HIGH-TECH EMPLOYMENT IN THE OTTAWA-CARLETON REGION:

TOO MANY JOBS AND NOT ENOUGH PEOPLE

by Roly J. Roy, B.A. M.A. (History)

A thesis submitted to the
Faculty of Graduate Studies and Research
in partial fulfillment of
the requirements for the degree of

Master of Arts

Department of Political Science
Carleton University
Ottawa, Canada

ABSTRACT

Downsizing efforts by the private and public sectors have resulted in thousands of job losses. The federal government, insisting that its mandate is not to create jobs, has forced the Ottawa-Carleton region to diversify its government-based economy. The area's subsequent success in attracting information technology (IT) companies has prompted its nickname 'Silicon Valley North'. Hundreds of high-technology firms have created thousands of employment opportunities. To address these opportunities the region's three post-secondary institutions have developed computer-related programs but despite these efforts the area's high-tech industry is unable to fill more than two thousand job vacancies. To determine the reasons behind the hiring difficulties a questionnaire was sent to the region's high-tech firms. An analysis of the responses, coupled with an examination of the computer-related curriculums offered by the area's post-secondary educational institutions has produced conclusions, and recommendations, which suggest actions to be taken by all three parties: the post-secondary institutions, government, and the high-tech community.

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION 1

The Effect of Technology on the Labour Market 1

Government Policy Towards High-Tech Job Growth 2

The High-Tech Profile of the Ottawa-Carleton Region 6

Too Many Jobs and Not Enough People 9

CHAPTER II: THE QUESTIONNAIRE 12

Information Gathering Using a Questionnaire 12

The Questions 16

The Responses 26

CHAPTER III: ANALYSIS OF THE QUESTIONNAIRE RESULTS 30

Question #1 31

Question #2 33

Question #3 34

Question #4 36

Question #5 36

Question #6 38

Question #7 43

Question #8 45

Question #9 48

Question #10 51

Questionnaire Conclusions 58

CHAPTER IV: POST-SECONDARY CURRICULUM ISSUES 62

Correlations Between Questionnaire Conclusions and Post-Secondary Curriculums 62

CHAPTER V: CONCLUSIONS 87

Strategies for Reform Regarding Educational Curriculums 87

Strategies for Reform Regarding Educational/Business/Government Initiatives 97

Summary Listing of Conclusions 103

Summary Listing of Strategy Reforms 105

APPENDICES 109

BIBLIOGRAPHY 131

LIST OF TABLES

Table 1:

The top 25 software firms (based on revenue) and the number of employees in each firm 8

Table 2:

Computer-Related Programs Offered at Algonquin College 65

Table 3:

Communication-Related Courses Offered in Computer Programs at Algonquin College 79

LIST OF FIGURES

Figure 1:
The Cover Letter Accompanying the Questionnaire 14

Figure 2:
The Questionnaire 15

Figure 3:
Business Types 31

Figure 4:
Business Size According to Number of Employees 33

Figure 5:
Number and Type of Employment Positions 35

Figure 6:
Job Applications Received and Accepted 36

Figure 7:
Applications Received/Accepted 37

Figure 8:
Reasons for Applicant Rejection 39

Figure 9:
Reasons Why Job Applicants Unsuccessful 41

Figure 10:
Successful Applicants Educated in Ottawa Area 43

Figure 11:
Post-Secondary Educational Sources 46

Figure 12:
Business Recruiting 47

Figure 13:
Business and Educational Institution Curriculum Consultation 48

Figure 14:
Consultation Between Post-Secondary Institutions and Business 50

Figure 15:
Business Size 51

Figure 16:
Percentage of Businesses Experiencing Hiring Difficulties 52

Figure 17:
Hiring Difficulties Based on Business Type 53

Figure 18:
Improvements to Post-Secondary Programs 54

Figure 19:
Software Skill Requirements for Job Vacancies 67

LIST OF APPENDICES

I: Hiring Patterns Based on Post-Secondary Institutions 109

II: The curriculums of information technology programs at Algonquin College 114

III: The curriculums of information technology programs at Carleton University 124

IV: The curriculums of information technology programs at the University of Ottawa 127

CHAPTER I

INTRODUCTION

The Effect of Technology on the Labour Market

Within the last few years, the Canadian labour market has experienced vast and fundamental changes in the workforce and in the way work processes are undertaken. Deteriorating economic conditions have prompted organizations, both public and private, to trim excesses in order to minimize expenditures while at the same time maximizing revenues. The inevitable "downsizing" of these organizations has resulted in the elimination of jobs in the hundreds of thousands. Though the workforce has been reduced in order to cut costs, related job tasks and functions have not correspondingly disappeared. Consequently, the majority of workers have had to assume more responsibilities and job duties. This, in turn, necessitated the introduction of changes to the traditional methods of performing these tasks. The advent of technology, particularly high-tech computer technology, facilitated these changes. Indeed, it was computer technology which enabled organizations to re-engineer themselves. (In fact, the word "downsize" is a term originally used in the computer field, whereby a company reduces and refits its technology to address the

company's business objectives more efficiently and effectively.)

The introduction of computers in the workforce has been nothing short of revolutionary, changing not only how work is done, but also altering the skills required to do the job. The impact of corporate downsizing, coupled with the change in employee skill sets, has resulted in a shift towards technology-oriented professions. This has led to a job market which has become more demanding and specific in terms of required capabilities and knowledge levels. These new requisites have left many people, who were once productive employees, sitting on the sidelines.

Government Policy Towards High-Tech Job Growth

As mentioned, traditional businesses have benefitted from the new technology but, unfortunately, often at the expense of the individual. The Federal government, while recognizing the non-diminishing ranks of the unemployed, has stated flatly that its purpose is not to create jobs, but to create an environment for job growth (its own recent downsizing exercises having added to the unemployment rolls). This stand has been voiced not only by the government's parliamentary members, but by the Prime Minister as well. The Liberal Member of Parliament for Ottawa Centre, Mac Harb, stated during government orders on March 7, 1996:

> "...governments in general set an atmosphere that is favourable for private sector job creation. Finally, it is the private sector that creates jobs, not the government[1]."

Mr. Harb was simply reiterating the public policy stated by the Prime Minister, the Right Honourable Jean Chrétien, who stated during routine proceedings on February 28, 1996:

> "In our first two years the government has done much to actively foster a climate of job creation and it has met with success. Government does not create jobs; it creates the climate for the private sector to create jobs. That is what we have done and continue to do, laying the foundations for long term sustained job growth[2]."

The job creation climate that Jean Chrétien and Mac Harb spoke of was elaborated upon during the House of Commons budget readings during mid-March of 1996. The initiatives, introduced by the government to encourage high-tech development, culminated in many programmes, one venture being Technology Partnerships Canada. As George Proud (Parliamentary Secretary to Minister of Labour, Liberal) describes the initiatives:

> "However, government cannot [create jobs] alone and more important, as has been said, it is not supposed to. The role of government is to create the economic environment which will allow

---

1 Harb, Mac. *Government Orders - The Budget.* Hansard, House of Commons debates. Ottawa: March 7, 1996. (web site: http://www.parl.gc.ca)

2 Chrétien, Jean. *Routine Proceedings.* Hansard, House of Commons debates. Ottawa: February 28, 1996. (web site: http://www.parl.gc.ca)

> the private sector to create the jobs that are needed to get Canadians back to work.
>
> It is through partnerships with the private sector that our role can be fulfilled. One way the government can do this is to target its investment in the key areas of our economy.
>
> The budget also increases investment in technology and innovation through a number of actions over the next three years funded by the reallocation of $270 million from budget savings. For example, Technology Partnerships Canada will be established to encourage risk sharing with the private sector and to leverage investment in the development and commercialization of high technology projects and processes. Funding will grow from about $150 million in 1996-97 to about $250 million by the year 1998-99[3]."

The fact that the government has invested so heavily in promoting a high-tech environment for job creation indicates that it too realizes the importance of the computer in the workforce. It also realizes that jobs will be offered not only to those individuals who work with computers, but to those who are directly involved in the research, development and manufacture of computer systems and components. In fact, it is the high-technology field which has spurred the economic recovery in many areas by offering thousands of high-paying skilled positions to qualified employees.

---

3 Proud, George. House of Commons - *The Budget*. Hansard, House of Commons debates. Ottawa: March 18, 1996. (web site: http://www.parl.gc.ca)

The government's public policy regarding the creation of an environment conducive to job creation in the high-tech industry is secondary to the mandate of this research and therefore will not be examined in depth. The determination of whether the policy is due to government self-interest (the public choice approach[4]), consensus decision-making (the incremental-pluralist approach[5]) or a result of some other rationale[6] is of less importance in this study than how the policy has been addressed by society. In particular, the initiatives undertaken by the high-tech community and post-secondary institutions of the Ottawa-Carleton region will be examined. The accumulated research data will provide a quantitative analysis of the area's success rate in terms of job creation by the high-tech companies and the ability of the higher learning centres to provide the human resources for these jobs.

The three-way interface between the government, post-secondary educational institutions and the information technology industry is an important area of concern in today's society. The high-tech community is a rapidly growing industrial sector providing

---

4 Doern, G. and Phidd, R. *Canadian Public Policy - Ideas, Structures, Process*. Scarborough, Ont: Thomson Canada Limited, 1992, p. 9-10.

5 Ibid., p. 6-8.

6 For a complete listing of approaches in analyzing public policy please refer to Doern, G. and Phidd, R. *Canadian Public Policy - Ideas, Structures, Process*. Scarborough, Ont: Thomson Canada Limited, 1992; Jenkins, W. *Policy Analysis - A Political and Organizational Perspective*. Suffolk, Britain: The Chaucer Press, 1978; Ripley, R. *Policy Analysis in Political Science*. Chicago: Nelson-Hall, Inc., 1985; and Weimer, D. and Vining, A. *Policy Analysis - Concepts and Practice (Second Edition)*. New Jersey: Prentice-Hall, Inc., 1992.

state-of-the art goods and services on a global scale. Because of its expansion, the IT industry has created new employment opportunities which must be filled by skilled personnel. If the government/educational/business climate is such that these positions are left unfilled it will result in the high-tech community not only losing ground in terms of international competition and trade but will also have a negative impact on national and regional economic interests. It is therefore necessary to ascertain whether the current three-way relationship is productive in achieving the objectives of creating employment opportunities and matching these jobs with qualified candidates. Unfortunately, statistical information relating to high-tech jobs is not currently being accumulated separately by Statistics Canada[7]. Therefore, this research will provide insight into the effectiveness of the government's mandate to create an environment for job creation, the high-tech industry's ability to create the jobs and the adeptness of the post-secondary educational institutions to supply qualified personnel to fill the jobs.

The High-Tech Profile of the Ottawa-Carleton Region

One geographic area which has been notably involved in promoting and developing the high-tech industry, nicknamed "Silicon Valley North," has been the Ottawa-Carleton

7 Hill, Bert. *Region suffers record job* loss. The Ottawa Citizen, February 8, 1997, Ottawa, Ontario.

region of Ontario. With over 700 small, medium and large high-tech businesses in existence, covering the spectrum of computer-related goods and services, this region employs literally thousands of people. The top 25 software firms alone employ nearly 3,000 people, as listed in Table 1. The Ottawa-Carleton high-tech industry has performed magnificently in addressing the federal government's stance that it is the responsibility of the private sector to create jobs. One report by James Bagnall, a business writer for the daily newspaper The Ottawa Citizen, states:

> "This region is in the midst of a strong economic recovery led by its technology firms. High-tech companies employ more than 37,000 directly and the industry has been growing nearly 10 per cent a year.[8]"

In the past two years alone, thousands of jobs have been created by companies such as Corel, Cognos and Nortel. On September 7, 1996 Ottawa Citizen business writers Bert Hill and Kristin Goff reported:

> "Driven by high technology, the communications sector has led the recovery of the local economy with 8,400 jobs in the last four months. For example, Corel Corp. hired 291 people in the past 12 months including a dozen more in August [1996].[9]"

---

8 Bagnall, James *Citizen turns page to region's high-tech future*. The Ottawa Citizen, August 26, 1996.

9 Goff, Kristin and Hill, Bert. *High-technology sector leads economic revival.* The Ottawa Citizen, September 7, 1996.

Company	Number of Employees
Corel	850
Cognos	630
JetForm	300
Fulcrum Technologies	200
CrossKeys Systems	152
Simware	136
QNX Software Systems	120
Gastops	78
ObjecTime	55
Milkway Networks	55
Gallium Software	50
Enterprise Software Systems	40
CADLink Technology	40
ProMIRA Software	40
OmniMark Technologies	38
Linktek	35
Data Kinetics	25
TYDAC Research	25
KOM	25
Cadabra Design Libraries	20
Byte	18
MED2020 Research Libraries	14
Animatics Multimedia	14
T-Base Research & Development	12
Fastlane Technologies	10
Total	2982

Table 1:
The top 25 software firms (based on revenue) and the number of employees in each firm. (Source: Branham Group Inc. survey for the Ottawa Citizen)[10]

10 Bagnall, James. *The New Economy of Software Valley*. The Ottawa Citizen, October 10, 1996, Ottawa, Ontario

This type of hiring pattern was not only evident in other high-tech companies during the summer and spring of 1996, but of the year before as well:

> "Newbridge Networks Corp. will hire another 900 people over the next two or three years, boosting its local employment level to more than 3,000 by the end of the decade. In the past year alone, Newbridge has added 400 jobs - a 20 per cent jump in its workforce.[11]"
>
> "The software industry...is creating good jobs:
>
> - In 1995, telecommunications giant Nortel hired 1,000 recent university graduates...for its laboratories in Nepean.
> - Ottawa's Cognos Inc. is expected to add 500 more employees...[12]"

Too Many Jobs and Not Enough People

The positions offered by the high-tech sector of Ottawa-Carleton require skilled employees conversant with the latest in information technologies. To that end, the post-secondary institutions in the area, notably Algonquin College, Carleton University and the University of Ottawa all offer computer-related programs. Every year hundreds of graduates from these three institutions[13] enter the workforce to seek employment in the high-tech field,

---

11 Chianello, Joanne. *Newbridge plans to hire 900, build new Kanata office tower.* The Ottawa Citizen, June 7, 1996.

12 Dare, Patrick. *Programmed for Success.* The Ottawa Citizen, May 18, 1996.

13 As of the winter of 1997, the number of students enrolled in computer studies at Algonquin College was 1408 (from the Office of the Registrar); as of 1996, the number of undergraduate students enrolled at Carleton University (from *Databook 1995-1996*, published by Budgets Planning at Carleton U.) and University of Ottawa (taken from its website http://www.csi.ottawa.ca) was 1330 and 350 respectively, bringing the total to 3088 students. (Note: The figure for the University of Ottawa does not include students enrolled in its Dept. of Engineering's Computer Science programs.)

in response to the need of computer firms for skilled, computer-literate employees. It would appear that the existence of computer studies within a high-tech sector would make for a perfect combination where both industry and the individual are able to satisfy each other's needs. Curiously, this does not seem to be the case.

For whatever reason, it has been noted by business that between 2,000 and 3,000 technology jobs remain vacant due to the lack of qualified personnel. Nationally, the vacancy numbers range at about 7,000, indicating that approximately 36% of all vacant high-tech positions are located within the Ottawa-Carleton region. This is not a new phenomenon, for the members of the Software Human Resource Council (SHRC - a non-profit organization created in 1992 to address the software human resource issue) note that the vacancy rate for technology positions has increased steadily since 1991. From their Software and Competitiveness Report of 1995 they state: "In 1991 thirty per cent of the companies surveyed by SHRC had unfilled software positions. This jumped to 39 per cent by 1995.[14]" The problem still exists today. As Joanne Chianello, a high-technology writer for The Ottawa Citizen, writes:

> "The dearth of software-engineering skills is affecting companies across Canada, where at least 7,000 software jobs remained vacant last year. In the Ottawa area, there are 3,000 unfilled jobs at the 700 technology companies[15]."

---

14 Software Human Resource Council *Software and National Competitiveness Report*, 1995.

15 Chianello, Joanne. *Groups battle skills shortage in high-tech.* The Ottawa Citizen, June 8, 1996.

The question that needs to be answered is why the vacancies continue to exist. It is this question which will be examined in detail. As a brief overview, this study will survey the reasons behind the inability of business to recruit suitable employees, and what roles the federal government and post-secondary institutions within the Ottawa-Carleton region have played in attempting to address the situation. Hopefully, through this research, conclusions will surface which can provide recommendations to remedy the situation.

Specifically, the results of a questionnaire submitted to 400 high-tech firms will be analyzed to determine the reasons why these organizations are experiencing a severe shortage of skilled personnel. Additionally, the computer-related curriculums of Algonquin College, Carleton University and the University of Ottawa will be scrutinized to determine if there are any program shortcomings regarding the subject matter being offered versus the requirements of the high-tech sector. In conclusion, recommendations will be brought forward in an attempt to better meet the needs of the high-tech sector of Ottawa-Carleton and thereby eliminate the skills shortage currently being experienced by the industry. In these times of economic hardships and reduced job possibilities, it is inexcusable that literally thousands of high-paying job opportunities remain vacant.

CHAPTER II

THE QUESTIONNAIRE

Information Gathering Using a Questionnaire

In order to determine the reasons why the region's high-tech companies are unable to fill job vacancies with local graduates a questionnaire was submitted to four hundred high-tech organizations within the Ottawa-Carleton vicinity. The questionnaire method was selected because it is an efficient approach used for contacting a large sample space. As questionnaires traditionally have a low response rate the type and content of the questions were carefully designed to ensure, to a greater degree, that the questionnaire would be completed and returned.

Also, to increase the probability that a questionnaire would be returned, the accompanying cover letter explained the purpose of the survey and included a statement outlining that a summary of the results would be forwarded to all those who responded (Figure 1). The questionnaire was short (one page) to reduce the time needed to answer the questions and again to increase the return rate. Additionally, the questions were designed in such a manner to be either i) dichotomous (two-choices); ii) ranking questions which solicited preferences; and iii) intensity-scale questions to reflect the degree of feeling (either

positive or negative). The last question of the survey was unstructured and open-ended in order to garner opinion (a copy of the questionnaire is shown in Figure 2).

The questions were designed with specific subject matter in mind to obtain particular information. Such areas as type of business, number of employees, number of positions vacant and number of regional graduates hired were researched. The emerging hiring profile of Ottawa-Carleton's high-tech industry provided insight into issues such as what type of businesses have the most vacancies, which businesses have the greatest difficulty finding personnel for the job vacancies, why the difficulties exist and how can they be mitigated.

