of communication.

Recommendation 2-1: *Improvement in communication could usefully start with more open and regular dialogue between the Department and the Dean of Science regarding progress in the search for a Head.*

We were told about serious interpersonal conflicts between faculty members, and about cliques that have nucleated around various individuals over the past few years. We did not hear, nor did we wish to hear, the names of people involved or the history of their quarrels. Such cliques are divisive, form an impediment to a properly functioning department, and are another symptom of poor communication.

Recommendation 2-2: *We recommend that the Department hold a retreat with a professional mediator to recognize and resolve interpersonal conflicts prior to the arrival of a new Head. Such conflicts must not be allowed to compromise the effectiveness of a new Head or to limit the possibility of attracting a good person to this position.*

2.2 Assuming Responsibility for the Department's Future

We have been told by each of the Vice President Academic, the Dean of Science and the Interim Dean of Graduate Studies that they regard the Computer Science Department as important to the academic future of Memorial University. Of course every other department is pressing for an increased share of a fixed budget. These administrators cannot justify increased resources for the Computer Science Department until they are

convinced that the resources will be used in a productive way. It is up to the Department to make its own case. Although there is no question that having a permanent Head would help to do this, the Department's future cannot be left entirely in the hands of one person who is yet to be appointed.

Recommendation 2-3: *We urge all the members of the Department to begin collegial discussions aimed at addressing at least some of the resource-related problems that they themselves have identified. They must stop dwelling on past difficulties and start taking individual and collective responsibility for their future.*

2.3   Strengths on Which to Build the Department

The Computer Science Department has many resources on which to build a strong future. The following are but a few examples.

Although its undergraduate enrolment has declined over the last few years, the Computer Science Department is still among the most popular disciplines in the Faculty of Science, as judged by the number of undergraduate degrees awarded. This decline could be halted and reversed with a bit more attention to the content and delivery of the undergraduate program. There are excellent, but as yet largely untapped, opportunities for collaboration with other academic units in the University. Representatives of the School of Business, the Faculty of Engineering, and the departments of Economics, Geography, Mathematics & Statistics, and Physics & Physical Oceanography all expressed interest in closer collaboration with Computer Science. These collaborations could make the undergraduate program easier to deliver, more attractive to a wider range of students, and consistent with national and international trends toward broadening the intellectual scope of Computer Science. We are pleased to see that the Department is currently undertaking a review of its Undergraduate Program, and has already identified many needed changes and new opportunities.

Recommendation 2-4: *The Computer Science Department should move expeditiously to complete the review it has started of its Undergraduate Program. This review should involve consultation with members of cognate areas around the University so as to maximize the very real opportunities for fruitful collaboration.*

Graduate enrolment in the Department has declined to levels where the program is in jeopardy. We believe that, with the cooperation of the School of Graduate Studies, resources currently existing within the Department could readily support 10 to 15 graduate students rather than the 5 that are now enrolled. It is not unreasonable that further funds could be found to increase the graduate program to a steady state of around 25 students in the long run. The Department could do much more to attract good graduate students, in particular from the ranks of its own undergraduate students. As in the undergraduate program, opportunities abound for exciting teaching and research collaboration with other academic units in the University.

Approximately half of the current faculty members receive some level of external research funding. This is a solid basis for involving more faculty members in research and graduate student supervision. We note that training of Highly Qualified Personnel is an increasing focus for NSERC. There is a real danger that those faculty members now receiving funding may have difficulty retaining this funding unless more graduate students complete their programs. Time is short within which to save the Graduate Program, and by extension the Research Program in Computer Science.

Recommendation 2-5: *The Computer Science Department should move expeditiously to initiate a review of all aspects of its Graduate Program. In particular, the Department needs to assess all sources of funding for graduate students, improve its recruitment strategies (including recruitment of its own BSc/ BA graduates), and develop ways to offer graduate courses that are more than addenda to senior undergraduate courses. Involvement with other academic units of the University would be very useful in addressing all these issues.*

The systems support personnel provide a level of support for the Department's teaching, research and administrative needs that would be the envy of most Canadian universities. It is important that ways be found to keep such skilled people in the Department, especially since Computer Science has many specialized software/hardware requirements. Current arrangements with other academic and administrative units on campus allow software maintenance done by the Systems support staff specifically for the Computer Science Department to be exported at virtually no extra cost to the Department. Although there could be greater cost recovery from other units for this work, the end product is of very high quality and provides the systems support group with a sense of pride and accomplishment. We would not like to see this achievement undercut by an overly hasty move toward full cost-recovery. Increased cost recovery might be justified if the money were used to improve the retention of appropriately qualified systems personnel.

Recommendation 2-6: *The University needs to address the issue of job classification and equitable remuneration so that staff can have a reasonable career path within the Department.*

The undergraduate students explicitly mentioned the instructional assistants as being key to their academic progress. These people play a vital role in undergraduate education, and offer a model that other universities could usefully emulate.

The administrative staff members are conscientious and efficient. They are ably filling roles that are more commonly filled by faculty members. This utilization of administrative staff does not appear to be driven by a shortage of faculty members, but rather by a dearth of interest on the part of faculty members. We emphasize that this comment is in no way intended to disparage the excellent job being done by administrative staff in the areas.

Although space allocated to the Department is not generous, it is in most aspects consistent with current requirements. An exception is the shortage of faculty office space. We believe, however, that reallocation of existing departmental space could significantly alleviate this problem.

Recommendation 2-7: *The Department should realistically evaluate their use of existing space before requesting additional space from other units of the University.*

2.4 Comparison With Other Canadian Departments

Despite having a strong base on which to build, the Computer Science Department is essentially stalled. Virtually every other Department of Computer Science in the country had a major growth spurt in faculty and other resources during the last five years, sometimes even doubling in size. Memorial's Computer Science Department has stood still, and is now clearly among the smallest PhD-granting Computer Science Departments in Canada. It desperately needs more faculty members to be nationally competitive, to cover a reasonable breadth of Computer Science topics, to provide fresh insights, and to provide a critical mass of researchers. Over the last 15 years the nature of the discipline has changed dramatically, and encompassed a multitude of areas that formerly did not exist. Whereas it used to be possible for a department of 15 to 20 faculty members to offer a full spectrum Computer Science program, this is no longer the case. The Department has a right to expect more resources from the University, but the University has a right to expect a viable plan for using these resources. Each must be prepared to meet the other halfway.

Recommendation 2-8: *Additional faculty resources and additional space should be allocated to the Computer Science Department in step with the effective implementation of a clearly presented plan for expansion of their Undergraduate Program, for renewal of their Graduate Program, for increased levels of externally funded research, and for faculty renewal.*

3. Undergraduate Program

Many aspects of the undergraduate program need to be re-examined. We are pleased to note that the Computer Science Department has a curriculum review in progress, and that the Department itself has independently recognized many of the issues that we identified. Nevertheless, it is important to mention these issues explicitly in our report in order to underscore their importance.