Due to the dizzying pace of information technology development and improvement, the skills required to perform specific job functions also have the possibility of changing. To keep the research as up-to-date as possible, while at the same time ensuring that the organizations solicited have actual records for referral, the recipients of the questionnaire were asked to consider all of the questions within a time frame period of one year, specifically from June 1995 to June 1996 and to return the questionnaire as soon as possible. The questionnaire was submitted to the organizations during August 1996 with the last of the returns arriving during the late fall of 1996.

The next section displays a copy of the cover letter and questionnaire followed by a detailed examination of the rationale behind the design of each question.

Mailing Address
Fax Number
Date

Dear Sir/Madam:

As a graduate student in the Political Science Department of Carleton University, I am completing a Master's thesis that focuses on the difficulties experienced by high-technology institutions in staffing positions with post-secondary graduates educated and resident in the Ottawa area.

Recently, several sources have expressed the public policy view that the private sector, not the government, should be spear-heading job creation. In the Ottawa region, the high-technology industry within the private sector has had an exemplary record concerning job creation. However, though literally thousands of job vacancies are available, many of them are not being filled by post-secondary graduates educated in the Ottawa area.

The enclosed survey is designed to discover the reasons behind this dilemma. By revealing what is required (by business) and what is being delivered (by Ottawa area post-secondary institutions) a missing piece of the puzzle may emerge. Subsequent recommendations arising from the results of this survey could assist in providing the Ottawa area high-technology industry with more appropriately qualified graduates and also contribute valuable information to public and private educational institutions as well as to the regional, provincial and federal governments.

Due to the ever-changing nature of the information/high-technology industry, I would be grateful if you could return the completed questionnaire by August 20, 1996, either by fax or by mail. A summary of this report will be made available to each respondent.

I wish to take this opportunity to thank you for completing the questionnaire which, you may be assured, is not a time consuming task.

Sincerely,

Roly Roy

Figure 1: The Cover Letter Accompanying the Questionnaire

1. Your organization's primary business function:

- ❑ Manufacturing
- ❑ Hardware Development
- ❑ Software Development
- ❑ Communications
- ❑ Consulting
- ❑ Education
- ❑ Other (please specify)

_____

2. Number of employees in your organization (Eastern Ontario location only):

- ❑ 1-5
- ❑ 6-50
- ❑ 51-100
- ❑ 101-500
- ❑ 501-1000
- ❑ 1001-5000
- ❑ > 5000

3. Number of job opportunities available to post-secondary graduates within last year:

- ❑ 1-5
- ❑ 6-10
- ❑ 11-20
- ❑ 21-30
- ❑ 31-50
- ❑ 51-100
- ❑ >100

4. Average number of applications received per vacancy:

- ❑ 1-10
- ❑ 11-25
- ❑ 26-50
- ❑ 51-100
- ❑ 101-250
- ❑ 251-500
- ❑ >500

5. Average percentage of applicants accepted:

- ❑ 0%
- ❑ 1-2%
- ❑ 3-5%
- ❑ 6-10%
- ❑ 11-20%
- ❑ >20%

6. Was there a major reason(s) why job applicant turned down:

❑ Yes ❑ No

If Yes, please rank the following in order of importance:

- ❑ education level inadequate
- ❑ communication skills inadequate
- ❑ skill set inadequate
- ❑ over-qualified
- ❑ other (please specify)

_____

_____

7. Of those graduates who were successful, what percentage were educated mainly in the Ottawa area:

- ❑ 1-5%
- ❑ 6-10%
- ❑ 11-20%
- ❑ 21-50%
- ❑ 51-75%
- ❑ 76-99%
- ❑ 100%

8. Of the successful candidates from the Ottawa area, their post-secondary education was education was from (check all that apply):

- ❑ Algonquin College
- ❑ Carleton University
- ❑ Ottawa University
- ❑ Other College or University (please (specify):

_____

- ❑ Private college or institution (please specify):

_____

9. Do you discuss computer curriculum issues with any Ottawa Ottawa educational institutions?

❑ Yes ❑ No

If Yes, please check all that apply:

- ❑ Algonquin College
- ❑ Carleton University
- ❑ Ottawa University

10. Is there a problem in obtaining qualified post-secondary graduates (educated in the Ottawa area) to fill high-tech employment vacancies? ❑ Yes ❑ No

If Yes, what do you feel is lacking in the high-technology programs currently being offered by Ottawa's post-secondary institutions? (please use extra pages for comments, if necessary)

Figure 2: The Questionnaire

The Questions

1. Your organization's primary business function:

- ❑ Manufacturing
- ❑ Hardware Development
- ❑ Software Development
- ❑ Communications
- ❑ Consulting
- ❑ Education
- ❑ Other (please specify)

This is a fundamental question required in the research. A firm's business function will allow the analysis to determine which business types have the greatest number of job opportunities, as well as which ones experience the most difficulty in finding qualified personnel to fill the vacancies.

While the majority of respondents classified their main functions under one category, there were a few who selected multiple categories. In these instances, the firms in question had their job vacancies divided equally between each of the categories.

When combined with information garnered from other survey questions, this query provided insight into extended issues. These concerns include how many Ottawa-Carleton graduates a specific type of firm recruited and from which post-secondary institutions did they graduate, thereby revealing the strengths and/or weaknesses of the computer programs of each institution.

2. Number of employees in your organization (Eastern Ontario location only):

- ❑ 1-5
- ❑ 6-50
- ❑ 51-100
- ❑ 101-500
- ❑ 501-1000
- ❑ 1001-5000
- ❑ > 5000

By indicating the number of employees within each organization a relationship between company size and job vacancy rate may be established, allowing for the determination of where employment will be most readily available (e.g. from the small business sector or the large multinationals).. While it appears logical to assume that the larger the organization, in terms of personnel, the greater the likelihood of increased job opportunities, this may not necessarily be true.

The question restricted the survey to the company's premises in the Ottawa-Carleton region in order to assess the issue of company size and job vacancy rate on a more equitable level.

3. Number of job opportunities available to post-secondary graduates within last year:

- ❑ 1-5
- ❑ 6-10
- ❑ 11-20
- ❑ 21-30
- ❑ 31-50
- ❑ 51-100
- ❑ >100

Calculation of the total number of job opportunities available during the period June 1995 and June 1996 will reveal if the recurring statistic of 2,000 to 3,000 vacant high-tech job positions in the Ottawa-Carleton region is realistic.

The question specifically restricts the answer to relate to post-secondary graduates only in order to determine how many of the aforementioned 2,000 - 3,000 job vacancies require employees with a post-secondary education.

By correlating the information from the first three questions of the survey, it will be revealed what type of job vacancies in the high-tech industry are available as well as identifying the percentage of employment postings offered, based on organization size.

4. Average number of applications received per job vacancy:

- ❑ 1-10
- ❑ 11-25
- ❑ 26-50
- ❑ 51-100
- ❑ 101-250
- ❑ 251-500
- ❑ >500

The results from this question will enable the survey to ascertain the composition of the high-tech work force. The job vacancies refer to those positions considered in Question 3. Therefore, the results will reveal if the subject background of post-secondary graduates is concentrated in a few particular fields or if the skills of the graduates cover a more diverse spectrum of information technology. Conclusions reached may determine whether regional college and university curriculums currently provide the skills required for the high-tech community.

By relating these figures with those of previous questions (i.e. job applications per job vacancy based on organization type), insight regarding the application pattern of high-tech job applicants may be revealed. It may be further determined why similar organizations, in terms of function, may have different hiring experiences.

5. Average percentage of applicants accepted:

- ❑ 0%
- ❑ 1-2%
- ❑ 3-5%
- ❑ 6-10%
- ❑ 11-20%
- ❑ >20%

This question relates to those applications which survived the initial screening process and were retained for further consideration. By comparing these figures with the numbers obtained in Question 4, a more accurate assessment will be obtained pertaining to the number of applicants deemed qualified for the employment vacancies (based on resumes and not actual interviews).

Through the comparison of cumulative totals of applicant numbers and job vacancies, a general indication of whether there are enough potential employees to fill the 2,000 - 3,000 job vacancies will be examined, again based on preliminary information obtained from applicant resumes.

6. Was there a major reason(s) why applicant turned down: ❑ Yes ❑ No

If Yes, please rank the following in order of importance:

- ❑ education level inadequate
- ❑ communication skills inadequate
- ❑ skill set inadequate
- ❑ over-qualified
- ❑ other (please specify)

The first part of this important question (a dichotomous type) will reveal what percentage of job vacancies remain unfilled due to reasons relating to the skills of an individual. If a major reason existed in deciding not to hire a candidate, it necessarily must relate to the appended question regarding education levels and skill sets.

The second part of the question will reveal why individual applicants were unsuccessful in being hired, and more importantly, will also provide insight into the reasons why thousands of high-tech employment opportunities within the Ottawa-Carleton region are remaining vacant, despite the hundreds of post-secondary graduates entering the work force each year.

An analysis of the responses to this question will provide enlightenment concerning the skill criteria that business considers is lacking in filling job vacancies . Possible recommendations regarding the roles of the key players in creating an up-to-date workforce may also emerge.

7. Of those graduates who were successful, what percentage were educated mainly in the Ottawa area:

- ❑ 1-5%
- ❑ 6-10%
- ❑ 11-20%
- ❑ 21-50%
- ❑ 51-75%
- ❑ 76-99%
- ❑ 100%

Results from this question will allow for the determination of what percentage of job vacancies, that are being filled, are composed of individuals receiving their post-secondary education within the Ottawa area.

The numbers extracted from this question will also reveal the degree of shortage of skilled personnel in the Ottawa-Carleton region relating to a particular type of organization, (based on its primary function).

Hopefully, subsequent conclusions will indicate whether the skills acquired from post-secondary institutions are similar to the skills required by high-tech companies. If differences do exist, perhaps recommendations may be brought forward to facilitate a greater degree of matching.

8. Of the successful candidates from the Ottawa area, their education was from (check all that apply):

- ❑ Algonquin College
- ❑ Carleton University
- ❑ Ottawa University
- ❑ Other College or University (please specify):
- ❑ Private college or institution (please specify):

The previous question examined the issue of what percentage of successful hirings was educated primarily within the Ottawa area. This question details which of the graduates hired by high-tech companies in the Ottawa-Carleton region received their post-secondary education in one of three primary institutions (i.e. Algonquin College, Carleton University or Ottawa University). Additional choices were provided to allow for instances of educational background which did not strictly fit into the three categories

The results obtained will help indicate not only which institution is fulfilling most of the employment needs of the region's high-tech community but also which one is currently satisfying the needs of a specific sector within the information technology area. This information will also reveal if companies tend to utilize graduates from one educational facility over another, or perhaps purposely desire candidates with a combination of education from differing institutions.

9. Do you discuss computer curriculum issues with any Ottawa educational institutions?

❑ Yes ❑ No

If Yes, please check all that apply:

❑ Algonquin College
❑ Carleton University
❑ Ottawa University

In order to address the hiring requirements of businesses, educational institutions must be aware of the skills and knowledge levels required by companies to fill their employment vacancies. Additionally, this awareness must be reflected in the curriculum content provided by the post-secondary facilities.

The analysis of this question will reveal what percentage of companies are in contact with Ottawa area educational facilities. It will also indicate the type and size of organizations that are discussing curriculum content and will reveal which educational institutions are most proactive in dealing with the needs of the high-tech industry.

The conclusions derived from the results of this question will indicate the current strengths and/or weaknesses of the region's educational facilities in addressing the hiring needs of the high-tech community.

10. Is there a problem in obtaining qualified post-secondary graduates (educated in the Ottawa area) to fill high-tech employment vacancies?

❑ Yes ❑ No

If Yes, what do you feel is lacking in the high-technology programs currently being offered by Ottawa's post-secondary institutions?

The first part of the question involves the use of a simple dichotomous question. The numbers received will alleviate any concerns as to the validity of remarks in the recent past stating that firms cannot fill vacant job positions. It will also provide further indication regarding the efficiency of the area's post-secondary institutions in providing suitable graduates for these employment openings.

Ideally, a questionnaire should terminate with an important open-ended question[16]. It should provide the respondent with an opportunity to express an opinion revolving around the subject matter of the questionnaire. Comments solicited through this portion of Question #10 will provide insight into what businesses feel is lacking in terms of skill sets. Respondents are also provided with an opportunity to suggest what Ottawa educational institutions need to undertake in order to produce qualified post-secondary graduates.

16 O'Connor, B. and Regan, E. *End User Information Systems*. Toronto: Macmillan, 1994, p. 488.

The Responses

Questionnaires were sent to a total of 400 high-tech companies, ranging from software developers to third-party vendors and consultants. Eighty responses were received, resulting in a response rate of 20 percent, (due to requests for anonymity, the businesses which were sent a questionnaire and those who responded are not listed.) Questionnaires traditionally experience low response rates, some as little as 5 percent[17]. Reasons for the diminished response rates vary from simple dislike of the questionnaire format and layout (including paper texture, colour and type of reproduction) to more serious concerns such as anonymity or contravention of company policy regarding the release of any kind of personnel information. Other reasons may originate not from the questionnaire but from the individuals being asked to fill out the survey. Studies indicate that nonrespondents may have character traits different than those who do respond, such as being "higher in leadership, gregariousness, and reading habits.[18]" Other reasons include education levels, time constraints and demographic and socioeconomic differences[19].

Regardless of the reasons behind the nonresponses, what is of crucial importance is

---

17 Balsley, H. and Clover, V.T. *Business Research Methods*. Columbus, Ohio: Grid, Inc., 1974, p. 78.

18 Ferber, Robert. *Readings in Survey Research*. Chicago: American Marketing Association, 1978, p. 312

19 Ibid., p. 311.

the validity or degree of representativeness of the sample of respondents. Does a substantial nonresponse bias exist which may colour the analysis of the returned questionnaires? To ensure that the analysis of the study is valid, the researcher must determine if the character of the nonrespondents is similar to those of the respondents. It is generally accepted that if there is evidence that the characteristics are essentially similar, then no further examination between the two entities need be pursued as purported by Warwick:

> "Nonresponse bias can never be fully analyzed because, by definition, some of the necessary information is unavailable...Ideally, we would like to know if...the nonresponse cases in the sample differed significantly from [the respondents, but] we shall never know in a definitive way...Nevertheless, it is possible to use those bits of information available about the [nonresponses] to make appropriate comparisons between the two groups...If no significant differences appear in the comparisons made...the analysts can move ahead[20]."

Furthermore, as Balsley and Clover state:

> "If there happens to be evidence or knowledge on the part of the researcher that the nonrespondents would have the same characteristics as the respondents, then no further action is necessary. However, if such information is not available, and the facts are not known, then a secondary survey may be necessary...[21]"

---

20 Lininger, Charles A. and Warwick, Donald P. *The Sample Survey: Theory and Practice*. New York: McGraw-Hill Inc., 1975, p. 294.

21 Balsley, H. and Clover, V.T. *Business Research Methods*. Columbus, Ohio: Grid, Inc., 1974, p. 265.

In the case of this survey, the facts are known because the sample used (the 400 firms) is a finite, and known, universe. They were chosen based on a number of criteria. To facilitate the creation of the high-tech company database, they had to exist in directories specifically created for Ottawa-Carleton's high-tech community. Two directories were researched: the Ottawa-Carleton Economic Development Corporation (paper-based)[22] and the Global-X-Change Communications Inc. Directory (electronic-based)[23]. Additionally, the high-tech companies were required to have some form of electronic communication available (facsimile capabilities were the most preferable) in order that the questionnaire may be sent out and returned quickly, with a minimum of inconvenience and cost for the respondent. The last criterion was basic, the company still had to be operational.

In determining that the character of nonrespondents is similar to respondents, it is the 'corporate character' of the organization that must be examined, not the character traits of the individual who is actually filling (or not filling) in the questionnaire . It is known that, similar to the respondents, the nonrespondents are all involved in some form of information technology enterprise. Consequently, the nonrespondents also require skilled employees of a post-secondary nature since their work objectives and processes involve either the creation,

---

22 OCEDCO. *High Technology Related Companies*. Ottawa: Ottawa-Carleton Economic Development Corporation, 1995.

23 Global-X-Change Communications Inc. *Silicon Valley North High Tech Directory*. Ottawa, 1995. (web site: http://www.globalx.net/svn/directory/index.html)

use or sale of high-tech related products. Therefore the similarities in the work environment, coupled with the similitude of 'employee milieu' between the respondents and the nonrespondents, legitimize the results obtained from the questionnaires in being representative of the entire high-tech industry in the Ottawa-Carleton region.

CHAPTER III

ANALYSIS OF THE QUESTIONNAIRE RESULTS

This section will analyze the actual results obtained from the questionnaire. The responses to each question will be examined sequentially accompanied by an explanation and conclusions, if appropriate. Subsequently, data results will be interrelated to further provide insight into the root causes of the high vacancy rate currently existing in Ottawa-Carleton's high-tech industry. For example, though not presented as a question in the survey, it will be possible to determine if particular business types hire graduates from any specific post-secondary institution by combining the data results referring to the post-secondary education of a successful applicant and the type of high-tech organizations hiring these graduates. Another example of utilizing solicited data to formulate extended conclusions is the relating of business size (in terms of number of employees) to those organizations which actively consult with post-secondary educational institutions in order to reveal the participation rate of small, medium and large organizations.

An analysis of the direct responses, as well as the interrelated data, will lead to substantive recommendations pertaining to the key players (i.e. the federal government, post-secondary institutions and the high-tech community) in providing a skilled workforce for the information technology industry in the Ottawa-Carleton region.

1. Your organization's primary business function.

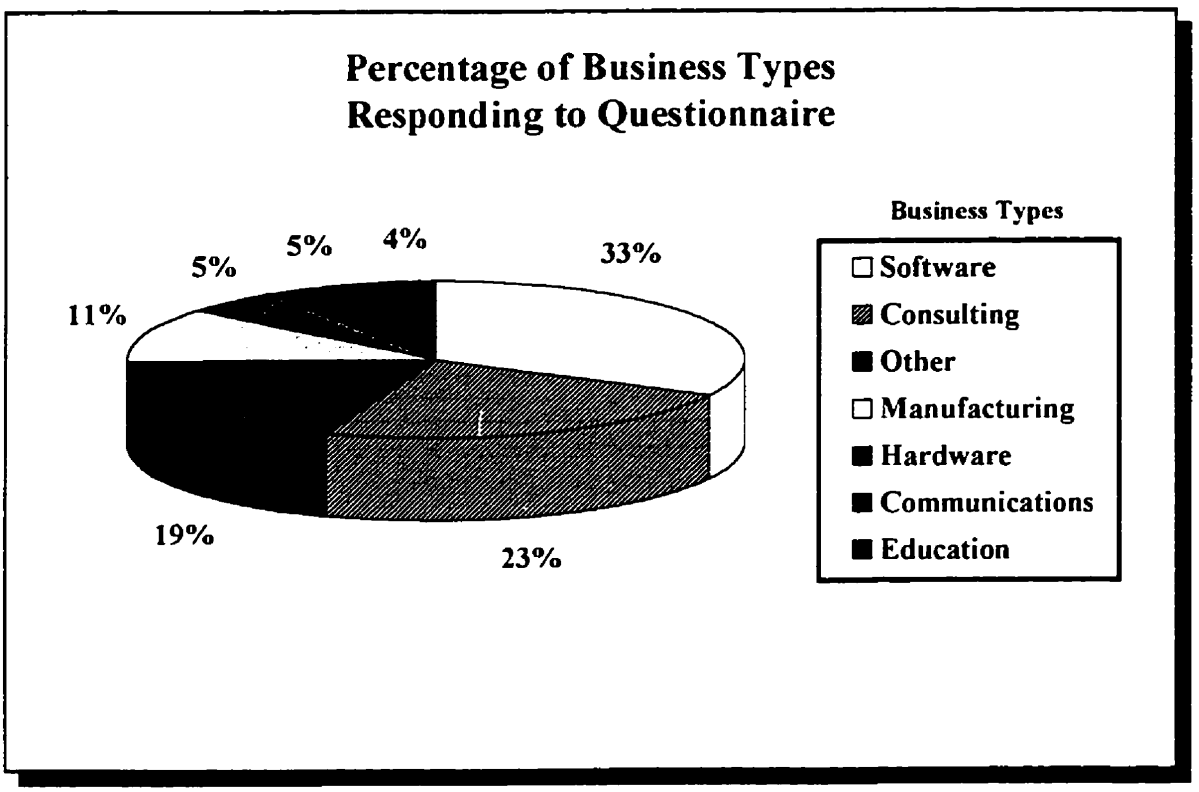


Figure 3: Business Types

Approximately one third (33%) of all respondents are businesses which deal with software development. Interestingly, media articles have identified the software sector of the region's high-tech community as having a huge proportion of the industry's job vacancies. Bert Hill, an Ottawa Citizen business writer, has commented: "Other studies have said Canada

needs thousands of skilled software workers, including at least 2,000 in the capital region.[24]" Another Citizen writer, Patrick Dare, states: "There are an estimated 2,000 unfulfilled jobs in the computer-software business in the capital region.[25]" Future analysis of the data in Figure 3, related to Question #7, will reveal whether this business type is experiencing the most difficulty in filling employment vacancies.

The remaining respondents are basically evenly split (apart from the 'other' category) across the high-tech spectrum. The fact that the second largest sector of respondents is composed of consultants (23%) is of no surprise because, as of January 1997, there were no less than 281 computer-related consulting firms[26] operating within the Ottawa-Carleton region. Since consulting firms offer private and public (e.g. federal, provincial and municipal levels of government) organizations a variety of skilled workers, based on the requirement of the client, it is conceivable that these companies are having a difficult time finding recruits to fill their high-tech positions.

---

24 Hill, Bert. *Telecom industry to address skill shortage*. Ottawa: The Ottawa Citizen, Sept. 18, 1996.

25 Dare, Patrick. *Carleton must think big to survive, says incoming president Van Loon*. Ottawa: The Ottawa Citizen, July 11, 1996.

26 Bell Canada. *Yellow Pages*. Ottawa: Tele-Direct Publications Inc., 1997.

2. Number of employees in your organization (Eastern Ontario location only).

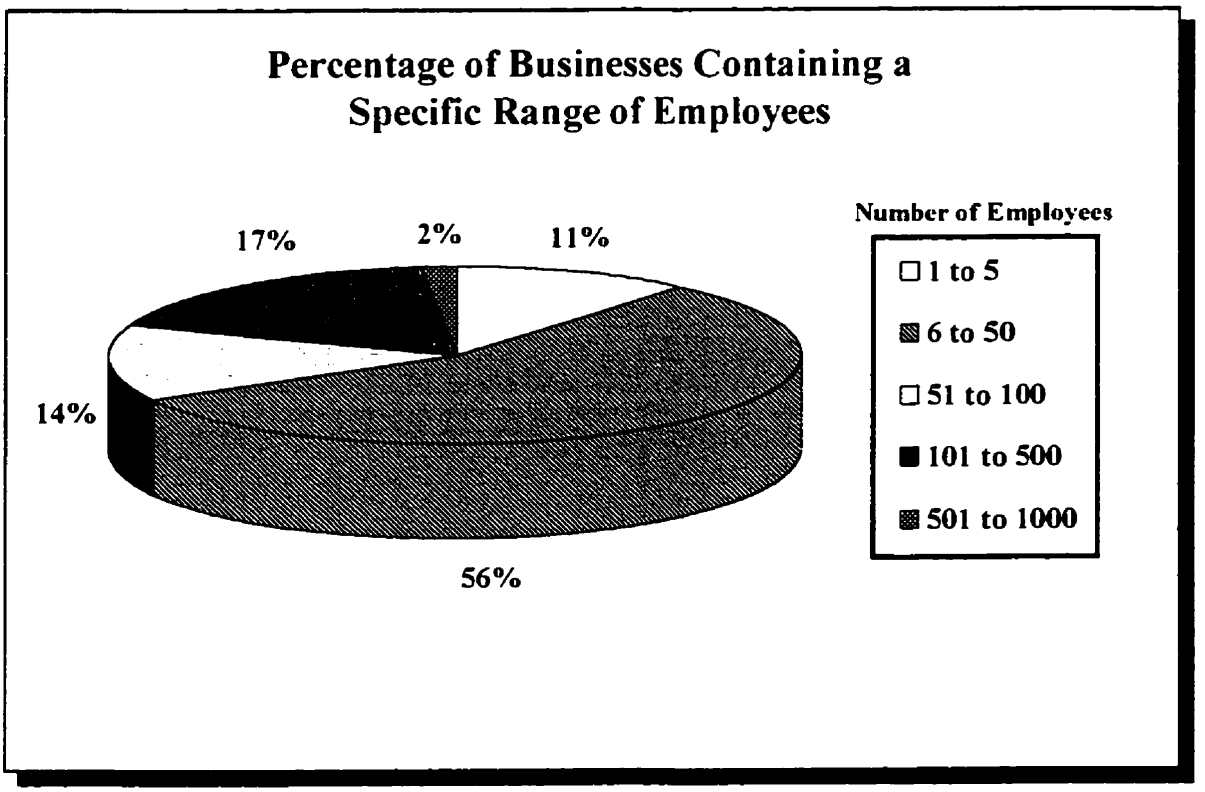


Figure 4: Business Size According to Number of Employees

The majority of businesses (56%) responding to the survey were of a small to intermediate size (6-50 employees). However, well over a quarter of the respondents (31%) were firms which employed from 51 to 500 employees (2% have up to 1000 employees).

Under the premise that the more revenue a company has, the more likely it is able to sustain a larger number of staff, the results, illustrated in Figure 4, indicate that the

overwhelming majority of businesses are companies which are moderately to highly successful. In order to maintain and/or improve this situation, it is imperative that the companies support an employee skill level which will facilitate ongoing success. One obvious method would be to hire new graduates who already possess appropriate current technology skills.

In itself, this statistic does not provide insight regarding which firms have the job vacancies. Are the large companies providing most of the vacancies, or are the medium to small size companies offering the majority of employment opportunities? Later analyses may answer this question through the correlation of data obtained concerning both business size and job opportunities.

By revealing which firms are posting the majority of job positions and coupling that with the required technical background of graduates, the survey will potentially provide insight into why the vacancies continue to exist.

3. Number of job opportunities available to post-secondary graduates within last year.

In order to obtain an approximate figure regarding the number of positions made available by the high-tech companies during the period June 1996 and June 1997, a few basic calculations must be made.

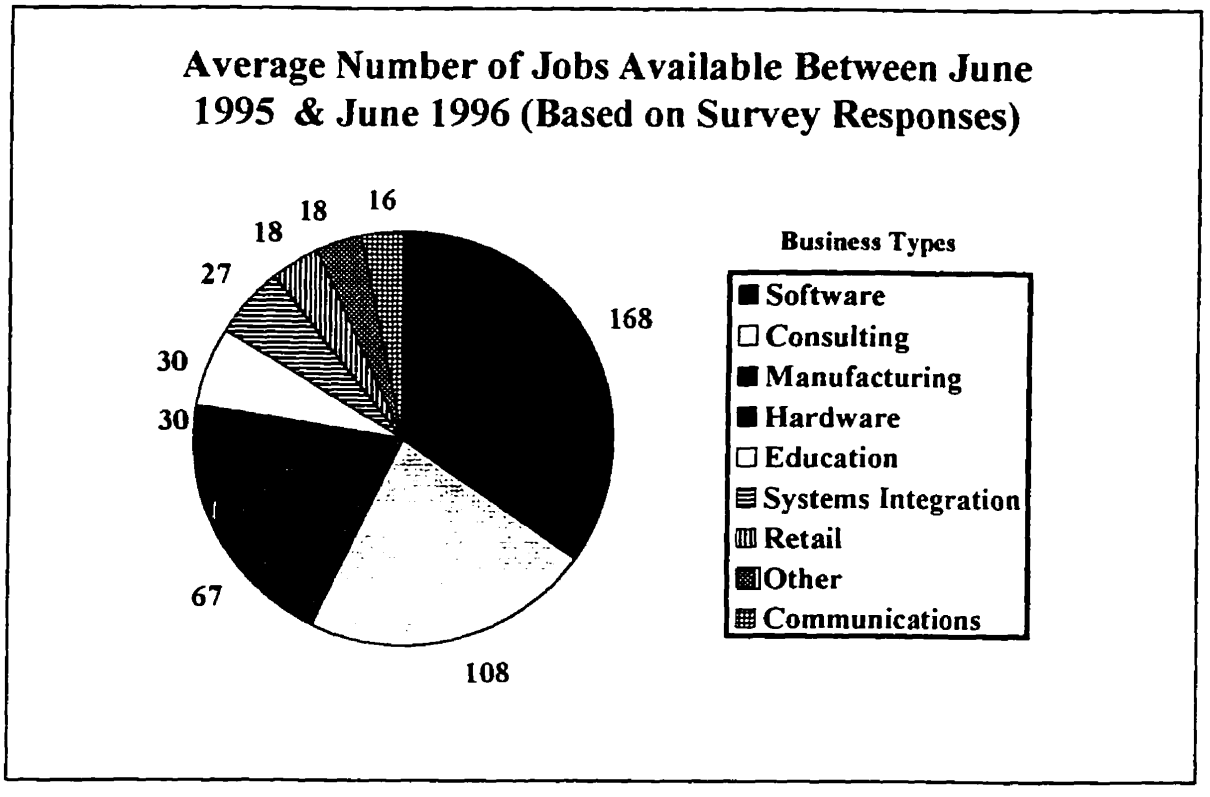


Figure 5: Number and Type of Employment Positions

Based on the survey response, eighty firms made available 482 jobs between June 1995 and June 1996. If we extrapolate this figure to 700 companies[27], the number of positions created within a one year time frame equals approximately 4200 jobs (482/80 x 700). Referring to statements that 2,000 to 3,000 vacancies remain open, the question that emerges

---

27 Chianello, Joanne. *Groups battle skills shortage in high-tech*. The Ottawa Citizen, June 8, 1996.

is which companies are not finding successful candidates, and why. To answer this query requires a detailed examination of various combined data results as well as an investigation into the technical educational backgrounds of both the successful and unsuccessful candidates. Both of these issues will be dealt with further on in the study.

4. **Average number of applications received per job vacancy**

   versus

5. **Average number of applications accepted per job vacancy**

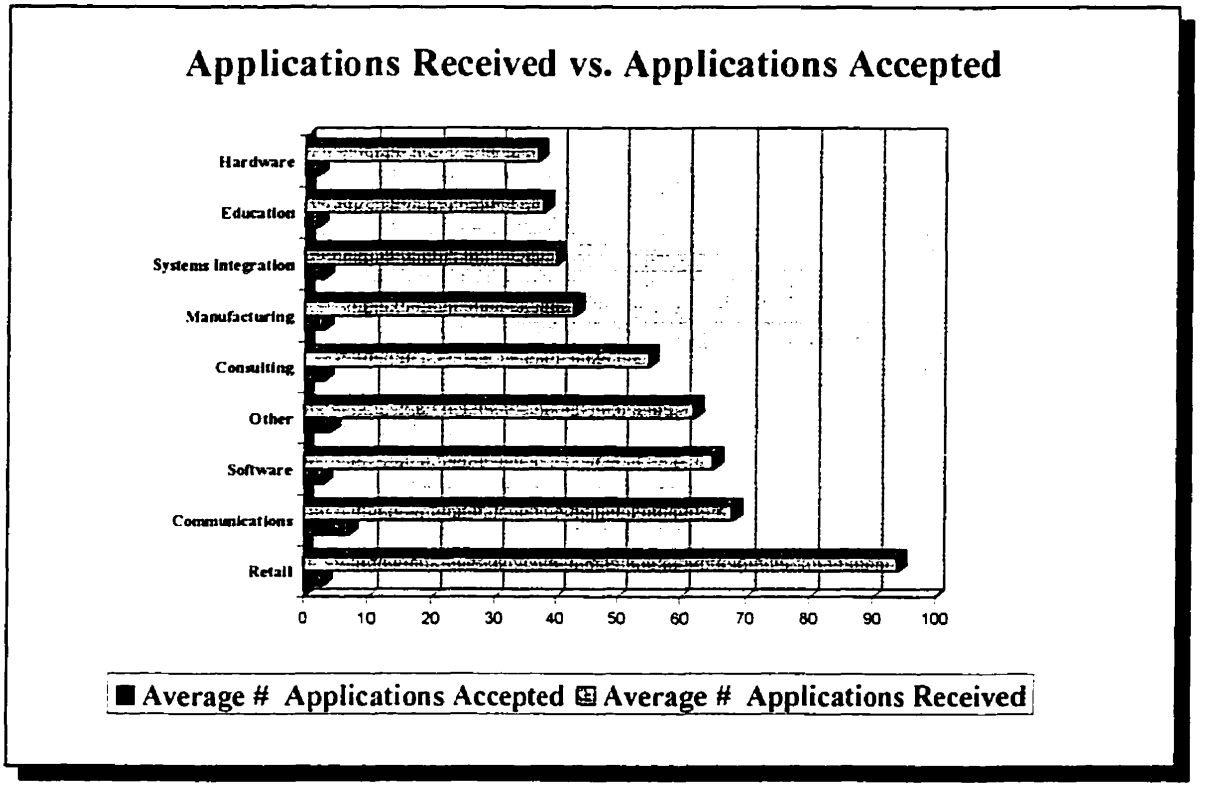


Figure 6: Job Applications Received and Accepted

In revealing the average number of job applications received per job vacancy by the responding organizations, an alarming discovery is made concerning how few of the applications are actually accepted. As evidenced in Figure 7, in every category of the high-tech industry, the percentage of submitted applications that were accepted averaged approximately six per cent (minimum of 3 % for retail applications and maximum of 10% for communications). It appears that it is not a question of a lack of people, but a question of not enough qualified people.

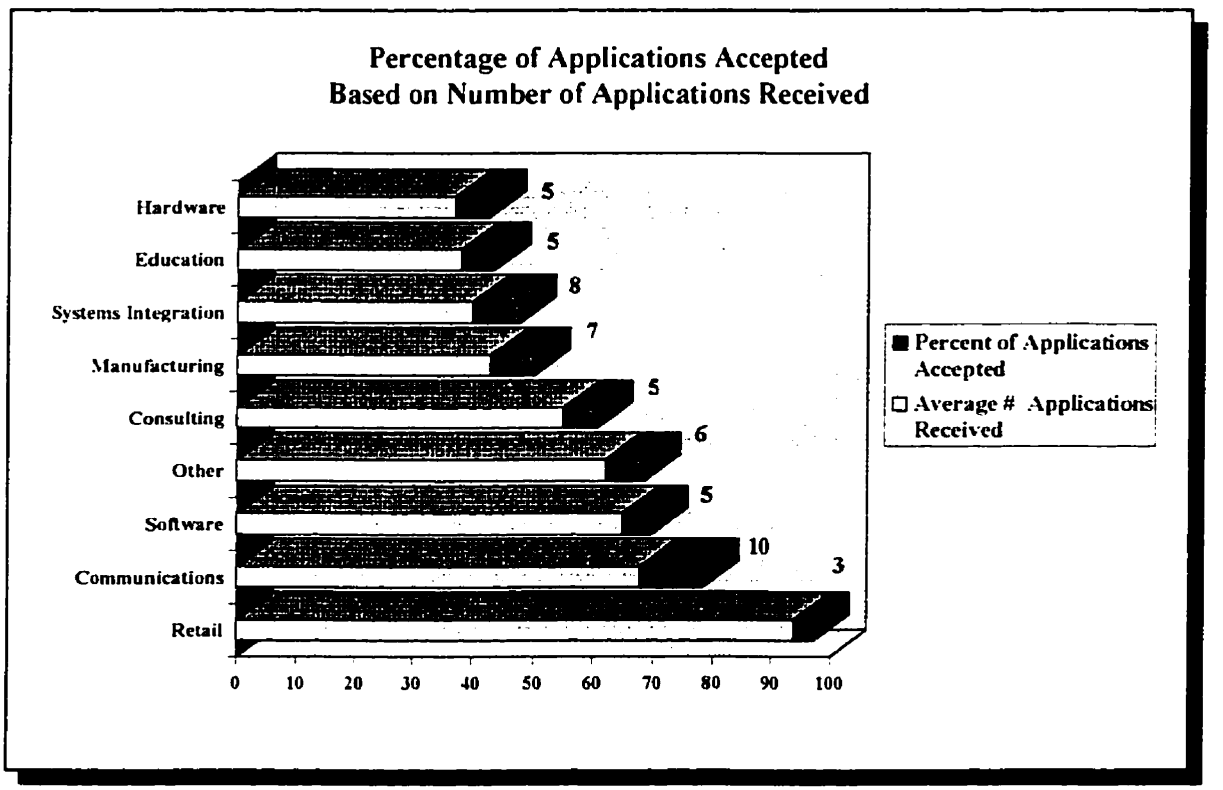


Figure 7: Applications Received/Accepted

The reasons behind the low application acceptance may be varied. Perhaps individual applicants are applying for positions for which they are not qualified or possibly the technological education they are receiving does not adequately address the current job requirements of the industry. If curriculum content is revealed to be an issue, the relationship between the high-tech industry and the college and universities, or the lack of it must be taken into consideration. The study will determine if there is a dialogue between the two sectors and what, if any, improvements business feels must be implemented to better address their workforce needs.