3.1 Program Content

Although the current program is rigorous in terms of depth, it is not as broad as programs available in most other Canadian universities. Theoretical aspects of Computer Science receive undue attention within the core part of program, with application areas being largely relegated to options in the 4th year.

Recommendation 3-1: More application areas should be moved to earlier in the curriculum, and made part of the core program. This is particularly true for the Department's Software Engineering program. At present, this program has a very small number of students and it would be beneficial to see the numbers increase.

Even though the current curriculum is somewhat overly formal, students are getting a sound education in Computer Science. Unfortunately, students do not appear to realize this, and expressed a worry that they don't have sufficient practical skills. A curriculum change that integrates more application areas will help to overcome this perception, but more than this could be done.

Recommendation 3-2: The Department should consider having their programs accredited by the Computer Science Accreditation Council (CSAC) in order that students can be reassured that these programs meet national standards. In particular, it would be helpful to have the Software Engineering program accredited in order to attract more students to this pioneering, but controversial and under-subscribed, program.

The Internship program offers valuable work experience, and counters any misconceptions the students may have that they are poorly prepared for the real world. Ideally, more students should have an opportunity for at least summer work that is relevant to their program. This creates confidence that they are learning useful material and are competent performers. Feedback from students who have had industrial work experience helps others to gain confidence. Unfortunately, finding internship placements is difficult at this time of downturn in the information technology industry. For this reason, it will be difficult to grow the Internship program in the immediate future.

It may be useful to look at alternative models for giving students some experiential learning. A more traditional co-op program such as is found at some other Canadian universities would be one possibility. It would be very difficult, however, to implement a co-op program at the present time because of the scarcity of appropriate placement positions.

***Recommendation 3-3:** The Department should maintain its Internship program but should not expect to expand it until the overall outlook for the IT industry improves.*

***Recommendation3-4:** The Department should not consider introducing a co-op program without a realistic evaluation of placement possibilities for the students in such a program.*

As well as having more emphasis on the applied areas of Computer Science, a new curriculum should also try to present more of the "softer" side of the discipline. In particular, students need to develop better communication skills, and should be introduced to more of the social impact of information and communications technology. We note that alumni surveys identify a lack of opportunity to improve written and oral communication skills. Students we met expressed similar concerns.

***Recommendation 3-5:** The Department should either institute courses of its own that give students more opportunity to develop their written and verbal communications skills, or should encourage their students to take such courses in other academic units (e.g. Business 2000 – Business Communications).*

The issues considered above are fairly broad. One specific issue that is worth mentioning concerns the 1st year course CS1700. This course deliberately provides a broad introduction to the discipline of Computer Science at the expense of practical skills such as programming. As a consequence there is too big a leap from this course to the more narrowly focussed 2nd year courses. Other departments, especially the other Science departments, also want an introductory course involving more programming on which to build subsequent courses in their individual departments.

***Recommendation 3-6:** The Department should add a course with more applied objectives, such as developing programming skills, at the 1st year level. This could be taken by Computer Science majors in addition to CS1700, or taken as a stand-alone course by students from other departments.*

3.2   Program Delivery

3.2.1   Program Support

The Review Committee was very impressed with the calibre of support for the undergraduate teaching program, particularly during first two years of the program. Undergraduate students explicitly commended the work of the Departmental instructional assistants, calling attention to the help they provide both during the scheduled laboratories under their supervision, and outside of formal class and laboratory times. The instructional support staff helps undergraduate students over preliminary hurdles so that these students can really come to grips with the discipline of Computer Science.

3.2.2 Class Sizes

Undergraduate class sizes are smaller than those found at many if not most Canadian institutions. These small class sizes create opportunity for a high level of interaction between faculty and students. Such interaction not only clarifies academic issues in specific courses, but can also foster a community spirit within the Department.

Unfortunately, this opportunity for interaction is not being fully realized. There would seem to be communication problems between faculty and students in some of the courses. Students specifically mentioned language barriers as a problem.

Recommendation 3-7: *A variety of techniques, ranging from use of computer technology to slowing down the classroom interaction, should be investigated to help overcome language-based communications difficulties. In some courses, it is possible that more effective use of the Web and tools supporting interactive help might alleviate some of the problems.*

3.2.3 Time to Complete the Undergraduate Program

The Self-Assessment document prepared by the Computer Science Department recognizes a problem with the overly long time taken, on average, to complete an undergraduate degree. It appears that the workload in many of the Computer Science courses is very high, and students feel it would be impossible to take five such courses in any single term. This is an ongoing difficulty in many Computer Science programs in Canada, but it does require careful evaluation. Recognizing the time-consuming nature of Computer Science courses, the program should be structured so that a student of average intellectual ability and diligent work habits can complete a Computer Science program within the same four year term needed for other undergraduate degrees at Memorial. This does not appear to be the case, and we believe that several factors may be contributing to the problem.

3.2.3.1 Limited Academic Advising

Each Computer Science Major is assigned a faculty member to act as an academic advisor. According to the students with whom we met, and according to the results of alumni surveys, this advising function is not working. Students imply that some faculty members are unwilling or unable to offer advice outside their own research area. Students, for whom these faculty members are assigned as advisors, don't always realize that they can go to other people for academic advice. An inappropriate choice of courses can delay graduation and lead to frustration.

Recommendation 3-8: *It is important for the Department to create an effective system for providing high quality academic advice to students, and to also ensure that all of the students know how to access this system.*

3.2.3.2 Inconsistent Content of Core Courses

The material within the core courses needs to be offered in a consistent manner from section to section, and the material covered should not change drastically from one offering to the next. Students told us that the material covered in any given core course can vary significantly according to which faculty member teaches the course. Different instructors will naturally have different interpretations of the brief course descriptions that appear in the University Calendar. For this reason, some variability is understandable and desirable. However, without substantial consistency it is impossible for instructors in subsequent courses to know what pre-requisite material students have actually covered. This puts the students in the position of having to learn supposedly pre-requisite material on their own, in addition to keeping on top of the new material being taught. Much of this unwarranted variability may exist because of a lack of detailed information on specific course syllabi.

Recommendation 3- 9: The Department should, as part of the review of its Undergraduate Program, ensure that each course taught in the Department has a specific and detailed list of topics, which have been agreed to by the Department. Perhaps 15% of the content of any course could be variable to accommodate the interests of the individual teaching the course. Faculty members assigned to teach a course should be given a copy of these objectives at the time the course is assigned to them.