6. Was there a major reason(s) why applicant turned down?

The answers to this question provide the most insight as to why the high-tech community is experiencing such a high job vacancy rate. While the two categories of 'inadequate education level' and 'over-qualified' can be dismissed as being from applicants with either too little or too much education, the remaining three categories are revealing. The main reason why organizations feel that they are unable to fill job vacancies is due to an inadequate skill set (34%). It is not that the applicant's education level is insufficient, but because the skills garnered within the school program do not meet the needs of the industry.

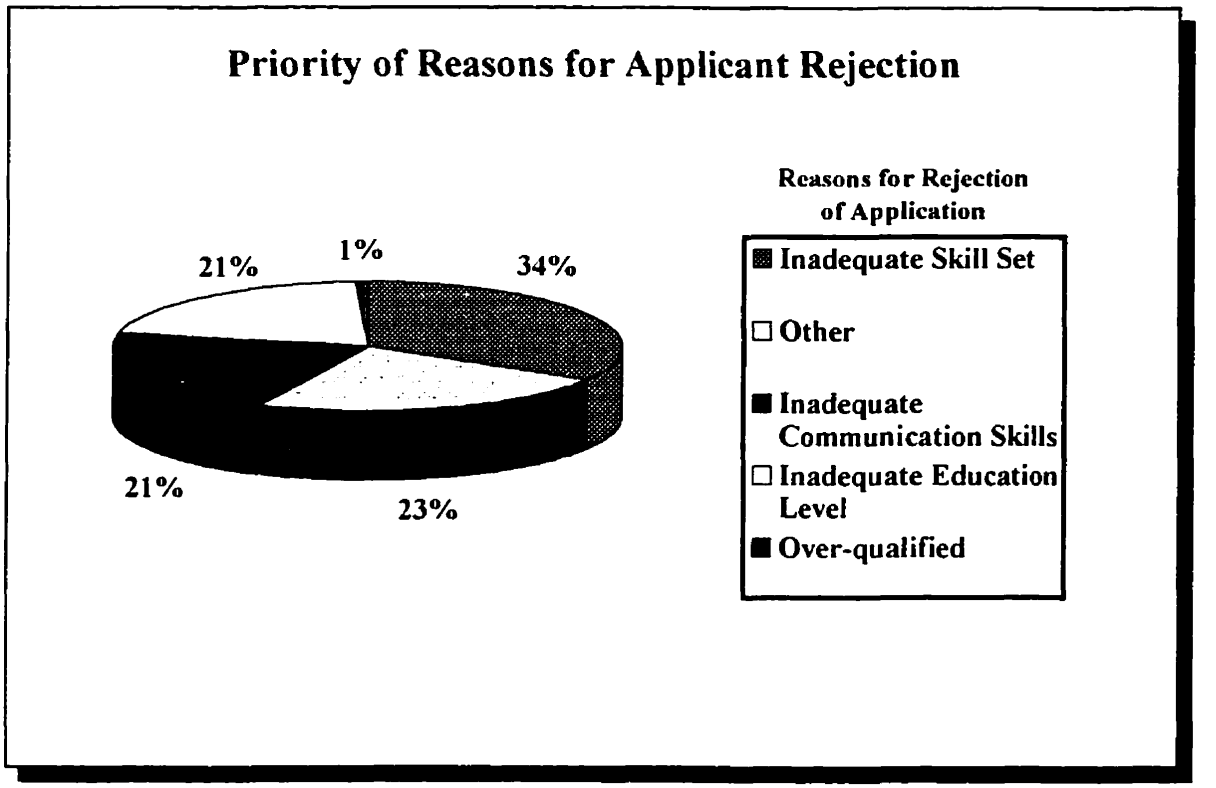


Figure 8: Reasons for Applicant Rejection

This is hardly surprising, however, for two main reasons. The diverse special skills required to be current in information technology are dynamic, changing as quickly as new technology is introduced. In order to keep pace with these new skill requirements, post-secondary curriculums should also adapt, in a timely manner, to include new technology education. It takes time and financial resources to develop courses and to secure the proper means to impart the information to students. This means having educators knowledgable

concerning the current technologies as well as having the related software and hardware equipment required to utilize the new technology.

What is more surprising, however, is the realization of the remaining two reasons why applicants are being turned down for employment opportunities. Over one fifth of all candidates (21%) were unsuccessful in obtaining employment due to a lack of communication skills (written and/or oral). The importance of this aspect of an individual's development cannot be overstated. After all, the field of endeavour is information technology, and of what value is information if it cannot skilfully be communicated? Unutilized information is useless information. Whether it concerns the relating of new ideas within a team environment, writing a document or report, or delivering a presentation to a group of individuals, it is imperative that an individual has the ability to understand, speak and write well, including all of the basic aspects such as spelling, grammar, and the use of a succinct vocabulary. Why do 21% of job applicants within the high-tech field exhibit a lack of communication skills? If the source of the issue began prior to post-secondary education, who is responsible in finding a solution at this stage? Would it be the graduating job applicant, the post-secondary institution, a government body, or the industry itself?

The 'other' category accounts for an additional 23% of applicants who are unsuccessful in their job search. As outlined in Figure 9, the 'other' reasons reveal not only

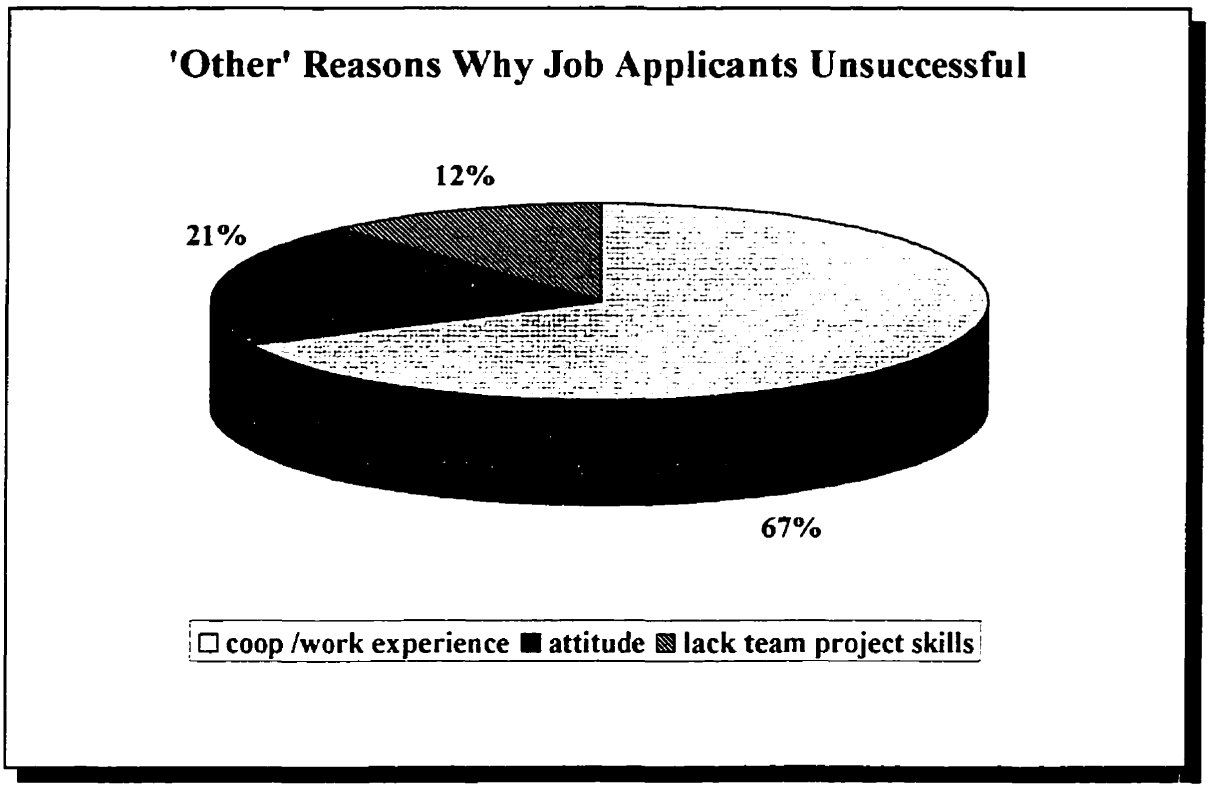


Figure 9: Reasons Why Job Applicants Unsuccessful

shortcomings in terms of technological skills (i.e. co-op/work experience and project teamskills), but also social skills (attitude). Of the 23 percent figure, 67% related to lack of co-op/work experience, 21% was due to attitude shortcomings and 12% dealt with lack of project team skills. In terms of overall percentages, these figures translate into 15%, 5% and 3% respectively of all reasons why applicants were unsuccessful.

The overwhelming majority of companies feel that post-secondary graduates do not

have enough work experience when applying for a job. Organizations cite that experience, in the form of co-op educational programs, would go a long way in preparing students for a career in the high-tech field. The lack of project team skills is closely related to insufficient work experience. The inability to work within a team environment could be a result of simply not being exposed to a 'team-type' work setting. The lack of co-op experience probably has a bearing on this statistic.

However, the inability to work in a team environment could also be a result of something entirely different: attitude. Respondents stated that over one fifth of the applicants (21%) displayed an improper attitude towards work and business which was the prime reason for not being hired. This coincides with a survey undertaken by the Canadian Federation of Independent Business, which stated:

> "Small business says young Canadians need a better work ethic.
>
> [Eighty-eight] percent of small businesses said work ethic was the most important attribute they looked for when hiring youths. And 43 percent of businesses surveyed said poor work attitude was a big problem in finding skilled help of all ages.[28]"

Though having revealed that 21% of job applicants display an undesirable attitude towards work and business, the questionnaire responses do not provide insight as to why

---

28 Evenson, Brad. *Youth work ethic needs improvement, survey shows*. Ottawa: The Ottawa Citizen, October 25, 1996, Ottawa, Ontario.

this attitudinal problem exists. Recommendations to better this impediment to a job applicant's success rate will, out of necessity, be made upon conjecture as to the cause of the problem (e.g. lack of social skills, naivety of the business/corporate world, ethical standards, etc.).

7. Of those graduates who were successful, what percentage were educated mainly in the Ottawa area (according to business type)?

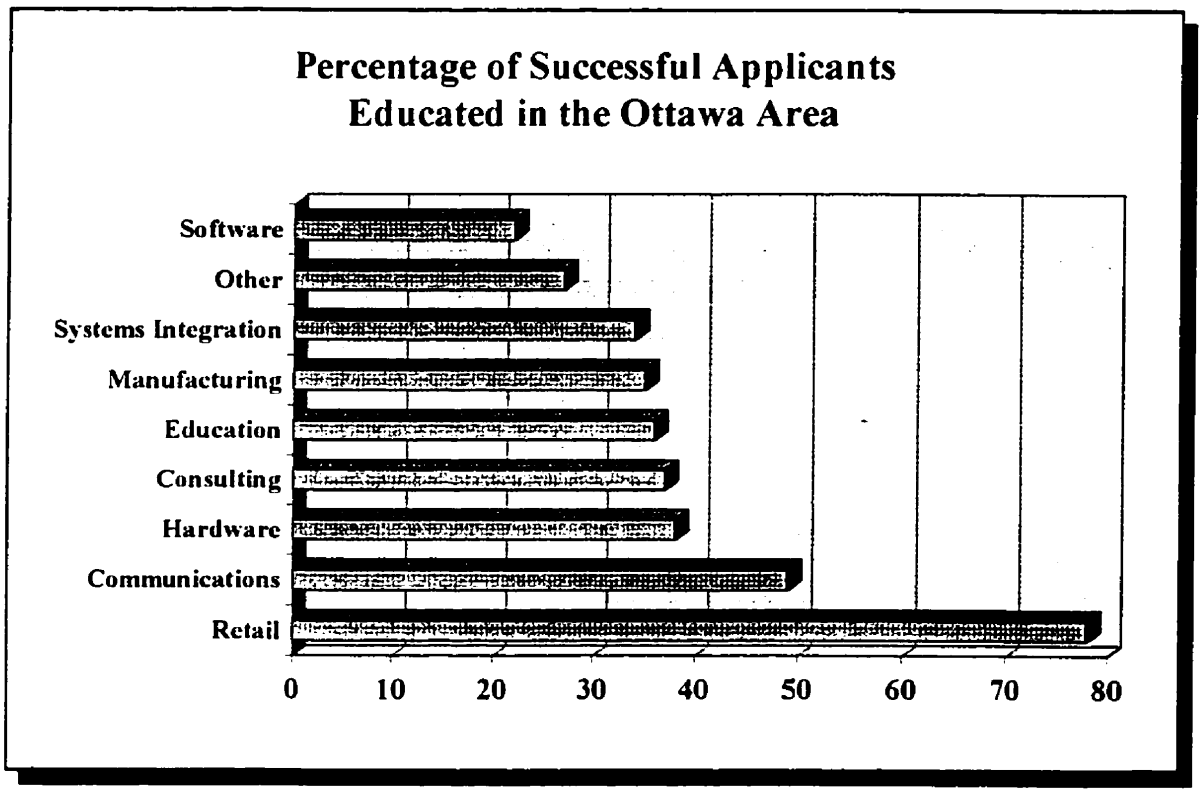


Figure 10: Successful Applicants Educated in Ottawa Area

The graph in Figure 10 confirms the statements made by industry professionals. There is a shortage of skilled graduates in the Ottawa area, resulting in thousands of job openings remaining vacant. On average, approximately 40 percent of all successful candidates originate from the Ottawa area. While the retail sector employs the largest percentage of locally educated graduates, the software industry employs the smallest percentage of Ottawa graduates, with a figure of 22 percent. As the education writer for the Ottawa Citizen, Patrick Dare, stated: "There are 2,000 to 3,000 unfilled technology jobs [in Ottawa-Carleton], many of them software jobs.[29]"

These figures are interrelated with those numbers associated with the reasons why applicants are refused employment. But there are other reasons put forth which may account for the low percentage of successful Ottawa educated graduates. In addition to inadequate skill sets, lack of experience and attitude, a very small minority of respondents felt this problem may be due partly to the departure of graduates leaving for employment in the United States. One organization sees this as a serious risk to the nation's economy. The Ottawa-based group for high-tech industry, the Canadian Advanced Technology Association (CATA) has stated similar sentiments, but on a national scale: "The exodus of computer and electrical engineering graduates to the U.S. poses a significant risk to

29 Dare, Patrick. *Programmed for Success*. Ottawa: The Ottawa Citizen, May 18, 1996. Ottawa, Ontario.

Canada's economy.[30]" Whether this exodus does in fact make an impact on hiring practices within the Ottawa-Carleton region is not evident in this survey.

The range of issues contributing to this serious problem of a forty percent hiring rate within the area's high-tech community is a matter of concern and reflection involving the college and universities providing the technical knowledge, the graduating students who are anticipating employment opportunities, the businesses which require skilled graduates and the Canadian government whose responsibility admittedly is to create an environment conducive to creation of employment opportunities.

8. Of the successful candidates from the Ottawa area, their post-secondary education was from:

As illustrated by the statistics in Figure 11 survey respondents indicate that ninety percent of all successful applicants from the Ottawa area received their post-secondary education locally. Of that 90%, the three regional educational institutions, Algonquin College, Carleton University and University of Ottawa comprised 30%, 33% and 27% of the total respectively. From these figures alone it is impossible to determine where the strengths and weaknesses exist in the curriculums of the college and universities. By

30 Strathdee, Mike *Canadian firms fear brain-drain as students look to U.S. for jobs*. Ottawa: The Ottawa Citizen, October 10, 1996, Ottawa, Ontario.

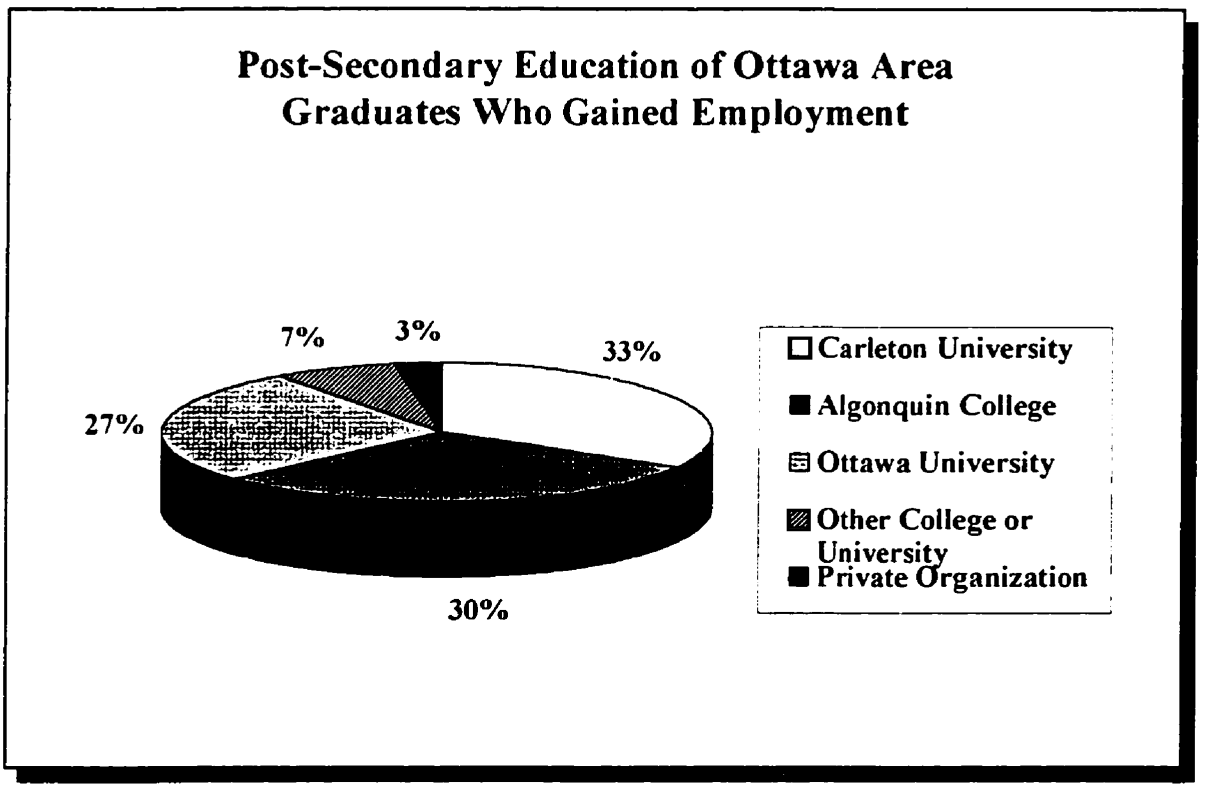


Figure 11: Post-Secondary Educational Sources

combining question responses it is possible to discover if specific business types tend to obtain new employees from a particular post-secondary institution (of the three mentioned). Figure 12 charts out this data to more clearly investigate if a business recruiting trend does in fact exist.

It must be remembered, however, that the "successes" of the post-secondary curriculums are translating into Ottawa area graduates qualifying for only 40 percent of the

total number of employment positions available within the region. While this graph will determine which institution is more successful in terms of developing job ready graduates in one high-tech discipline as opposed to another, there still must be an existing shortcoming which is reflected by the low percentage of suitable job applicants from the Ottawa-Carleton region.

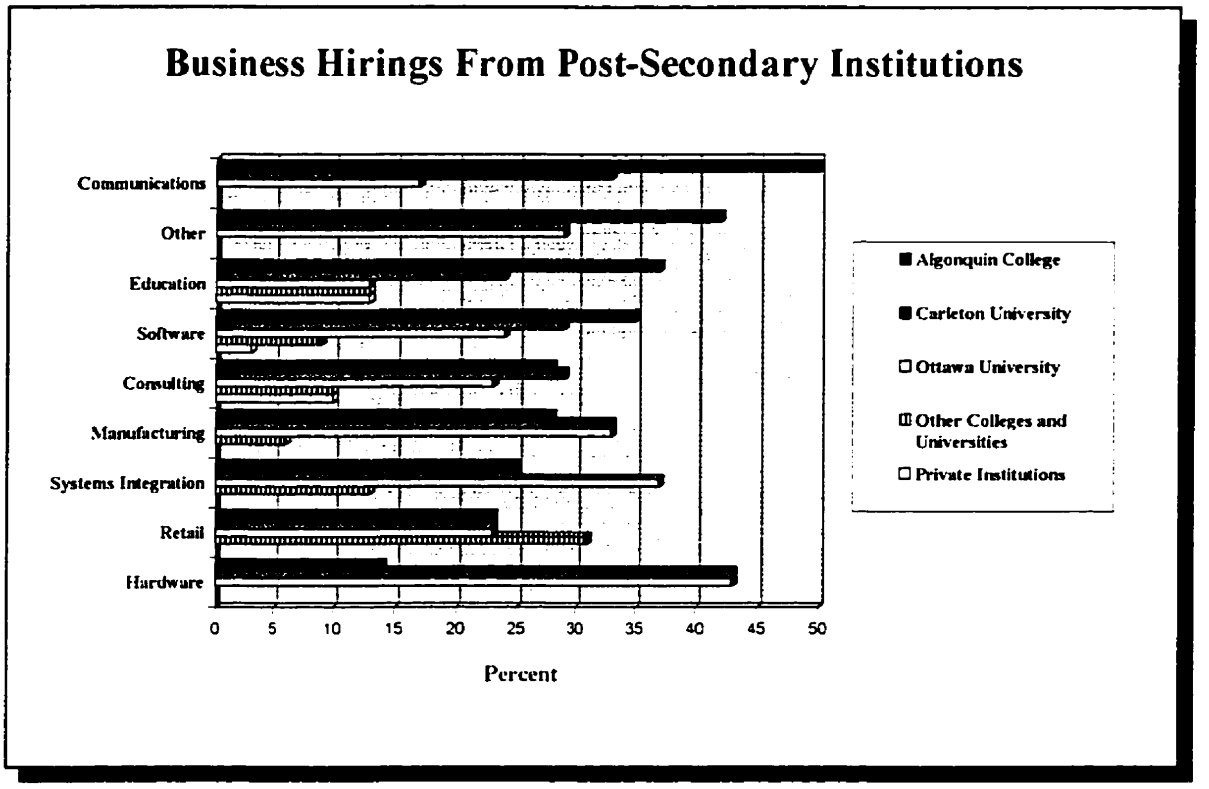


Figure 12: Business Recruiting

A striking revelation from the statistics represented Figure 12 is that there is no strong leader in the teaching of information technology. If only the three area institutions are

examined, employment placements are originating primarily from Algonquin College and Carleton University. Other interesting facts learned include that approximately half of the business types surveyed are recruiting the majority of their staff from Algonquin College.

9. Do you discuss computer curriculum issues with any Ottawa educational institutions?

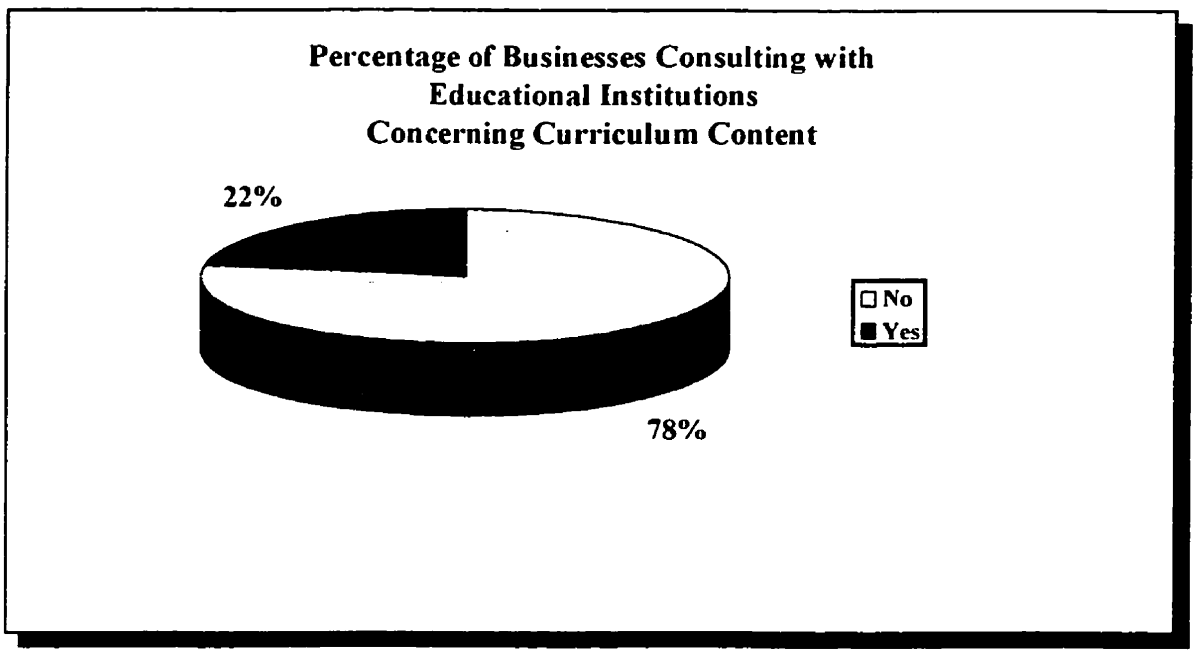


Figure 13: Business and Educational Institution Curriculum Consultation

As evidenced in Figure 13, an overwhelming majority of businesses (78%) do not have any type of communication with the post-secondary institutions regarding curriculum content. The consequence of this lack of communication appears to be reflected in the number of survey respondents who felt that graduating students do not possess the required

skills to join the high-tech workforce. Upon whom does this responsibility rest to ensure that the college and universities are cognizant of what the high-tech industry requires in terms of current technology skills? Of the 22 percent of businesses that do communicate with post-secondary institutions, Figure 14 illustrates the percentage of contact for each one. The percentages reflect, to a certain degree, the amount of jobs garnered by the respective institutions (refer to the last graph in Appendix I). Of the 22% of businesses which do consult with educational institutions concerning curriculum issues, 43 percent of them correspond with Algonquin College, with 33% and 24% of the businesses consulting with Carleton University and the University of Ottawa respectively.

An equally important issue revolves around not the number, but rather the size of businesses that communicate with the college and universities. Many of the jobs being created in the Ottawa-Carleton high-tech community are surfacing from small and medium size organizations. As James Bagnall, business writer for the Ottawa Citizen stated in November 1996:

> "New hiring by high-technology firms...helped to push employment levels to [record levels]. Many of Ottawa-Hull's new jobs are being generated by dozens of small and medium-sized technology firms...[31]"

---

31 Bagnall, James *High-tech drives torrid Ottawa-Hull job market.* Ottawa, the Ottawa Citizen, November 9, 1996, Ottawa, Ontario.

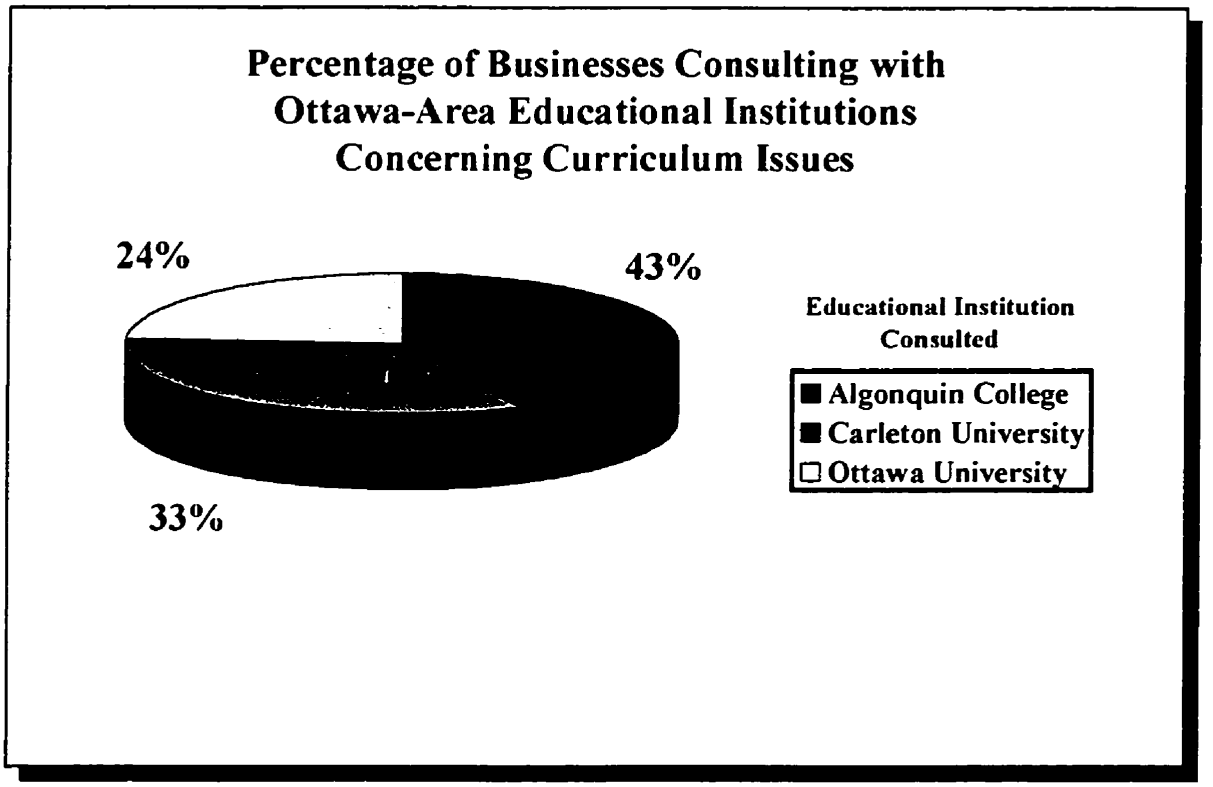


Figure 14: Consultation Between Post-Secondary Institutions and Business

Figure 15 illustrates the percentage of small, medium and large size businesses which consult with the college and universities (for quantitative purposes a small firm was considered to have between 1 and 5 employees, a medium-sized firm between 6 and 100 employees and a large firm having over 100 staff members). As shown, the percentages of each business size do not appear to be weighted heavily in favour of any one type. Therefore, the situation remains the same: while various sizes of businesses communicate

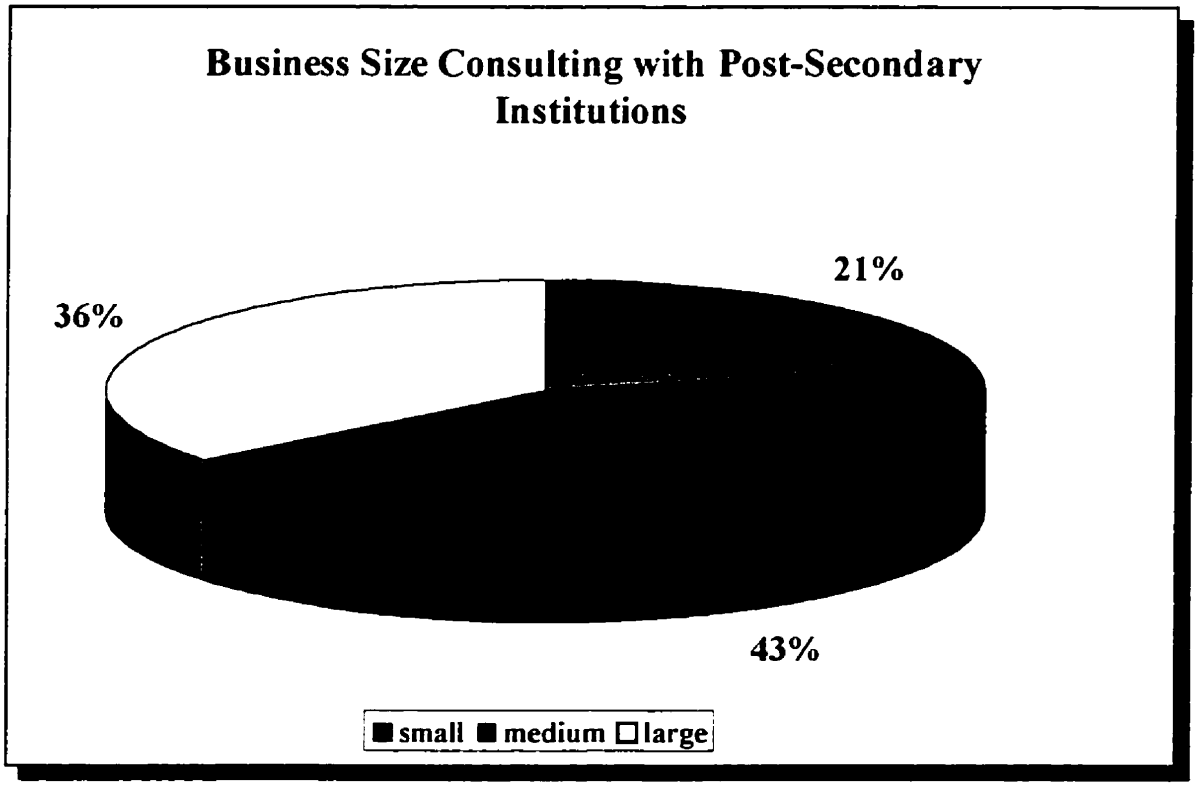


Figure 15: Business Size

with the post-secondary educational institutions, the percentage of businesses actively involved is quite low.

10. Is there a problem in obtaining qualified post-secondary graduates (educated in the Ottawa area) to fill high-tech employment vacancies?

Overall, the percentage of high-tech businesses within the Ottawa-Carleton region which are having difficulty in filling job positions is slightly more than half. Figure 16

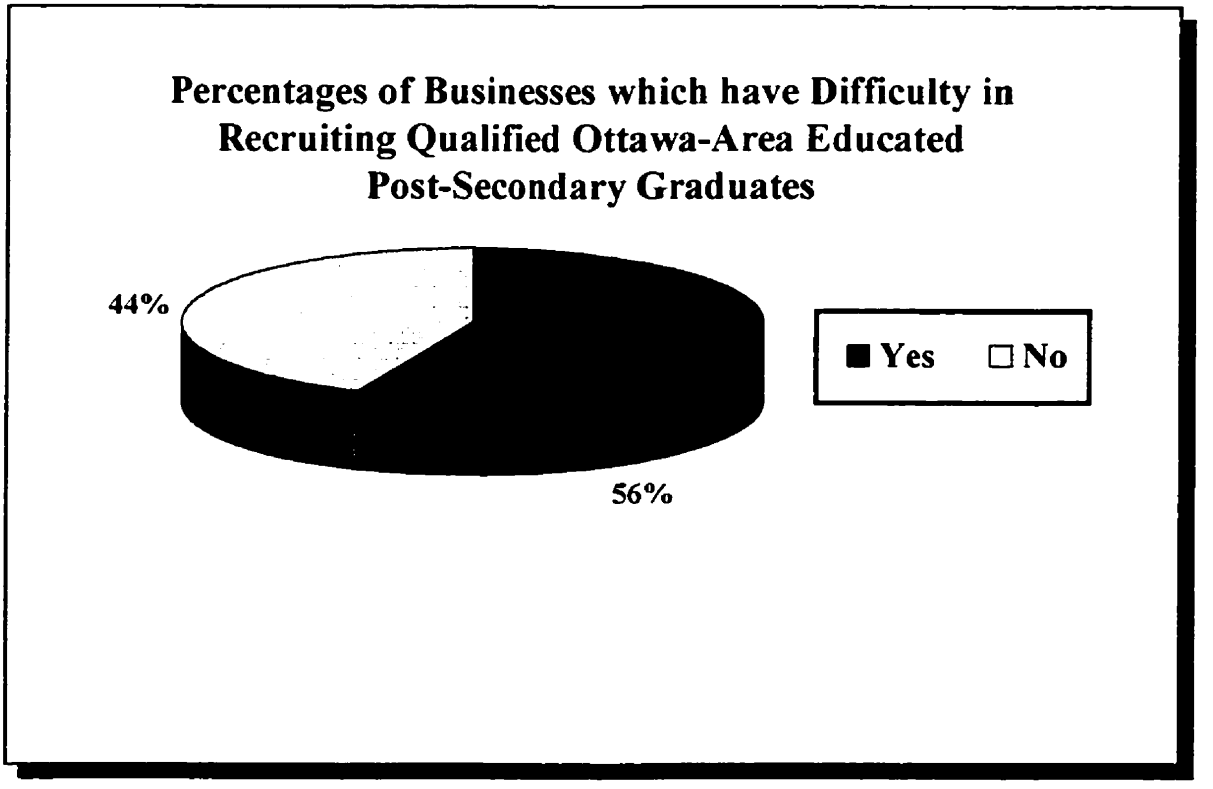


Figure 16: Percentage of Businesses Experiencing Hiring Difficulties

indicates that fifty-six percent of all businesses surveyed had hiring problems. Media accounts would suggest that a larger percentage of businesses have experienced difficulty but previous analysis in this study has revealed that certain sectors of the high-tech community are experiencing greater difficulty than other areas. To determine what sectors were experiencing problems, a breakdown of those firms into business types was undertaken.