3.2.3.3 Interaction Between Instructors

We suspect that there could be better interaction between instructors of courses that would normally be taken simultaneously by students. The student workload would be better balanced if such courses could avoid each having a major assignment or test at the same time. This coordination of assignments and tests could relieve some of the burden that leads students to take fewer courses than are needed to complete their programs in a timely manner.

Recommendation 3-10: Instructors of courses that are likely to be taken concurrently should endeavour to coordinate due-dates for major assignments, term tests and other projects so as to spread the overall work load more evenly over the semester.

3.3   General Issues and Opportunities

3.3.1   Undergraduate Enrolment and Interdisciplinary Outlook

The Self-Assessment document recognizes a downward trend in undergraduate enrolment. We agree that this is a concern, although we note that this is a recent trend nationally. In absolute terms there are still plenty of students, with the Computer Science Department having among the larger enrolments in the Faculty of Science. However, there is obviously room for improvement and expansion.

We see little overall value to the University in having the Computer Science Department luring students away from other academic units at Memorial or *vice versa*. We believe that a more productive approach is to forge interdisciplinary programs with other units that would be attractive to many more students and to other types of students. In doing so, there is enhanced opportunity to increase overall enrolment at Memorial. For example, there are approximately a dozen classes offered in the Faculty of Engineering & Applied Science that would appear to cover material that is often in a Computer Science program. The cross listing of some of these course in Computer Science would require no new resources, and would help to address some of the concerns of the students regarding what they perceive as an overly theoretical orientation of the existing program.

The consensus across Canada is that the future direction of Computer Science as a discipline lies significantly in interactions with other disciplines. We are impressed with the level of relevant expertise in other academic units at Memorial, and note that there are currently eleven joint degrees listed in the Calendar. Increased collaboration between the Computer Science Department and, for example, Mathematics & Statistics, Geography, Engineering, Business, and Continuing Studies would be mutually beneficial. These other units seem extremely open to interactions with the Computer Science Department, at undergraduate, graduate, and research levels. The Computational Science program is a very good example of the kind of thing that can be done through increased collaboration.

Much more should be done to forge and enhance these linkages, to create essentially a "greater" Department of Computer Science.

Recommendation 3-11: *Faculty need to be cross appointed from other departments and units, and to be treated as part of the Department. There should also be more cross-listing of courses from other departments. This would automatically raise the profile of Computer Science across campus and offer a wider range of choice to students at essentially zero cost to the University. We caution that joint programs often suffer from requiring too many of each department's core courses. There is a need for compromise between departments in order to construct joint programs that are not unreasonably onerous to complete.*

There is an opportunity for many new service courses in the University, specialized to meet the desires of other units on campus. The Computer Science Department, in collaboration with these other units, could create and offer such courses, some of which could turn into incubators for entire new undergraduate or graduate programs. We stress that such efforts would almost certainly require new faculty positions in the Computer Science Department. Such interdisciplinarity is something that the Computer Science Department should be seriously considering as it ponders its future directions.

Recommendation 3-12: *The Department should open discussions with other academic units at Memorial with a view to developing new courses of mutual interest, which could be taken by a wider variety of students and could be taught by a wider variety of faculty members.*

3.3.2   Library Resources

Library resources are good for the present theoretical bent of the Department. These resources may not be adequate for a more broadly balanced program.

Recommendation 3-13: *Consultation with personnel from the QEII Library should be part of any planning exercise, in order to ensure appropriate Library support for diversification of the undergraduate teaching program into more applied areas.*

3.3.3   Recruitment and Retention

Student retention is a challenge faced by many Computer Science departments. During the last 5 years, the carryover of students' enrolments from the 1st year to 2nd year at MUN has been about 40% each year (Table 1), and the carryover from the 2nd to 3rd year courses has been only 40 to 60%. A different course structure in the 1st year should address the need for students to succeed early on in a computer science major or minor.

The students taking 3rd year courses are the most serious candidates for the major. Keeping students in the 2nd year level courses is critical for feeding into the 3rd year program. Although a relatively good proportion of students continue from the 2nd to the 3rd year level, two issues should be addressed: 1) the overall enrolment in the 2nd year courses has declined by about 45% (from 646 to 353) since 1997 (Table 2); and 2) the carryover of registration within the 2nd year level courses is low, being only 50% to 60%. This is indicated by the fact that only about half of the students registered in 2710 or 2740 are completing the second course of each series, 2711 and 2741 respectively.

Retention of students at the senior level from 3rd to 4th year does not appear to be a problem. Nevertheless, this retention is highly variable over time, perhaps because of uneven course offerings. Once the students have reached the 3000-level courses, a high proportion of them, 70% to 100% in the last five years, complete the series of courses required for a major.

Table 1: Carryover in courses required for the major, from 1997 to 2001.

	97 to 98	98 to 99	99 to 00	00 to 01
Carryover 1st to 2nd level courses	0.43	0.37	0.37	0.41
Carryover 2nd to 3rd level courses	0.58	0.48	0.57	0.43
Carryover 3rd to 4th level courses	0.85	0.56	1.12	0.48
From 2710 to 2711	0.50	0.59	0.52	0.48
From 2740 to 2741	0.60	0.65	0.54	0.62
From 3711 to 3714	0.88	0.76	0.79	0.87
From 3724 to 3725	0.98	0.69	0.71	0.84

Table 2: Number of registrations in Computer Science courses, from 1997 to 2001.

CS Course Number	1997	1998	1999	2000	2001
Major and Minor requirements					
1700	508	483	386	247	246
2710	218	223	185	160	102
2711	114	108	132	96	77
2740	210	216	173	122	100
2741	104	126	140	93	76
Major requirements					
3711	86	93	81	89	51
3714	21	76	71	64	77
3724	92	95	93	76	76
3725	63	90	66	66	64
3740	84	107	69	77	83
4718	51	59	52	85	36
4721	0	77	53	51	66

Although new directions, such as suggested above, offer the opportunity to bring new students into Computer Science, this is unlikely to happen without better strategies for recruitment and retention. The current program is not competitive in attracting students from outside or inside the province. Recruiting is not well handled even inside University. We suspect that many students from Newfoundland and Labrador interested in Computer Science are going to other universities rather than to Memorial.

Although the quality of the program is clearly a *sine qua non* for maintaining student registrations, attention should also be paid to the human dimensions of student retention. The Department needs to work much harder to forge social contact with their students who feel isolated and unappreciated. The recent faculty-student start-of-term social mixer is a good example of the kind of thing that should happen more frequently. The on-going involvement in the ACM programming contest is excellent. However, more must be done. Better contact with the undergraduate students may well pay dividends down the road in getting more of them interested in graduate studies at Memorial.