As can be seen in Figure 17, the largest information technology sector having the most difficulty hiring new personnel is software development (37%). The finding again concurs with previous analysis and with media reports. The business with the second highest percentage is that of consulting (24%). As mentioned earlier, these firms hire people to assist other corporations in a wide variety of end user information systems. Consequently, they require individuals with knowledge and experience which covers a wide spectrum of

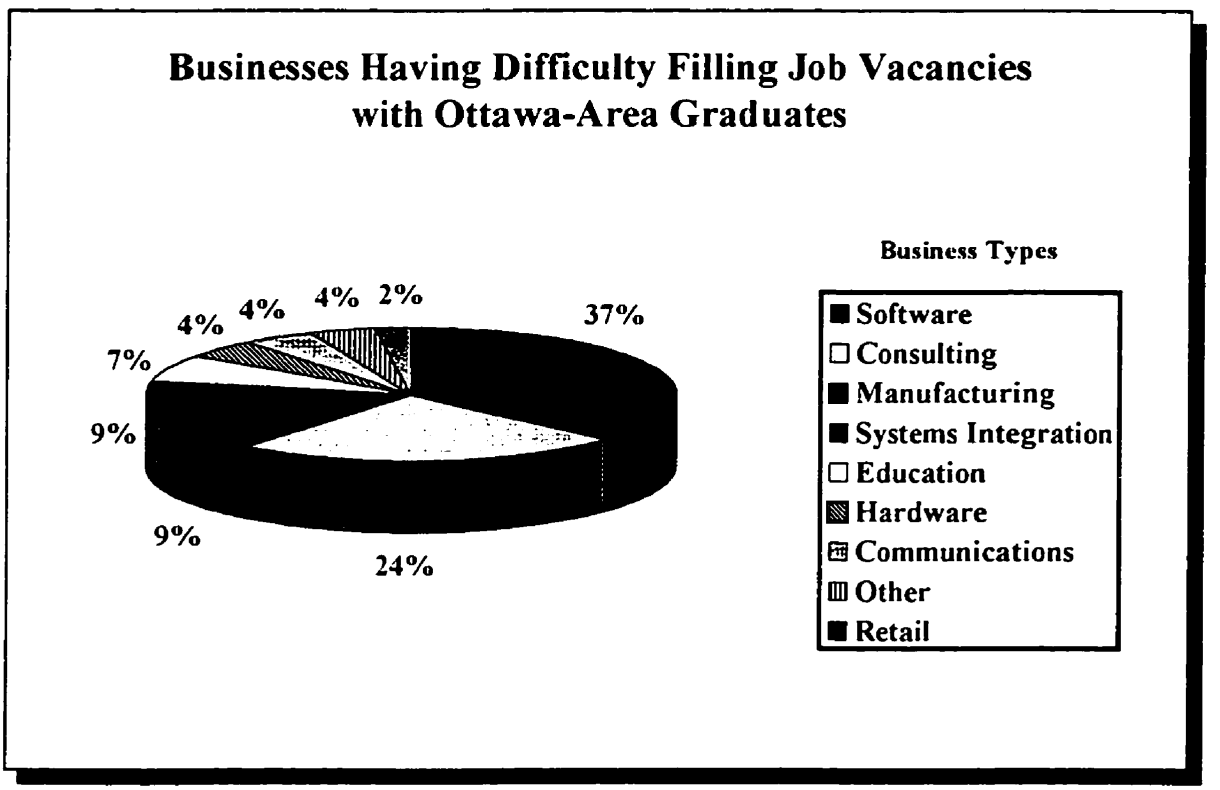


Figure 17: Hiring Difficulties Based on Business Type

the information field. It appears that they are not receiving graduates with this type of background (as outlined previously in Question #6). The reason for this assumption is based on the second part of question #10 which ask the respondents for their input regarding what is lacking in post-secondary computer-related programs.

10. Is there a problem in obtaining qualified post-secondary graduates (educated in the Ottawa area) to fill high-tech employment vacancies?

If Yes, what do you feel is lacking in the high-technology programs currently being offered by Ottawa's post-secondary institutions?

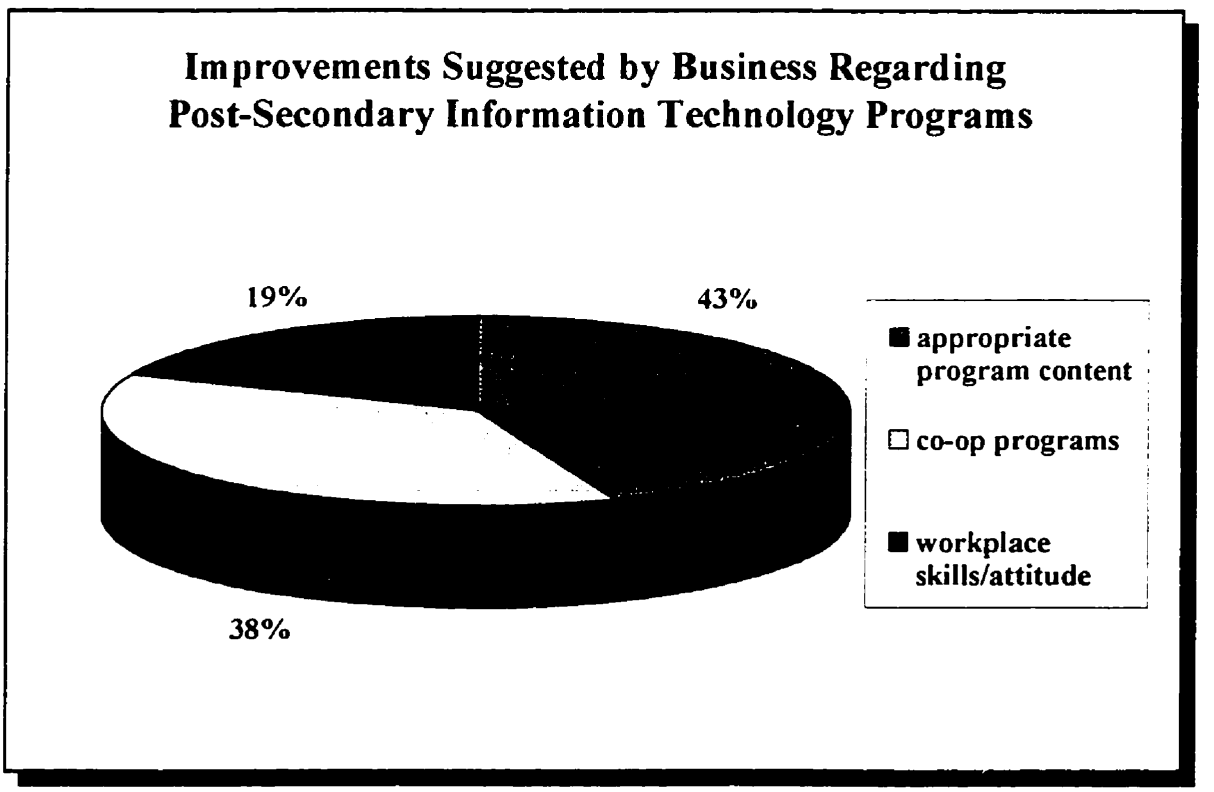


Figure 18: Improvements to Post-Secondary Programs

Not surprisingly, the three areas which the high-tech community feels need the most improvements (Figure 18) are the same as the three most important reasons why graduates were not successful in obtaining employment. It may be recalled that Question #6 asked if there was a major reason, or reasons, why an applicant was turned down. The most prevalent responses were inadequate skill sets, inadequate communication skills, and 'other' reasons, including a lack of co-op experience, a lack of team project skills and inappropriate attitude.

High-tech firms are not questioning the skill levels of graduates but rather the composition of their skill sets. Several mentioned that the knowledge base of the graduates did not match the needs of the organization. It is a question of content, with high-tech organizations wanting curriculum studies to address their individual requirements. While it is impossible to develop courses which are tailored for each one of the over 700 high-tech firms, the companies desire that the technology being taught would be more current. As a few of the respondents stated:

> "What Ottawa's Universities and Colleges fail to do is offer courses like MIT or Georgia Tech -- appropriate for our high-tech surroundings."

> "[What is lacking] mainly is the speed how courses are introduced to cover platforms, operating systems, and programming languages that the industry requires and uses today."

> "Exposure to current technology and products (both community college and university) [is required]. Programs should be designed to provide some specialty not just overall knowledge."
>
> "[Curriculum content] is not relevant to the market requirements. [It is either] not technical enough or off the mark altogether."
>
> "Content/quality of programs is a problem...[The curriculum] doesn't meet our needs."

The second most important area for improvement, listed by high-tech organizations, was the real lack of work experience. They are not referring to graduates having years of relevant work experience, but simply some general exposure to the operation and functioning of an organization. What these companies are critical about is the serious shortage of co-op options being offered within post-secondary computer-related programs. By having this exposure, graduates do not experience a type of 'culture shock' when they leave the academic atmosphere of a classroom and enter a world of deadlines, group dynamics, and concerns revolving around productivity, efficiency and effectiveness. Again, quoting directly from the questionnaires:

> "Not enough co-op positions offering a wider experience base upon graduation."
>
> "Need more students in co-op programs."
>
> "We feel that an opportunity to gain practical experience in the high-tech industry is the factor lacking in today's curriculums (i.e. co-op or internship programs). Most institutions offer this as an option. As a consulting company, experience is our most important asset."

> "The main issue is the obvious lack of real experience. This is known and the way around it is on the job training. This leads to the candidate requiring the drive and initiative as well as the ability to learn and begin contributing early."

The last quote hints at something else which appears to be lacking in the region's high-tech graduates. The third most important aspect which questionnaire respondents feel is lacking in university and college curriculums is the development of appropriate work habits and proper attitudes. Individuals must know how to work responsibly and dependably on an individual basis and in a team environment involving cooperation and compromise. One respondent stated, in the last set of quotes, that co-op work experience would help in addressing the problem but curriculums also must adapt to include teachings on how students are to act, respond and contribute to a real-world work environment where the objectives of the company are foremost, not those of the individual. Similar concerns manifested themselves in the following comments from other respondents:

> "...as mentioned, many grads do not have the maturity/where-with-all to 'carry the ball' so to speak. In a small business especially, they must be aware that they directly impact the bottom line. Many cannot cope with that pressure... "

> "Lack of respect for experience in industry. Lack of 'bottom line awareness' with respect to project and corporate management."

> "What we need in "Silicon Valley North" are those grads who can innovate, are self-starters and can make a contribution."

> "To my understanding, these programs are unrealistic in the sense that the students are led to believe that technical knowledge, alone, is a guarantee of success. By far the most important factor is logical, constructive thinking associated with a good grounding in human relations. Incredibly a lot of graduates are functionally illiterate in language, while knowledgeable in technical functions."

Questionnaire Conclusions

The responses received based on the ten survey questions have revealed much information concerning employment within the Ottawa-Carleton high-tech community. For instance, the type of information technology industries providing most of the job opportunities are software firms, followed by consulting companies and manufacturing organizations (Figure 5).

Ironically, it is these exact same areas which are having the most difficulty in hiring appropriately skilled graduates from the three post-secondary educational institutions (Figure 17). The question arises that if these high-tech sectors are largely contributing to the economic stability and growth of the region, why aren't both the appropriate government levels and the local educational institutions assisting in the economic resurgence by identifying and solving the problem with the resources at their disposal and in conjunction with the high-tech industry? The fact that so few regional graduates are even considered for the job vacancies, let alone accepted, is verified by the questions which asked how many applications

were received and how many were accepted. The astounding ratio averaged out to approximately 15:1! For every fifteen applications submitted for a job opening, only one was accepted for further consideration (Figure 7).

The underlying reasons for the hiring difficulties of companies and the low ratio rate of accepted applications were revealed by the question which asked respondents why candidates were being turned down. The primary reason was related to a lack of appropriate and/or current technical skills. This revelation is justifiable, to a certain extent, due to the rapid, ever-changing face of technology and the costs associated in maintaining current technology within the educational institutions. Secondly, high-tech organizations felt that candidates lacked the proper communication skills, an essential attribute for those wishing to be employed in the information technology field. Finally, many companies responded that work experience, work skills and a proper business attitude were all lacking in many of the job applicants from the Ottawa-Carleton area (Figures 8 and 9).

Another reason which may be attributed as being part of the problem is whether or not the high-tech community and the college and universities have a dialogue in order to exchange information regarding each other's needs. The questionnaire revealed that over three-quarters (78%) of the high-tech companies in the Ottawa-Carleton region do not discuss computer curriculum issues with the educational institutions (Figure 13).

Responses to the questionnaire also provided insight concerning the areas of high-technology in which the college and universities were successful in providing appropriate

technical skills. These areas included educational companies, hardware developers, communication firms and retail outlets. This was evidenced by the fact that these firms were having relatively little trouble in finding the appropriate candidate from the annual crop of new graduates (Figure 17). In order to examine the technical content of curriculum courses in greater detail, Question #8 asked from which of the three post-secondary institutions the differing high-tech industries were recruiting their new employees (Figure 12). Without consideration of whether or not the high-tech firms were hiring graduates from a single institution, or from multiple campuses, the percentage of graduates being hired from Carleton University was 33%, Algonquin College 30% and the University of Ottawa 27% (Figure 11). However, if the data is delineated to display hiring patterns based on single and multiple institutions, evidence reveals that Algonquin College supplies a slightly greater percentage of successful aaplicants than the two universities (refer to the last graph in Appendix I). The reasons behind this result may lie not only in the basic 'raison d'être' of colleges and universities, but also because of the subject matter being taught at these institutions. While universities focus on the theory of computer science, colleges traditionally emphasize the practical aspects of computer science technology - not why it works, but how it works. Businesses do not want to have to teach a graduate how to perform a particular task, they want the individual to be able to contribute immediately to the organization's productivity.

Lastly, the survey responses provided insightful information regarding what the high-tech community felt was lacking in the curriculums of the college and universities. Not

surprisingly, the reasons which emerged were similar to those provided as justification for not hiring graduates. Companies indicated that curriculums should provide for the teaching of current technology as well as include pertinent work experience. Interestingly, companies felt that the college and universities should ensure courses prepared students to function in a business environment by familiarizing them with team and project dynamics as well as developing a 'business attitude' focussing on productivity, efficiency, effectiveness and respect (Figure 18).

The preceding paragraphs summarized the findings of the questionnaire. The results of the questionnaire were analyzed in a general fashion which, in turn, alluded to general conclusions. In summary, the projected number of jobs created annually within the Ottawa-Carleton region is 4200, with the software and consulting industries accounting for approximately 57% of all job vacancies. The two most important reasons why job candidates were unsuccessful in obtaining employment are a lack of proper technical skills and a lack of oral and written communication skills. Of the successful candidates who did obtain employment within the region's high-tech community, only forty percent received their education locally. The survey also reveals that less than twenty-five percent of all high-tech businesses have a dialogue with the post-secondary institutions concerning curriculum issues. Overall, fifty-six percent of all high-tech companies have difficulty recruiting qualified graduates educated in the Ottawa area. The next section will examine these conclusions in detail and attempt to determine if and why they are justified.

CHAPTER IV

POST-SECONDARY CURRICULUM ISSUES

Correlations Between Questionnaire Conclusions and Post-Secondary Curriculums

In examining the conclusions extracted from the questionnaire, one of the most distressing revelations is that only one application in fifteen is retained for further consideration. A corresponding conclusion indicates that only forty percent of successful job applicants were educated in the Ottawa-Carleton region. The reasons why area graduates did not obtain employment from the local high-tech industry, along with suggestions to improve the situation, were provided by the respondents

The responses to Question #10 of the survey, which asked what improvements were needed in post-secondary institutions, broke down into three main areas: i) provide current and appropriate technological instruction; 2) ensure increased co-op experience; and 3) develop suitable work skills and attitudes. These three spheres of concern directly parallel responses to Question #6 which asked why job applicants were unsuccessful (i.e. inadequate skill sets, lack of communication skills, co-op/work experience and proper business attitudes). Because the recurring opinion revealed by the high-tech industry is that the region's college and universities are not producing job ready graduates, the curriculums of the three post-

secondary institutions will be examined.

Conclusion: The main reason job candidates were unsuccessful in obtaining employment was due to an inadequate skill set.

Thirty-four percent of survey respondents listed a lack of adequate or appropriate skills as the main reason for not recruiting local graduates. This sentiment has been echoed by comments made by various companies not only locally, but on a national level as well:

> "Ottawa-Hull created more jobs than any Canadian city in 1996, mainly on the strength of the region's high-tech sector. Of late, high-tech companies, though still creating jobs, have complained of letting jobs go unfilled because of a lack of specialized talent.[32]"

> "Proof of this [skills] shortage is the 20,000 IT jobs currently unfilled across the country. Why are these jobs unfilled? Because of...educational institutes failing to upgrade their computer/sciences curriculums to meet the specific needs of the employers.[33]"

What exactly do the current curriculums offer? Algonquin College provides approximately twelve different programs, ranging from full and part time certificate programs to full-time two and three year diploma curriculums (refer to Table 2). The programs of

---

32 Hill, Bert. *Region suffers record job loss*. The Ottawa Citizen, February 8, 1997, Ottawa, Ontario.

33 Williamson, Margaret. *No quick fixes for IT skills shortage*. Computing Canada. Volume 23, No.2 Willowdale, Ont.: Plesman Publications Ltd., February 3, 1997.

study[34] indicate that course content seems to provide a mixture of technical knowledge and business acumen, such as *Business Fundamentals, Management Concepts and Issues, Interpersonal Communication Skills* and *Economic Issues* (though some of these courses are listed as electives rather than mandatory).

The technical knowledge aspect, while varied among available programs, appears to lack in diversity within specific programs. Additionally, the subject matter appears to be either non-current or does not provide adequate coverage of the technology spectrum. One example relates to the *Computer Technology - Computing Science* Program (3-year diploma) which exposes students to "a variety of software languages, operating systems, development tools and debugging tools to design, code and test applications...[35]" Since Ottawa-Carleton's software industry is having the most difficult time in recruiting appropriate personnel, this program should be addressing their needs.

While the program does offer instruction in no less than four programming languages (C, Assembly, Cobol and Fortran) it provides only one course in object-oriented programming (OOP) using C++. Though gaining familiarity in the use of Assembly Language and Fortran

---

34 *Algonquin College Calendar, 1996-1998*. Nepean, Ont.: Registrar's Office, Algonquin College, August, 1996.

35 Ibid., p. 83.

is good in terms of learning programming concepts and how individual bits and bytes are controlled, their practical use is limited. (Cobol is the exception since many government departments still run mainframe applications originally developed in Cobol). The question is, how many high-tech firms are looking for graduates with knowledge in Assembly Language and Fortran?