Recommendation 3-14: In a review of the introductory courses in Computer Science for the Minor and Major programs, attention should be given to preparing the students to be able to complete a second year program successfully. Difficulties with the second year program may be discouraging students from completing a Major in computer science.

Recommendation 3-15: The Department should consider having regular quasi-social gathering such as "town hall meetings" for students to express their concerns, social evenings, etc. The Computer Science student society would be an ideal partner in helping to create these events, and in helping to make them successful. Of course without willing participation by the faculty and staff, such events will only exacerbate the students' sense of alienation from the Department.

4. Graduate Program

4.1 Number of Students

The graduate program in the Computer Science Department is essentially non-existent. A graduate program that had approximately 25 students a decade ago has only 5 students now. The supervisory load of those few students in the program is not evenly distributed. Only three faculty members are involved in any graduate supervision, and only two of the eight NSERC grant holders have any graduate students. This is a disaster for a modern Computer Science Department; the situation must be rectified as rapidly as possible.

It is very difficult, if not impossible, to maintain a high quality research program in the absence of a graduate program. Without a viable graduate program the Department risks being reduced to an undergraduate teaching department. Ignoring the issue is not an option if the Department wishes to remain relevant at Memorial University and on the national scene.

Recommendation 4-1: *The Department must produce a viable plan to increase the number of graduate students completing MSc and PhD degrees.*

4.2 Resources Available to Support Graduate Students

Although there are many possible reasons for this precipitous decline in the graduate program, none are insurmountable given current resources.

Many faculty members expressed concern that a lack of funding is a primary cause for the decline in graduate student numbers. Overall, this concern does not appear to be supported by the information we received. The total external research support received by the department (Table 21A, CIAP Fact Book, 2001) was $159,662 in 1996-97 and $195,248 in 1997-98 while it had risen to $281,024 in 1999-2000 and to $303,866 in 2000-01. Similarly, at their last renewals, five of the current NSERC grant holders received increases, which averaged over 25%, and two received small decreases.

Although the number of funded researchers is down, partially caused by the departures of some individuals, the trend of the support received by those who are funded is positive, as Table 3 demonstrates. In many departments of this size, these figures would be taken very positively.

Table 3: Average NSERC Research Grant per Funded Researcher

Year	Amount	Year	Amount
1992	$12,909	1998	$15,690
1993	$13.667	1998	$16,249
1994	$13,889	2000	$19.049
1995	$14,383	2001	$19,049
1996	$15,690	2002	$21,029
1997	$15,690		

Consequently, external research funding does appear to be available to support a reasonable number of graduate students, if the faculty members wish to do so. External funding, when combined with baseline budget from the School of Graduate Studies (SGS) and special funds from SGS should be adequate to support 10 to 15 graduate students. It may also be possible to access regular and industrial NSERC scholarships, other special scholarships (as one current graduate student has done). Ultimately, it should be possible to at least regain the 25 graduate student level as a steady state. The Department has an enlightened matching program for those who use NSERC funds to support graduate students.

Recommendation 4-2: An immediate goal of the Department should be to strongly encourage all faculty members with NSERC grants to have at least one graduate student.

4.3   Perceived Barriers to a Viable Graduate Program

4.3.1   Teaching Loads

The teaching loads of the faculty do not create a credible impediment to research and graduate student supervision. The normal teaching load is fairly standard as compared with other Computer Science Departments in the country. With limited undergraduate section sizes, the help of highly professional lecturers and instructional support personnel for many of the larger courses, excellent system support, and marking help available in most courses, undergraduate teaching should not impede active involvement in graduate studies.

4.3.2   Quality of Graduate Student Applicants

There seems to be an overly cautious approach to accepting graduate students. We were told that graduate applications often sit around for a long time before a decision is made about them. Expeditious handling of applications is very important if the Department is to avoid losing good students to other institutions. It is better to accept too many students than too few. Not all those accepted will come, and the Dean of Graduate Studies is generally receptive to appeals for more support if two students show up when only one was anticipated.

Recommendation 4-3: *Faculty members should not delay accepting a reasonable student in the hope that someone better will come along. The Department is a very long way from being over-extended in graduate supervision.*

We heard comments from some faculty members that foreign students frequently arrive in the Department, apply for Landed Immigrant status, and then leave to find work once this status is achieved. This is obviously hugely wasteful of time and resources, and discourages acceptance of other students from a similar background. If true, then greater effort must be expended to find another source of graduate students, or a better incentive for these foreign students to complete their degrees. External members of the Review Committee have faced similar problems but often were able to overcome them by persuasive arguments about the value of the completed degree. Moreover, the recent downturn in the information technology sector may help to alleviate the problem of students being lured away to industry before they finish their degrees.

4.4   Real Barriers to a Viable Graduate Program

4.4.1   Advertising the Program

Despite a general recognition by faculty members that the Department needs more graduate students, we feel that the Department has made little serious attempt in the last few years to attract graduate students, even from their own undergraduate program.

Recommendation 4-4: *Judicious use of summer NSERC scholarships and Departmental summer employment could "turn students on" to research during their undergraduate years (and even produce publishable research). Giving undergraduate students a chance to work on research fosters interest in graduate studies at Memorial.*

Many potential graduate students look at Web sites to get information about graduate programs and research. Potential graduate students, especially those from other Universities, would find it very difficult to tell what Memorial's Computer Science Department has to offer them in the way of graduate programs and research opportunities. By contrast, many other Computer Science Departments have excellent information sources on their Web sites.

There appears to have been little effort put into making faculty members' individual Web sites attractive and informative. With few exceptions, there are not even pictures of the faculty members. To make matters worse, a lot of the Web site material associated with faculty research has creation dates in the mid 1990s. Having what appears to be seriously outdated material on the Web site arguably leaves a worse impression than having no material at all. In this area, effective and timely communication to prospective graduate students is critical.

Recommendation 4-5: *The Department needs to revise its Web site to provide information about graduate programs and research that is up-to-date, explicit and easily*

located. Faculty members need to be encouraged to keep their personal Web sites up to date and informative to potential graduate students.

4.4.2 Misleading Calendar Entries

There seem to be numerous ancient graduate courses listed in the University Calendar, some that haven't been offered since the early 1980s.

Recommendation 4-6: *Course entries in the University Calendar should be revised as appropriate.*

4.4.3 Paucity of Graduate Course Offerings

The current low number of graduate students has made it administratively unattractive to offer the required number of courses for these graduate students. Instead, graduate courses are routinely combined with senior undergraduate courses. We do not think that this is a good practice, particularly if the Department wants to attract its own BSc students to stay as graduate students.