PROGRAM	DURATION	CERTIFICATION
Automated Office Techniques	1 year	Certificate
Business - Information Systems	2 years	Diploma
Business Admin. - Info. Systems	3 years	Diploma of Business
CADD Technician	2 years	Diploma
Computer Engineering Technology	3 years	Diploma of Technology
Computer Programmer	2 years	Diploma
Computer Systems Technician	2 years	Diploma
Computer Technology/Science	3 years	Diploma of Technology
Desktop Publishing Techniques	16 weeks	Certificate
GIS Technologist	3 years	Diploma of Technology
Graphic Design	2 years	Diploma
Technical Writer	3 years	Diploma of Technology

Table 2: Computer-Related Programs Offered at Algonquin College[36]

36 Ibid., p. 4-8.

An examination of the Saturday "Careers & Opportunities" section of The Ottawa Citizen during the period from June 1995 (the beginning of the questionnaire) to February 1997 revealed listings for literally hundreds of entry-level and junior employment vacancies for graduates within the Ottawa-Carleton region. There were fewer than ten job openings requesting that the candidate have knowledge of Assembly Language and under five employment opportunities which required familiarity with Fortran. However, the number of job vacancies requesting candidates be versed in OOP was approximately 360, with the overwhelming majority requesting knowledge and experience in C++. Obviously, as indicated in Figure 19[37], the information industry needs graduates with skills in various applications of object-oriented programming. By incorporating courses into the program which address these types of languages, only then will high-tech firms be able to find graduates with the necessary and desired skills.

Another such curriculum warranting examination is Algonquin College's *Computer Aided Drafting and Design Technician* Program (2-year diploma) which "trains graduates

---

37 Source: The Saturday edition's "Careers & Opportunities" Section in *The Ottawa Citizen* from June 1995 to February 1997.
GUI = Graphical User Interface
OOP-A-D = Object-Oriented Programming/Analysis/Design
Windows 3.x/95 = Programming in all versions of Windows
TCP/IP = Transmission Control Protocol/Internet Protocol
ATM/ISDN = Asynchronous Transfer Mode/Integrated Digital Services Network

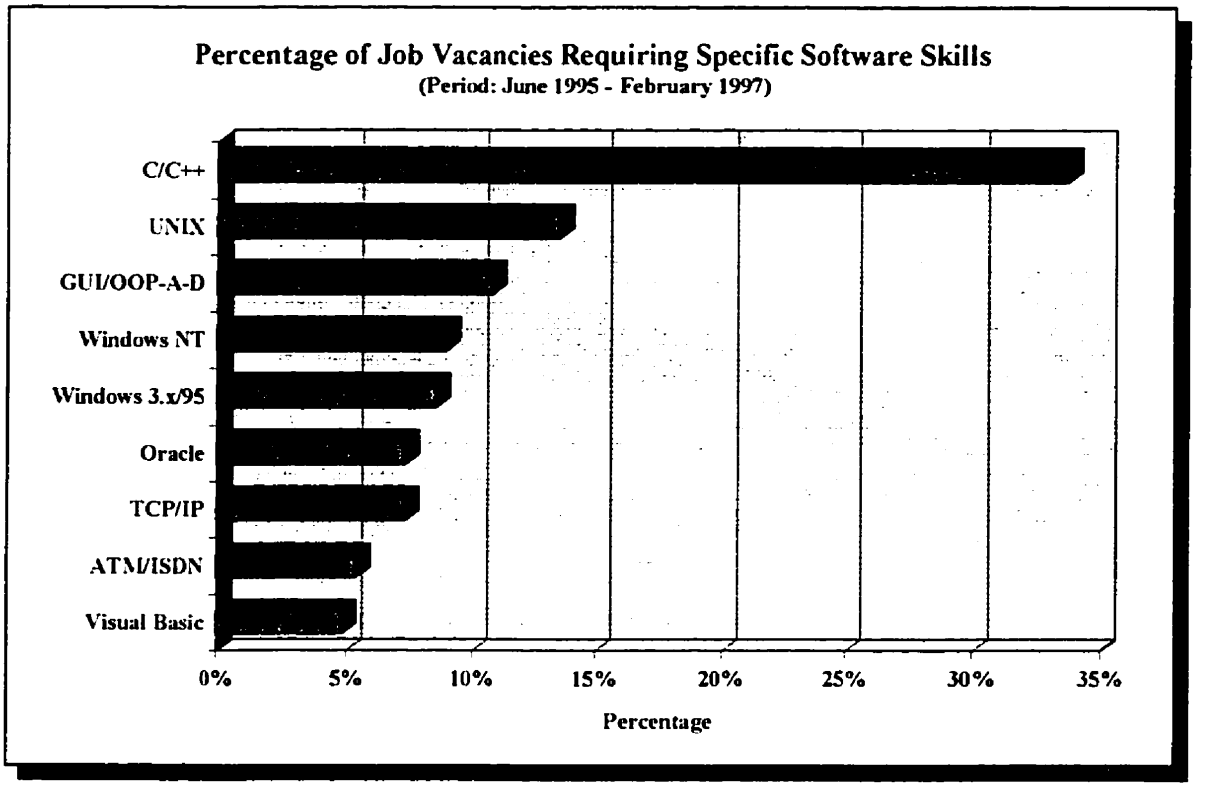


Figure 19: Software Skill Requirements for Job Vacancies

to work in the high technology industry creating engineering and electronic drawings[38]". However, this program restricts the usage of software to one application (AutoCAD), while the high-tech industry requires that students be exposed to other CAD applications (i.e. Microstation) as well as the wide array of functionalities these applications provide. Focusing on the mechanical and electronic aspects of CAD is good, but perhaps other

38 Ibid., p. 77.

functionalities should be introduced, such as architecture (homes and buildings) and urban planning (subdivisions). Another important aspect of CAD work is digitizing, the transformation of a paper drawing or map into a digitized format. Though digitizing is covered in the *Geographic Information Systems (GIS) Technician* program, not all digitizing activities are of a GIS nature. Many high-tech firms utilize digitizing techniques and when they interview prospective candidates, they expect students to have a fundamental knowledge of this process.

The problem lies not in the fact that graduates do not have skills, but that they do not have a wide range of skills which will allow them to be compatible with a greater number of business requirements. Programs of study must broaden their focus to include what is being used by industry today.

Algonquin College on the whole, however, does provide quality programs which are recognized by the high-tech industry (as evidenced by the hiring of Algonquin graduates over a wide spectrum of information technology fields - refer to Figure 12, P.47 and Appendix I). The *Computer Programmer* program (2-year diploma), for example, not only provides instruction on 'older' programming languages such as Cobol, but also for the newer OOP languages, such as Visual Basic and C++. It also provides courses relating to data communication, networking and systems design and analysis. Education is also provided in workplace skills, with courses such as *Management Concepts and Issues* and *Interpersonal*

Communication Skills. The result of this multi-disciplined approach is that the high-tech companies are provided with graduates who possess software expertise, and also proficiency in utilizing and sharing information within the dynamics of a workplace setting.

Another multi-disciplined program is *Business Administration - Information Systems* (3-year diploma), which is designed to provide students with "basic education in all aspects of business administration and a specialization in [information technology].. This program provides business-related education concerning micro/macro economics, management principles and operations as well as business finance and law. On the technical side, courses provide instruction in Cobol and OOP (Visual Basic and C++), networking and data communication, as well as systems analysis, design and architecture. With respect to workplace skills, students can choose to take courses dealing with international trade, banking, labour economics, critical thinking, communication (speaking and writing) as well as psychology or the workings of the Canadian government. At graduation time, high-tech organizations are presented with an individual who can provide skills which address both aspects of their business - the technical side (performing the work processes) and the operational side ('taking care of business').

The computer programs at Algonquin College may have some shortcomings, but overall the institution provides a high level of quality education, mixing technical, business and social knowledge. The problem lies in the programs which do not include current technology in their curriculums. (For a complete listing of programs and their associated

course content, please refer to Appendix II.)

An indication of just how closely Algonquin College addresses the needs of Ottawa-Carleton's high-tech community can be revealed by identifying the software application skills required by the region's high-tech industry (since it is this sector that is having the most difficulty finding recruits) and comparing these required software skills to the technology being provided by the college's curriculums. As evidenced in Appendix II, Algonquin College's program content does address the most requested skills of the area's high-tech job requirements. If this is the case, then why does the high-tech industry report a shortage of skilled candidates, with just one in fifteen applications accepted? Is it because of shortcomings in curriculums offered at either Carleton or Ottawa University? An examination of the programs offered by these two institutions, similar to that performed on Algonquin College, will provide further enlightenment.

Similar to Algonquin College, a good number of Carleton University graduates are recruited for employment by Ottawa-Carleton's high-tech organizations. The university's undergraduate computer studies consist of a four year Honours program resulting in a Bachelor Of Computing Science degree. It also provides for a combined Honours program which allows concentrations of studies in two fields, in conjunction with the Department of Physics and the Department of Mathematics and Statistics. To obtain a degree, a total of twenty credits must be taken, with seven and one-half of those credits from Computer Science

(other credits relate to Mathematics and Statistics (3), Arts or Social Sciences (2 1/2),and two from either Science or Business). Upon completion of common core courses, students are able to specialize in one of five fields: Software, Hardware, Theory of Computing, Scientific Applications and Management and Business. Carleton University provides a description of each of these options through their web site:

> "Software Option
>
> This option is intended for students whose interests include the design and implementation of large-scale software systems, such as language processors, operating systems and data management systems.
>
> Hardware Option
>
> This option is intended for students seeking to combine an interest in computing with an interest in electronics. It prepares students for careers in the design and construction of both large- and small-scale computer systems.
>
> Theory of Computing Option
>
> This option is intended for students with an interest in the theoretical aspects of computer science. While retaining a good number of practical courses, the option emphasizes the theoretical aspects, thus providing the student with a sound foundation for systems analysis or graduate studies.

Scientific Applications Option

This option is intended for students whose interest in computers centers around the applications of computers to science. It provides a strong framework of computer science courses to which additional science courses may be added.

Management and Business Systems Option

This option is intended for students whose interests include the application of computers to business. It is designed to prepare students for the career in this field, with a combination of Computer Science courses and a strong component of courses selected from those offered by the School of Business.[39]

For all Computer Science students, first year computer-related compulsory core courses include an introduction to programming and systems programming and computer applications. All of these courses are identified in the school calendar[40] as lecture classes, with practical hands-on experience gained through assignments. Second year compulsory computer courses involve data structures, computer architecture and programming. It is the programming course which begins to make use of programming languages and tools. Third year instruction includes operating systems, software systems design, database management, algorithm analysis and discrete structures. The core courses of the Computer Science

39 Carleton University. *Undergraduate Program Course Requirements Web Site* (http://www.scs.carleton.ca/scs/ug2.html)

40 Carleton University. 1996-1997 Undergraduate Calendar. Carleton University: Ottawa, Ont.

program provide students with a solid background in computer theory while assignments allow students to grasp a firm understanding of the concepts through practical application (involving the use of object-oriented programming languages such as C++ and Smalltalk).

Not unlike many other industries, but perceived as more of a necessity within the high-tech industry, new employees must be equally cognizant of not only why things work, but also how they work as well. Indeed, high-tech firms require that new employees contribute immediately to the organization without having to further train the recruit in the fundamental operations of the technology at hand. As one of the respondents stated, the graduate must *hit the ground running*. The possibility, mentioned earlier, that skill shortages may be related to Carleton University's curriculum content is not visibly apparent. In comparing the skills required by the region's high-tech community with the skills being taught at Carleton University, it is observed that here too Carleton is addressing the concerns of the region's high-tech community by providing instruction in the most requested software applications (see Appendix 4).

Similar to Algonquin College, Carleton University also provides a program which exposes students to varied applications through computer laboratory time incorporated as part of the course content. The program, offered by the Faculty of Engineering, permits a student to obtain a Bachelor of Engineering degree, specializing in Computer Systems. While the core courses focus on chemistry, mathematics, physics and computer applications, later

years involve subjects such as real-time systems, computer architecture and software engineering (please refer to Appendix III for a complete listing of curriculum courses). The coupling of theory and lab work facilitates the student's understanding of engineering systems based on computer components. As the calendar states:

> "A Computer Systems Engineer is one who can combine advanced software and hardware to build [engineering systems]. The Computer Systems Engineering program aims to provide students with an excellent foundation in the principles, methods, computer tools and elements of professional practice for this purpose.[41]"

The results of the survey corroborate the quality of this program, as indicated by the portion of the Ottawa-educated applicants from Carleton University which were hired by the manufacturing and hardware firms (refer to Figure 12 and Appendix I).

If Algonquin College and Carleton University are addressing the skill needs of the high-tech sector, why the shortage of skilled labour? Before discussing this question, let us examine the programs at the University of Ottawa where the Computer Science Department offers a Bachelor/Honours of Science degree with two options. One option is of a more general nature in terms of computer science while the other focuses on information and management systems. The hands-on languages used are similar to Algonquin College and Carleton University: Assembler, Cobol, C, C++, Fortran, and Smalltalk (it also uses Pascal,

[41] Ibid., p. 97.

Prolog, and Lisp). Many of its courses also provide built-in lab time in order to apply the theory. While compulsory core courses focus on physics and mathematics, they also include many computer courses, which continue into the second, third and fourth years. The Department of Engineering also offers computer studies in Electrical Engineering, Computer Engineering and Engineering Management. The Electrical Engineering program offers concentrations in Communications and Signal Processing, Systems and Control, Electronics and Microwaves while the Computer Engineering places more emphasis on software and hardware aspects. Fourth year students, regardless of option chosen, are exposed to practical applications of theory through laboratory work. What appears to be different in the curriculum of the University of Ottawa is its diversity, though not in the use of current technology but rather of subject matter. Courses range from programming concepts and data structures to hardware equipment and principles. Other courses revolve around data transmission, software engineering and computer graphics (refer to Appendix IV for a complete curriculum listing).While the computer programs at the University of Ottawa do not seem to specialize in any one field, they do provide students with a wide range of knowledge. As the University's web site states:

> "We shall be involved in study, development and research in areas such as distributed data processing, software design, auto and visual systems, long-haul and local area networks, graphics, computer-aided design, simulation, numerical analysis, office automation and artificial intelligence.

> The undergraduate program of the Department aims at training students to obtain a firm and well-balanced foundation for meeting these challenges. Our courses include the theory and practice of all the fundamental aspects of computer science, in breadth as well as in depth.[42] "

On the whole, the University of Ottawa, like Algonquin College and Carleton University, does not provide its students the ability to perform in any specific information technology field. What it does provide, however, is a knowledge of a wide range of computer technology (from hardware and software to protocols and data transmission). This underlying foundation of all information systems means that regardless of computer platform or architecture, these graduates would more than likely be able to provide connectivity and functionality between differing computer systems. The results of the survey indicate that this is so by the fact that there is only one sector in which University of Ottawa graduates are hired more often, and that is Systems Integration, though they also do quite well in the Manufacturing and Hardware sectors (refer to Figure 12). The question remains, does the University of Ottawa address the skill requirements of the region's high-tech industry? Based on the curriculum content in Appendix IV, it appears that it does.

Having compared the skill requirements of the region's high-tech community to the

---

[42] University of Ottawa. *Ottawa University Computer Science Department.* Web site: (http://www.csi.uottawa.ca/dept/about/).

type of technology offered at the three post-secondary institutions, no obvious explanation emerges regarding why these companies are experiencing difficulties in recruiting qualified personnel. Though graduates appear equipped with the proper skills to enter the workforce, further scrutiny of job qualifications reveals that while high-tech companies require the skills students have been taught, the companies desire individuals who have multi-disciplined skills. No longer is it enough for a candidate to know one OOP language (i.e. C++), for the vast majority of firms also want the applicant to be familiar with differing operating systems, productivity software suites, communication protocols, etc. And they want the graduates to have more than just a superficial awareness of the varying technologies. As noted earlier, companies are downsizing, with fewer employees expected to handle the work done by several in the past. The luxury of being a specialist in one area appears to have given over to individuals who are comfortable operating within a multi-discipline environment.

Post-secondary institutions should begin to adapt curriculum content so that it reflects the depth of skills required by the high-tech community. Examination of the curriculums of the three institutions reveals that they are all teaching essentially the same level of information. Unfortunately, the problem for the institutions is double-edged. Not only are the college and universities not providing sufficient in-depth instruction in technical skills but some of the technical knowledge being imparted is outdated and no longer being used by the overwhelming majority of high-tech firms in the region. For example, each of the college and

universities provide instruction in Assembly Language and Fortran. Of the hundreds of jobs listed between June 1995 and February 1997 for entry level and junior positions, the number of positions requesting knowledge of these two programming languages was in the single digits for both languages combined! Another reason respondents from the high-tech community are not able to find suitable employees revolves around the poor written and oral communication skills of job applicants.

Conclusion: The second most important reason job candidates were unsuccessful in obtaining employment was due a lack of communication skills.

In this Information Age people need to accurately and expeditiously convey knowledge in either written or oral form. An individual lacking these skills is perceived to be of little value to the organization. Ottawa-Carleton's high-tech community is discovering that many of the current local graduates are unable to achieve the standards of communication required by the industry. The problems in communication exhibited are by no means trifling ones, but are quite basic. Many graduates, as one company states, are essentially "illiterate", unable to spell or use grammar correctly. Twenty-one percent of respondents stated that the lack of communication skills disqualified potential candidates from filling a job vacancy. It is not sufficient to declare that the entire problem is rooted at the elementary and secondary school levels. Students at that age need not know how to create financial reports, requests for proposals, needs analysis studies, benchmark evaluations, etc. During the post-secondary

stage of their education, however (just prior to entering the workforce), the need for development of communication skills is more pressing. Regardless of the computer program they are entering, the course curriculum should provide opportunities whereby the students are able to hone both written and oral communication skills. Once again, an examination of the college's and universities' curriculum will determine if these opportunities are available. In Table 3, the writing and speaking courses offered in each program at Algonquin College are identified.