There is no reason that faculty members shouldn't offer reading courses in their own speciality areas from time to time to interested students. Such courses pay dividends to the student(s) in the course but also to the faculty member by enhancing the faculty member's ability to keep up to the research frontier in his or her area of specialization. Such extra reading courses are routinely offered on a volunteer basis by professors at other universities, and are an essential part of a graduate program in a small department.

Recommendation 4-7: *The Department needs to make every effort to offer a graduate curriculum that is different, and is seen to be different, from its senior undergraduate curriculum.*

4.5   Opportunities for Interdisciplinary Collaboration

As with the undergraduate program, we see significant opportunity for interdisciplinary collaboration at the graduate level. At the moment, little advantage is being taken of such interdisciplinary prospects, in spite of the fact that some faculty members themselves are actively involved in interdisciplinary research interactions.

Recommendation 4-8: *Faculty members should look for opportunities to co-supervise students in other departments and to have faculty members from other departments co-supervise Computer Science graduate students.*

4.6   Need for Regular Seminars

The graduate program does not have, but should have, a regular research seminar series. This series could be usefully shared with other academic units on campus. Speakers could be recruited opportunistically from among visiting faculty members, a selection of Memorial faculty members, people from industry, senior graduate students, faculty candidates in Computer Science and related disciplines. Such a seminar series would provide a central focus for shared activity in the graduate program, and an interesting window on research for senior undergraduates, possibly helping to convince them to go on to a graduate program in Computer Science. Since speakers would possibly come from many disciplines related to Computer Science such a seminar series would also further encourage interdisciplinary interactions.

Recommendation 4-9: *The Department should consult with other cognate area on campus to arrange a regular and well-advertised research seminar series.*

5. Research and Scholarship

Departmental comparisons with other Universities suggest that research productivity and funding are not as strong as they could be, given the not overly onerous level of teaching responsibility. This is a difficult factor to assess because the CVs we received were sometimes vague, some were missing relevant information and not all CVs were received. Nobody in the Department appears to be a rising star, and some could soon be gone unless the morale and communication difficulties can be addressed effectively in the immediate future. This is more than worrisome. In a real sense the Department is at the brink.

5.1   Need for Research Focus in the Department

Despite having talented researchers, the Computer Science Department lacks well-focused areas of research strength. Instead, individual research interests cover a broad and somewhat haphazard spectrum of the entire Computer Science discipline. This encourages faculty members to work in isolation, and with less effect than would be possible if they had colleagues with whom to collaborate.

Research groups are needed to generate a critical mass of research and to foster more opportunities in the graduate program, especially in the more applied areas of Computer Science. Although more Computer Science faculty are needed to achieve this, there is also untapped opportunity for forming these groups with faculty from other units. The recently created Centre for Digital Hardware Applications Research is a good start, as is the Masters program in Computational Science. More such research groups should be forged both inside the Department and between the Department and other units.

As the Department adds new faculty members, their areas of research should be chosen to complement existing areas while adding strength in the more applied aspects of the discipline.

Recommendation 5-1: *The Department needs to consider which areas of Computer Science will be the focus of any future growth. These areas ought not to be random but rather designed to complement existing strengths inside the Department and in other units at Memorial. We suggest that these research linkages should be perhaps 50% internal and 50% external to the Department. This would foster interdisciplinary work without producing excessive duplications at the University level.*

5.2   Untapped Sources of Research Funding

The Department should take advantage of programs like CFI, and seek other funds such as summer NSERC supplements, NSERC collaborative and strategic grants, and possibly contracts with local industry.

If the Department were to take a more applied direction, it might be easier to find research funds. If research connections can be made to things of local concern (*e.g.* image processing applications in the resource industries), not only might more money be made available to support research, but also Computer Science at Memorial may be seen as more relevant to economic growth in Newfoundland and Labrador.

The Vice President (Research) has an internal competition in which externally funded faculty members can be paired with non-funded faculty members to get research up to the point where external funding becomes possible. Taking advantage of this opens opportunities for collaborative research and for increased external funding.

We cannot stress too strongly that the Computer Science Department is at a crossroads. Even those faculty members now having NSERC grants may have problems keeping them if there is not more training of Highly Qualified Personnel. Other Universities are hiring active young researchers who will be competing for the same research funding.

Recommendation 5-2: The Department needs to be proactive in seeking sources of research funding and pursuing these sources once they have been identified.

5.3   Improving the Department's National and International Profile

There is little evidence that Computer Science faculty members are significantly involved in national and international professional organizations. The geographic isolation of the Department, far from being a valid reason for this low participation, underscores the need to participate. Doing so is both very valuable for individual researchers as well as being a professional responsibility of those in the discipline. There is some such involvement but it could advantageously be expanded. These organizations are always looking for volunteers to serve on their executives and to fill other committee roles. Participation is a straightforward way to raise the Department's profile, and to forge new interactions with potential colleagues.

Recommendation 5-3: Department faculty members should consider playing a greater role on the national and international scene through more active participation in professional organizations.

6.   Faculty and Staff

6.1   Systems Support Staff

Members of the systems support staff provide excellent service to the Department and the University. The Department recovers some of the cost of services provided to other units (*e.g.* from the Mathematics & Statistics Department), but such cost recovery is not generally the case. Although we did not have an opportunity to consider this issue in depth, we are not persuaded that there is a big advantage to be had from full cost recovery. Our first impression is that this is a system that really works well. There is good morale in the systems group, and the end product is excellent. Cost recovery may just be shuffling money around to the detriment of the final product.

Recommendation 6-1: *The University should not institute fuller cost recovery for the work of the Computer Science Systems group without first investigating all aspects of this issue very carefully.*

6.2   Administrative Support Staff

Administrative support in the Department is of very high quality. The office staff personnel seem ready, willing, and able to provide support to all current activities of the Department. These people will play a crucial role as the Department forges new directions. They should be relied upon to help to make these new directions happen efficiently and effectively.

The administrative support structure is good but there is a breakdown of input into this system. Faculty members are not filling functions that are commonly done in other departments. For example it should not be necessary to allocate a departmental office staff member to the role of Graduate Officer, no matter how well this role is presently being executed (and it is apparently being very well executed).

6.3   Instructional Support Staff

Students specifically mentioned the high quality support that is provided by the Department's instructional assistants. We note that such support is not uniformly offered by other universities, but probably should be. In this area Memorial is a role model for other Universities.

6.3.1   Allocation of Faculty Members to Teaching Laboratories

Given the high quality of support provided by the instructional assistants, we see little need for faculty members to participate in instructional labs, as is currently done at 1st and 2nd year levels. Faculty members could be better deployed in other ways. We emphasize that we have no criticism of the quality of instruction being provided by these

faculty members in the instructional labs. We are simply questioning whether this is the best use of their time.

Recommendation 6-2: The Department should re-evaluate the use of contractual and permanent faculty members in the delivery of junior level instructional laboratories.

6.3.2   Salary Scales and Career Paths Within the Department

The significant contributions of systems, administrative and instructional support staff personnel need to be recognized by assignment to appropriate salary scales. This appears to be a particular issue for the systems support staff. It is important that skilled and conscientious people see a future career path to keep them in the Department.

6.4   Contractual Faculty Members

The Department has three contractual faculty members whose role is limited to delivering introductory and service courses with the Department. Student comments suggest a high level of satisfaction with the teaching duties carried out by these individuals.

6.5   Tenured and Tenure-Track Faculty Members

None of the serious problems we have identified in the Department will be fixed without the active and enthusiastic support of the faculty members. These individuals have the most to gain by fixing these problems and the most to lose by ignoring them.

Department faculty members seem to have the attitude that it is up to somebody else to solve their problems. Even though new faculty resources are needed, and other things could be improved through actions originating outside of the Department, fundamentally it is up to these faculty members to move forward on their own initiative. If they do so, then resources and other good things will follow; if they don't, nothing will change.

As we heard explicitly in our meetings with faculty members, there needs to be more mutual respect within this group. A lack of mutual respect, undoubtedly exacerbated by poor communication, has created a faculty complement that is demoralized and largely dysfunctional as a collaborative unit. The current Interim Head has worked hard to repair the collegiality and communication problems, but much work still remains to be done. Most of this work is the responsibility of each and every faculty member.

We see the responsibility of faculty members as being significantly more than can ever be quantified in a Collective Agreement. Better "departmental citizenship" cannot be legislated, but without it the Department is unlikely to achieve its full potential. We are advocating an environment in which differences of opinion are tolerated, discussed openly and, if not resolved, at least not allowed to paralyse the Department.

The lack of a permanent Head has caused serious problems for the Department, but isn't the essential cause of the communication and respect problems. The appointment of a

new Head, in and of itself, will change nothing unless the new Head receives massive cooperation from everybody in changing attitudes. It is critical that the Department faculty move forward with the new Head and put away past grievances. The new Head must try very hard to re-invigorate faculty members who appear to be disengaged, and must be highly sensitive to the collegiality needs of the entire faculty. If the new Head does not tread carefully in these matters, he or she will quickly be in a difficult position. It is up to everybody in the Department, and appropriate people elsewhere in the University, to help the new Head adapt to the Memorial context.

Recommendation 6-3: *The new Head should have access to appropriate advice and assistance in what will be a very challenging position.*

7.   Community Service

The Department performs some community service, including participating in a high school enrichment program. Although the absence of some faculty members' CVs prevented us from getting a complete picture, from what we saw, more could be done in this area. Enhanced community service would make the Department better known in the local community and would be of potential value in recruiting students to the Department's programs. There is some evidence that involvement in Community Service has declined over the last ten years or so.

Again, we note the positive benefits that could come from involvement with national professional organizations.

8.   University Citizenship

There is evidence that the Department does reinforce the goals of some other departments. In particular we note the Computational Science program with the other Faculty of Science departments, and the service provided by the systems staff to a wide variety of units. There could be a lot more done.

All departments with whom we met were enthusiastically receptive to cross-listing courses, and other cost-free things that could be done to mutual advantage. There seems to be an especially good opportunity to work with Engineering, with Business Administration and with Mathematics & Statistics. These units have several faculty members with fairly extensive Computer Science backgrounds and research interests. Continuing Studies has specific expertise that could be of relevance to the Department.

Some departments pointed out that interaction with Computer Science used to be better. All Departmental faculty members we met spoke of the need to increase interdisciplinary activity. However, talk is cheap. Making this desire a reality is significantly up to the Department. More interaction, by definition, will make a bigger and better Computer Science Department.

We cannot assess from the information provided how well individuals assume the necessary roles on University committees. Again, the lack of CVs from some faculty members, and the variability in information provided, have made this unnecessarily difficult.

9.   University Support

The level of University support appears adequate for the Department at its present level of activity. At the moment the Department is essentially an undergraduate department. When it returns to being a viable graduate department more space and faculty resources will be needed. We see no problem with keeping the Department under a bit of pressure as an incentive to improve.

9.1   Space Allocation

The space problems perceived by many members of the Department do not appear to the external reviewers to be that serious. However, we note the unacceptable situation that one junior faculty member seems to be in constant transit from one temporary office to another as faculty members go on leave.

Research and teaching laboratories, hardware and software, and meeting space all appear adequate for current needs. New space will be needed as the Department expands its programs and its faculty complement.

Space pressures are a common feature of many Computer Science Departments across the country in the last few years, and many departments have had to come up with creative solutions to alleviate their immediate difficulties. The Department at Memorial appears to have been unable, so far, to do this. It would be helpful if people in the Department could try to address some of their perceived space difficulties internally. For example, the recent provision of a faculty office by erecting a partition at the end of the very large seminar room is a good example of the sort of thing that can be done.

9.2   Personnel Allocation

Other Canadian Computer Science Departments are expanding rapidly in undergraduate and graduate areas. MUN appears to be getting left behind in this expansion. The solution to this problem rests partially with the level of University support. However, the Department does not appear to be maximizing the use of its current resources. In most institutions, resources follow rather than precede the demonstration of desperate need.

We are impressed with the willingness expressed to us by the Senior Administration to support the Department. Unfortunately, this willingness does not seem to be getting communicated to, or recognized by, members of the Department.

Symbolic of the breakdown in communication has been the almost total dearth of information flowing to the Department about the long delayed appointment of a new Head. It is not too strong to say that in the absence of any information, suspicion and paranoia are growing. An already bad morale problem has been exacerbated by the apparent failure of the Administration to communicate with members of the Department

in an effective manner. As noted in previous areas of this report, falling back on the minimal needs for notification as specified in a Collective Agreement is not acceptable. It is important that effective communication in an open and transparent manner exist between the Department and the Administration. Giving the Department the minimal information required leads to the immediate suspicion that, even this level of information, is provided grudgingly.

9.3   Comparison with Other Canadian Computer Science Departments

Figures published by the *Canadian Association of Computer Science/Association Informatique Canadienne* put the resources allocated to Memorial's Computer Science Department, and the graduate student and research funding produced by the Department into a national context.

Table 4, which compares the number of Full-Time Equivalent faculty members, shows that the faculty complement in Memorial's Computer Science Department is the smallest among PhD-granting departments in Canada.

Table 5, which compares the number of Staff members, shows that the Department is comparable in this respect to many other departments across the country, including those with significantly more faculty members.

Table 6, which compares NSERC research funding and graduate student enrolments, shows that the Department is nationally competitive in terms of total NSERC funding, but is a significant underachiever in terms of graduate student numbers. We emphasize our earlier point that NSERC funding will almost certainly begin to suffer if the graduate student numbers do not improve.

Table 4
Faculty Numbers
Comparison With Other Canadian Computer Science Departments

Based on 2002 survey carried out by the
Canadian Association of Computer Science/Association Informatique Canadienne

University	Current FTE Faculty	Other Faculty	Current Open Positions	Projected New Positions
Atlantic Canada				
Memorial	17	3	2	
Acadia	12	6	0	2
Dalhousie	29	13	0	3
New Brunswick	24.5	3	0	0
Comparable Institutions				
Calgary	39	0	14	0
Carleton*	22	7	1	5
Concordia*	30	25 (PT)	6	9
Guelph	19	0	3	0
Manitoba	25	5	7	0
Queen's	21	9	4	2
Saskatchewan	18	0	4	5
Simon Fraser	33	7	1.5	.5
UQAM	46	0	2	1
Victoria	24	6	4	6
Western Ontario	24	8	3	3
Windsor	23	7	3	0
York	37	1	3	3
Other Institutions				
Alberta	43	1	5	3
British Columbia*	33.5	2	5.5	7.5
McGill	26	1	10	0
Montréal	42	0	2	2
Waterloo	61	3	5	2

* based on 2000-2001 data (all other data 2001-2002)
- Universities in italics do not have a Ph.D. program but are trying to get one
- data are missing for a number of Universities, including Laval, Ottawa, Regina, Sherbrooke, McMaster, and University of Toronto. Among smaller institutions, only Acadia included
- "Other Faculty" entry includes a variety of teaching positions

Table 5
Staff Numbers
Comparison With Other Canadian Computer Science Departments

Based on 2002 survey carried out by
 the Canadian Association of Computer Science/Association Informatique Canadienne

University	Current Clerical Staff	Admin Staff	System Staff	Program-ming Staff	Hard-ware Staff
Atlantic Canada					
Memorial	3	1	6	+4 instructors	
Acadia	0	2	0	0	0.5
Dalhousie	5	2	0	3	0
New Brunswick	6+1	3	4+2	0	0
Comparable Institutions					
Calgary	4	6	14	0	0
Carleton*	0	5	4	0	0
Concordia*	5	2	11	0	1
Guelph	2	1	2	0	0
Manitoba	2	3	4	0	0
Queen's	0	3+2	3.5+1	0	.5
Saskatchewan	2+.7	5	5	+1	1
Simon Fraser	5	4	5	3	1
UQAM	4	8	3	0	2
Victoria	3.5	3	4+1	0	1
Western Ontario	4	+1	5	0	0
Windsor	4	2	2	1	3
York	5	1	4	1	0
Other Institutions					
Alberta	0	13	7	12	4
British Columbia*	10	2	7+3	0	2
McGill	3.5	2	0	6	0
Montréal	9	3	5	0	1
Waterloo	10+5	5	0	0	0

* Based on 2000-2001 data (all other data 2001-2002)
- Universities in italics do not have a Ph.D. program
- data are missing for a number of Universities, including Laval, Ottawa, Regina, Sherbrooke, McMaster, and University of Toronto. Among smaller institutions, only Acadia included
- the "+" sign indicates staff members who are not in base budget positions
- at some Universities some technical support personnel, are provided centrally

Table 6
Research Funding and Graduate Students
Comparison With Other Canadian Computer Science Departments

Based on 2002 survey carried out by the
Canadian Association of Computer Science/Association Informatique Canadienne

University	NSERC Funding – in $ K (Individual Discovery Only)	Full Time Ph.D. Students	Full Time M.Sc. Students
Atlantic Canada			
Memorial	171	4	3
Acadia	32.5	0	19
Dalhousie	407	20	162
New Brunswick	201	11	53
Comparable Institutions			
Calgary	555	17	66
Carleton*	571	27	132
Concordia*	570	10	232
Guelph	188	0	45
Manitoba	256	3	41
Queen's	463	18	30
Saskatchewan	419	10	47
Simon Fraser	736	38	96
UQAM	256	8	143
Victoria	598	18	80
Western Ontario	564	27	30
Windsor	401	0	81
York	800	10	42
Other Institutions			
Alberta	1000	46	66
British Columbia*	1065	38	87
McGill	662	30	96
Montréal	2500	65	177
Waterloo	2800	76	131

* based on 2000-2001 data (all other data 2001-2002)

- Universities in italics do not have a Ph.D. program

- data are missing for a number of Universities, including Laval, Ottawa, Regina, Sherbrooke, McMaster, and University of Toronto. Among smaller institutions, only Acadia included

10.   Plans, Goals, and Resource Allocation

The self-assessment document is missing any serious consideration of goals, and hence of plans to achieve these goals. During our interviews, members of the Department verbally expressed goals that were very generic (*e.g.* increasing the undergraduate and graduate enrolment *etc.*) Such goals are little more than wishful thinking without a concrete plan to achieve them.

Getting a new Head isn't a plan. Getting a permanent Head is, however, vitally important at this juncture. Active and vigorous leadership by this Head in forging plans for the Department on many fronts (undergraduate programs, graduate programs, research activities, recruiting of students and faculty, outreach to the community, *etc*.) will be needed. The Head will need the full support of all members of Department faculty, staff, and students as these plans are forged and acted upon.

Recommendation 10-1. *We would encourage the Department to identify a series of goals, each of which is achievable and moves the Department forward in its desired direction. Such goals should be carefully developed to be achievable, and not be unreasonably ambitious. Ideally this should happen as soon as practicable, and should include the new Head, even if that individual has not yet formally taken up the appointment.*

11. Summary of Recommendations

Recommendation 1-1: Every effort should be made to ensure that future Academic Review Committees receive at least a current CV from all faculty members in the unit being reviewed, and that these CVs be prepared according to some consistent guideline.

Recommendation 2-1: Improvement in communication could usefully start with more open and regular dialogue between the Department and the Dean of Science regarding progress in the search for a Head.

Recommendation 2-2: We recommend that the Department hold a retreat with a professional mediator to recognize and resolve interpersonal conflicts prior to the arrival of a new Head. Such conflicts must not be allowed to compromise the effectiveness of a new Head or to limit the possibility of attracting a good person to this position.

Recommendation 2-3: We urge all the members of the Department to begin collegial discussions aimed at addressing at least some of the resource-related problems that they themselves have identified. They must stop dwelling on past difficulties and start taking individual and collective responsibility for their future.

Recommendation 2-4: The Computer Science Department should move expeditiously to complete the review it has started of its Undergraduate Program. This review should involve consultation with members of cognate areas around the University so as to maximize the very real opportunities for fruitful collaboration.

Recommendation 2-5: The Computer Science Department should move expeditiously to initiate a review of all aspects of its Graduate Program. In particular, the Department needs to assess all sources of funding for graduate students, improve its recruitment strategies (including recruitment of its own BSc & BA graduates), and develop ways to offer graduate courses that are more than addenda to senior undergraduate courses. Involvement with other academic units of the University would be very useful in addressing all these issues. Time is short within which to save the Graduate Program, and by extension the Research Program in Computer Science.

Recommendation 2-6: The University needs to address the issue of job classification and equitable remuneration so that staff can have a reasonable career path within the Department.

Recommendation 2-7: The Department should realistically evaluate their use of existing space before requesting additional space from other units of the University.

Recommendation 2-8: Additional faculty resources and additional space should be allocated to the Computer Science Department in step with the effective implementation of a clearly presented plan for expansion of their Undergraduate Program, for renewal of their Graduate Program, for increased levels of externally funded research, and for faculty renewal.

Recommendation 3-1: More application areas should be moved to earlier in the curriculum, and made part of the core program. This is particularly true for the department's Software Engineering program. At present, this program has a very small number of students and it would beneficial to see the numbers increase.

Recommendation 3-2: The Department should consider having their programs accredited by the Computer Science Accreditation Council (CSAC) in order that students can be reassured that these programs meet national standards. In particular, it would be helpful to have the Software Engineering program accredited in order to attract more students to this pioneering, but controversial and under-subscribed, program.

Recommendation 3-3: The Department should maintain its Internship program but should not expect to expand it until the overall outlook for the IT industry improves.

Recommendation3-4: The Department should not consider introducing a co-op program without a realistic evaluation of placement possibilities for the students in such a program.

Recommendation 3-5: The Department should either institute courses of its own that give students more opportunity to develop their written and verbal communications skills, or should encourage their students to take such courses in other academic units (e.g. Business 2000 – Business Communications).

Recommendation 3-6: The Department should add a course with more applied objectives, such as developing programming skills, at the 1st year level. This could be taken by Computer Science majors in addition to CS1700, or taken as a stand-alone course by students from other departments.

Recommendation 3-7: A variety of techniques, ranging from use of computer technology to slowing down the classroom interaction, should be investigated to help overcome language-based communications difficulties. In some courses, it is possible that more effective use of the Web might alleviate some of the problems.

Recommendation 3-8: It is important for the Department to create an effective system for providing high quality academic advice to students, and to also ensure that all of the students know how to access this system.

Recommendation 3-9: The Department should, as part of the review of its Undergraduate Program, ensure that each course taught in the Department has a specific and detailed list of topics, which have been agreed to by the Department. Perhaps 15% of the content of any course could be variable to accommodate the interests of the individual teaching the course. Faculty members assigned to teach a course should be given a copy of these objectives at the time the course is assigned to them.

Recommendation 3-10: Instructors of courses that are likely to be taken concurrently should endeavour to coordinate due-dates for major assignments, term tests and other projects so as to spread the overall work load more evenly over the semester.

Recommendation 3-11: Faculty need to be cross-appointed from other departments and units, and to be treated as part of the Department. There should also be more cross-listing of courses from other departments. This would automatically raise the profile of Computer Science across campus and offer a wider range of choice to students at essentially zero cost to the University. We caution that joint programs often suffer from requiring too many of each department's core courses. There is a need for compromise between departments in order to construct joint programs that are not unreasonably onerous to complete.

Recommendation 3-12: The Department should open discussions with other academic units at Memorial with a view to developing new courses of mutual interest, which could be taken by a wider variety of students and could be taught by a wider variety of faculty members.

Recommendation 3-13: Consultation with personnel from the QEII Library should be part of any planning exercise, in order to ensure appropriate Library support for diversification of the undergraduate teaching program into more applied areas**.**

Recommendation 3-14: In a review of the introductory courses in computer science for the Minor and Major programs, attention should be given to preparing the students to be able to complete a second year program successfully. Difficulties with the second year program may be discouraging students from completing a Major in computer science.

Recommendation 3-15: The Department should consider having regular quasi-social gathering such as "town hall meetings" for students to express their concerns, social evenings, etc. The Computer Science student society would be an ideal partner in helping to create these events, and in helping to make them successful. Of course without willing participation by the faculty and staff, such events will only exacerbate the students' sense of alienation from the Department.

Recommendation 4-1: The Department must produce a viable plan to increase the number of graduate students completing MSc and PhD degrees.

Recommendation 4-2: An immediate goal of the Department should be to strongly encourage all faculty members with NSERC grants to have at least one graduate student.

Recommendation 4-3: Faculty members should not delay accepting a reasonable student in the hope that someone better will come along. The Department is a very long way from being over-extended in graduate supervision.

Recommendation 4-4: Judicious use of summer NSERC scholarships and Departmental summer employment could "turn students on" to research during their undergraduate years (and even produce publishable research). Giving undergraduate students a chance to work on research fosters interest in graduate studies at Memorial.

Recommendation 4-5: The Department needs to revise its Web site to provide information about graduate programs and research that is up-to-date, explicit and easily located. Faculty members need to be encouraged to keep their personal Web sites up to date and informative to potential graduate students.

Recommendation 4-6: Course entries in the University Calendar should be revised as appropriate.

Recommendation 4-7: The Department needs to make every effort to offer a graduate curriculum that is different, and is seen to be different, from its senior undergraduate curriculum.

Recommendation 4-8: Faculty members should look for opportunities to co-supervise students in other departments and to have faculty members from other departments co-supervise Computer Science graduate students.

Recommendation 4-9: The Department should consult with other cognate area on campus to arrange a regular and well-advertised research seminar series.

Recommendation 5-1: The Department needs to consider which areas of Computer Science will be the focus of any future growth. These areas ought not to be random but rather designed to complement existing strengths inside the Department and in other units at Memorial. We suggest that these research linkages should be perhaps 50% internal and 50% external to the department. This would foster interdisciplinary work without producing excessive duplications at the University level.

Recommendation 5-2: The Department needs to be proactive in seeking sources of research funding and pursuing these sources once they have been identified.

Recommendation 5-3: The Department should consider playing a greater role on the national and international scene through more active participation in professional organizations.

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Recommendation 6-3: The new Head should have access to appropriate advice and assistance in what will be a very challenging position.

Recommendation 10-1. We encourage the Department to identify a series of goals, each of which is achievable and moves the Department forward in its desired direction. Such goals should be carefully developed to be achievable, and not be unreasonably ambitious. Ideally this should happen as soon as practicable, and should include the new Head, even if that individual has not yet formally taken up the appointment.