PROGRAM	COURSE	CONTENTS
Automated Office Techniques	ENGLISH I	- writing (grammar, spelling, style)
	PLAIN ENGLISH(E)	- business writing
Business-Information Systems	ENGLISH I,II	- listening, writing and thinking skills - written and oral communication
Business Admin.-Info. Systems	ENGLISH I,II SPEAKING(E) BUSINESS REPORT WRITING(E)	- listening, writing and thinking skills - written and oral communication - speaking awareness, confidence and capability - researching/ organizing/ reporting data, written and -oral exercises

PROGRAM	COURSE	CONTENTS
CADD Technician	ENGLISH I	- speaking, listening, reading, writing and thinking skills
Computer Engineering Technology	ENGLISH I	- speaking, listening,reading, writing and thinking skills
Computer Systems Technician	-ENGLISH I - REPORTING TECHNICAL INFORMATION	- speaking, listening, reading, writing and thinking skills - research/writing skills and oral reports
Computer Technology/Science	-ENGLISH I -REPORTING TECHNICAL INFORMATION	- speaking, listening, reading, writing and thinking skills - research/writing skills and oral reports
Desktop Publishing Techniques	-ENGLISH I	- grammar, punctuation, spelling, style and usage
GIS Technologist	-ENGLISH I -REPORTING TECHNICAL INFORMATION	- speaking, listening, reading, writing and thinking skills - research/writing skills and oral reports
Graphic Design	-ENGLISH I,II	- speaking, listening, reading, writing and thinking skills
Technical Writer	-TECHNICAL WRITING I,II,III	- writing and editing prose - summaries, argue premises, draw conclusions, deductive/inductive logic - written projects and oral presentations
E = Elective		

Table 3: Communication-Related Courses Offered in Computer Programs at Algonquin College

As evidenced by the preceding table, Algonquin offers many communication courses dealing with various facets and levels of writing and speaking, thereby providing students with a good foundation in communication skills.

The Computer Science and Computer Systems programs of Carleton University provide no mandatory communication courses, as outlined in the 1996-1997 Undergraduate Calendar. It is possible, however, for a student to receive instruction in this area by enrolling in elective courses. The Computer Science Program allows for 2.5 credits from the Faculties of Arts and Social Sciences (one .5 credit equals a one semester course) while the Computer Systems program allows for 3 credits in the Humanities or Social Sciences disciplines. It appears that graduates from Carleton University are not receiving the necessary communication skills training required to compete in today's high-tech environment.

The University of Ottawa's Department of Computing Science website indicates that there is only one communication course offered in either of the programs - *Technical Report Writing*. This writing course is the only communication-related course that is mandatory in the Computer Science and Information and Management Systems programs. The University's Department of Engineering computer studies also offer the *Technical Report Writing* course plus an extra English course during the second year of studies. Additionally, students are requested to take one of two specified humanity-related courses (*Technology and Society in North America or Scientific Thought and Social Values*).

The product of today's high-tech working environment is information. Through the communication of ideas, team endeavours, strategic planning, seminars, training, etc. companies develop hardware and software to use and distribute information. Good, if not excellent, oral and written communication skills are required. It has become painfully obvious why high-tech firms in the Ottawa-Carleton region responded to the survey stating that potential job candidates do not have the necessary communication skills. An examination of the computer programs at the three post-secondary institutions revealed that only one facility provides a number of communication-related courses, at different levels, while another includes one mandatory report writing course and the third presents no mandatory communication course whatsoever! It is now understood why Algonquin College leads in so many sectors of the high-tech industry, specifically those organizations involved in training and communications (Figure 12). If post-secondary institutions are to meet the future needs of the high-tech sector, they should strive to produce graduates who possess superior oral and written communication skills as well as technical literacy.

Conclusion: The third most important reason job candidates were unsuccessful in obtaining employment was due to three factors: lack of work experience (co-op), lack of proper attitude and lack of team project skills.

In examining the three reasons stated in conclusion #8, the only one which could be addressed to a limited degree within a classroom setting would be team project skills. While

there are deadlines such as assignment due dates and responsibilities involved in performing a share of an assignment, other factors, which promote team project skills, can only be realistically found in the workplace (such as devoting entire work days to projects, weeks at a time, thereby forcing group dynamics to evolve). While business attitudes and team project skills can best be learned and experienced in a working environment it would be of value to make students aware of these issues during classroom hours.

For this reason, the high-tech firms request that graduates have work experience prior to applying for a job vacancy. Years of work experience is not a requirement, but rather that applicants have at least been exposed to a work environment during their course of studies so that they become 'acclimatized' to the procedures, protocols, responsibilities and demands that will be expected of them upon graduation and entrance into the world of employment. Carleton University's School of Computer Science states the raison d'être of co-op programs most eloquently:

> "Co-operative education is based on the principle that during the undergraduate years an academic program combined with integrated work experience in alternating terms, is relevant to, and desirable for, effective professional preparation...The motivation, responsibility and opportunity for insight gained through co-operative education can be of significant value to the student's future.[43]"

[43] Carleton University. 1996-1997 Undergraduate Calendar. Carleton University: Ottawa, Ont., p. 216-217.

What employers are requesting is that post-secondary institutions provide more co-op experience than is currently available. To what degree are co-op programs available to students of computer programs? Of the twelve programs offered by Algonquin College, half offer co-op program options. While some programs do not lend themselves well to a co-op stream of study, such as the sixteen week *Desktop Publishing Techniques* program, others could be well suited for this type of learning environment, such as the *Computer Aided Design and Drafting Technician*, *Computer Systems Technician*, *Geographic Information Systems Technologist*, *Graphics Design* and *Technical Writer* programs. Carleton University's School of Computer Science offers a co-op program while the Faculty of Engineering's Computer Systems program appears not to have a co-op option. The University of Ottawa's Computer Engineering, Computer Science, and Management and Information Systems (Faculty of Administration) offer a co-op program; however, it appears that the Information and Management Systems program (Department of Computer Science) does not.

Though the lack of co-op initiatives in certain programs offered by all three institutions automatically denies students work experience in their particular field of study, other factors could also cause students not to garner work experience during their studies, even if they are enrolled in a co-op program. The prevailing job market, economic hardships and company restructuring difficulties often dictate whether the high-tech firms in the region

are able to provide co-op opportunities. Perhaps stimulus from the government could encourage increased co-op opportunities. The co-op programs of both the college and universities are optional. Perhaps, with coordination from the high-tech community, it should become mandatory.

The suggestions outlined by the region's high-tech community regarding curriculum changes to the area's college and universities, and the resulting examination of the curriculums, have resulted in a number of conclusions. While the institutions are providing students with technical skills, they often involve technology which is outdated and not required by the vast majority of high-tech businesses. The relevant technology that is provided does not cover a large enough range of skills within an individual program to allow each graduate to be technologically multi-disciplined.

Companies are crying for job candidates who can write and speak effectively and competently. Some of the curriculums examined seem to be inadequate in this regard. In attempting to fulfil the preference of the high-tech sector for graduates to come to a job interview with a level of work experience, it appears that the institutions are performing adequately.

Perhaps the responsibility should be more correctly placed with the potential employers. If they insist on graduates with work experience, then they themselves must actively provide the opportunities by which students can attain this experience. In the next,

and final segment of this research, recommendations will be brought forward in an attempt to help solve the problem of not finding qualified graduates to fill the 2,000 to 3,000 high-tech job vacancies within the Ottawa-Carleton region.

CHAPTER V

CONCLUSIONS

Strategies for Reform Regarding Educational Curriculums

The survey has indicated that the current curriculum content of the area's post-secondary institutions is out of step with the current skill needs of the region's high-tech industry. To alleviate this discrepancy, the college and universities may wish to consider undertaking significant curriculum changes. It is time to remove the instruction of less relevant subject matter, such as the teaching of programming languages Assembly Language and Fortran, and concentrate on the more important software requirements which revolve around object-oriented programming. While the institutions currently do have courses relating to OOP, a need for more than just one OOP application exists. The educational facilities should be instructing students in other types of OOP such as Visual Basic, Visual C++, or PowerBuilder as well as the C++ programming they currently employ in their courses . Some professors may regard these languages as 'trivial' compared to the more powerful language of C++ but the reality is that the area's high-tech companies utilize these software applications. And if the college and universities are to produce graduates with relevant skills, they should consider addressing the needs of the high-tech firms.

Object-oriented programming is not the only skill requested by the high-tech firms. They require individuals who are knowledgable in the UNIX operating system, and data communication protocols such TCP/IP, ATM and ISDN. Data communications is becoming an increasingly important issue in the high-tech industry because it involves the movement of data. The information technology industry provides the global market with products which provide the means by which data can be transferred from one location to another. Businesses are increasingly sending data electronically, whether it be text, graphics or video, and require faster transfer speeds in order to improve productivity and efficiency. To respond to this requirement high-tech firms involved in communications technology are developing products using the aforementioned protocols, among others. In order to do this, they must have skilled personnel. In conjunction with businesses electronically sending data at faster speeds, they also have increased amounts of data to utilize and manipulate. Consequently, they require the use of relational database management systems (RDBMS). It has been shown from the study that a good proportion of the Ottawa-Carleton's high-tech community employ the Oracle RDBMS and require graduates who are knowledgable in the use of that application. Though the educational institutions provide instruction in the concepts of an RDBMS, perhaps its practical application should be based in Oracle.

Reform Strategy #1

The college and universities of the Ottawa-Carleton region should revamp their curriculums in order that courses offering instruction in outdated technology are removed and replaced with courses offering instruction in varied current technology, based on the needs of the high-tech community.

It is desirable that the region's post-secondary institutions be cognizant of the staffing requirements of the high-tech community. As shown in Figure 13, less than one quarter of all high-tech businesses have contact with the college and universities regarding curriculum issues. Of those who do have contact, approximately one quarter deal with Ottawa University, one third with Carleton University and the rest (43%) have discussions with Algonquin College.

While it is not feasible to personally contact all 700+ high-tech firms to identify their technology needs, there are alternative methods by which to obtain this information (e.g. annual questionnaires). It is also not feasible to develop curriculum courses which address specific, obscure requirements of all the high-tech firms. Through the analysis of the information received from the questionnaires however, it is possible to identify the major skill requirements, as was done with this survey (i.e. skill development in OOP, UNIX, RDBMS, etc.). Post-secondary institutions should consider initiating a closer relationship with industry if they are to produce graduates of value to these organizations. As stated by Wolfgang Stridel, executive director of the Software Productivity Centre, regarding the shortage of

qualified software engineers:

> "For one, the industry is growing faster than the available technical talent. Another reason for the shortage is the lack of qualified software engineers coming out of the university system. Not only that but those coming out of universities are not being properly trained by the schools. What's happening is that universities don't teach software engineering but computer science. They should not be cranking out computer scientists, but instead ones who have an understanding of software development processes in an industrial setting.[44]"

This sentiment is also echoed by other businesses in the high-tech community, at both regional and national levels. Doug Barber, president of Gennum, a manufacturer of hearing-aid chips states: "Ours is a knowledge-based business. Unlike the steel industry, there's virtually no material cost. It's know-how, and the education engines for generating these people are nowhere near prepared for the demand.[45]" From the Calgary-based office of the Canadian Advanced Technology Association, regional manager Calvin Fairbanks states: "Yes, the students need the raw materials such as text books but most importantly, at the college and university levels, they need the input from potential employers as to what exact skills they need.[46] "

---

44 Shoesmith, John. *Wanted: Qualified software engineers*. Computing Canada, Vol. 22 No. 18, September 3, 1996. p. 1.

45 Mayers, Adam. *Oh, say can you see the BRAIN DRAIN?*. The Ottawa Citizen, August 31, 1996. Ottawa, Ontario.

46 Williamson, Margaret. *No quick fixes for IT skills shortage*. Computing Canada. Vol. 23, No. 2 Willowdale, Ont.: Plesman Publications Ltd., February 3, 1997.

Reform Strategy #2

The area's college and universities should create a dialogue with a much greater percentage of Ottawa-Carleton's high-tech companies in order to identify the more important skill requirements of the industry.

Another reason why the educational facilities should be focusing on differing current information technology is again related to the needs of the area's high-tech firms. Invariably, in all employment opportunities researched, there was not one company which requested knowledge in just a single type of technology. High-tech companies require graduates who are multi-disciplined. Whether it be using a RDBMS in a UNIX environment or the ability to create OOP applications with the C++ or Visual Basic programming languages or have the ability to integrate application development with data communications, the region's high-tech community is requesting graduates with knowledge in more than just one area of information technology. The college and universities, to remain relevant, should strive to provide students the opportunity to learn these skills.

It is one thing to discuss the need for change in the college and universities, it is an entirely different matter to implement these recommendations. Presently, resources are limited, in terms of hardware, software and personnel in these institutions and, as a consequence, the number of students which can enroll in computer-related programs must be limited.

It is desirable that professors, who are knowledgable in older technologies, become familiar with emerging new hardware devices and software applications. These individuals require ongoing training and exposure to the operations of the high-tech community. Perhaps this training may be facilitated by educational institutions allowing professors to upgrade their skills by replacing periods of classroom teaching with sessions spent participating in the actual processes of a particular high-tech organization. Regardless of the approach, teaching current technology in the college and universities will involve large sums of monies, in terms of material goods (computer components and software applications), training expenses and salaries. As President Van Loon, of Carleton University, stated: "...educating young people for those jobs will require that the technology industry give significant financial help...[47]" The "significant financial help" Van Loon speaks of can run into the millions of dollars, as outlined in an article in The Ottawa Citizen concerning the teaching of current technology skills to students:

> "Universities have their own troubles. There's a huge demand for computer science graduates, but, like other faculties, the schools of computer science must cope without new staff and equipment. Computer labs can easily cost $250,000 and require the latest hardware to run the latest software. To get around this, the universities are turning to industry for partnerships.[48]"

---

47 Dare, Patrick. *Carleton must think big to survive, says incoming president Van Loon*. The Ottawa Citizen, July 11, 1996. Ottawa, Ontario.

48 _____. *Programmed for success*. The Ottawa Citizen, May 18, 1996. Ottawa, Ontario.

The adoption of two initiatives would be advantageous: i) professors should strive to constantly upgrade their technical skills, and ii) monies should be made available to purchase the physical resources. While the educational institutions are responsible for ensuring their professors are technically up-to-date, funding should be a combined responsibility among the educational institutions, the high-tech community, the government, and the students (as illustrated by tuition increases). If the college and universities wish to remain key players in providing skilled resources to high-tech companies it is important that they provide the appropriate funding.

Reform Strategy #3

The area's college and universities should upgrade the technology skills of their professors in order to provide instruction in the most current technology.

In partnership with the post-secondary educational institutions high-tech firms should contribute financially to the budgets of computer-related programs. Governments, as well, should shoulder some of the responsibility in ensuring that educational institutions provide instruction in the most current technology. Instead of decreasing funding to post-secondary institutions, the provincial government would be wise to follow a policy of increasing funds specifically to potential job growth sectors. Provincial Liberal Leader Dalton McGuinty stated in February, 1997 that high-tech employment opportunities were being lost due to

funding cuts (amounting to 400 million) to higher education by the ruling party.[49]

At the beginning of this paper, the Prime Minister was quoted as saying that it was not the responsibility of the government to create jobs, but rather to provide an environment within which jobs could be created. The number of jobs created, however, is irrelevant if skilled personnel are not available. An injection of funds into this specific area of the educational institutions is needed to facilitate instruction of current technology. The government's recent budget speech in February 1997 has addressed this concern to a certain extent. While not providing funding directly to the computer-related disciplines of the college and universities, Finance Minister Paul Martin did mention that an independent corporation, called the Canada Foundation for Innovation, was being established to modernize educational institutions and research hospitals. As stated on the federal government's Department of Finance web site concerning the actions of the 1997 budget:

> "The Canada foundation for Innovation will be established to provide financial support for modernizing research infrastructure -- facilities and equipment -- at Canadian post-secondary educational institutions and research hospitals in the areas of science, engineering, health and environment.
>
> The Foundation will be an independent corporation, at arm's length from government, with its members drawn from the research

[49] Hill, Bert. *Wooing the best takes effort.* The Ottawa Citizen, February 12, 1997. Ottawa, Ontario.

community and the private sector. They, not the government, will be responsible for spending decisions.

Through an up-front investment by the federal government of $800 million, the Foundation will be able to provide about $180 million annually over five years for research infrastructure.

Through partnerships between public research institutions and a wide range of contributors -- the private sector, the voluntary sector, individual Canadians and, to the extent they wish to participate, provincial governments -- the Foundation is expected to trigger roughly $2 billion in support for research infrastructure.[50]

Reform Strategy #4

The high-tech community should provide financial assistance, over what is currently being offered, to help offset the costs of installing new hardware and software.

Reform Strategy #5

The provincial and federal governments should take steps which will allow the college and universities to provide and maintain instruction in up-to-date technology skills.

---

50 Department of Finance. *Innovation and Technology: Keys to Job Creation*. Taken from the Department of Finance's web site containing information pertaining to the 1997 federal budget. February 18, 1997. (web site:http://www.fin.gc.ca/budget97/jobe/job2e.html#innov)

Another important concern of the region's high-tech community was the lack of communication skills witnessed in graduates applying for employment opportunities. Such a concern was justified as this study illustrated in discovering that the computer programs offered by the two universities provided very little mandatory education in communication skills. The University of Ottawa has one mandatory Technical Report Writing course while Carleton University has no mandatory communication course. The lack of required communication skills is the second most important reason why high-tech firms in Ottawa-Carleton do not hire graduates. To ensure that students learn these skills and are aware of their value in the high-tech workplace, the appropriate courses should be made mandatory at both Carleton University and University of Ottawa. Every computer-related program at Algonquin College has at least one mandatory communications course (refer to Table 4), with some having more than one and others having elective communications courses. The inclusion of these courses is reflected in the hiring rate of the institution's students, as illustrated in Appendix I.

Reform Strategy #6

Ottawa-Carleton's college and university curriculums should include, as part of their mandatory requirements, courses which involve the teaching of communication skills as they relate to researching, listening, writing and speaking in a business environment. These courses should focus on all of these aspects and deliver different levels of instruction (i.e. introduction to advanced).

Strategies for Reform Regarding Educational/Business/Government Initiatives

The remaining area of major importance to the high-tech community is the fact that graduates lack work experience. A solution to the problem, as suggested by the respondents themselves, is to offer increased co-op opportunities for students. As the study has indicated, while a good portion of programs offered at the college and universities do offer co-op options, there are many programs which do not. One method of providing more co-op possibilities would be to alter the curriculums in question to accommodate a co-op schedule.

The endeavour would be futile, however, if the job market is unable to accommodate the resulting increase in the number of co-op positions. Not all co-op students are currently able to locate employment. If the high-tech community wishes to hire graduates with work experience through a co-op learning experience it is not enough to ask the college and universities to modify their curriculums to include a co-op learning stream. The high-tech industry has a responsibility to provide the job positions necessary to accommodate all of the students. Assuming that there are seven hundred high-tech firms in the Ottawa-Carleton area, if each firm were to provide a minimum of two positions for co-op students (some already provide more), then a total of 1400 positions would be available. As proposed earlier, the active partnerships between the educational institutions and the high-tech firms would be one method of solving the co-op experience dilemma. The benefits of this would be two-fold. Not

only would students be receiving on-the-job work experience, but the discussions between the institutions and the businesses would ensure that the course content delivered to the students would be topical and relevant. In fact, this arrangement already exists to a certain degree with all three institutions. As The Ottawa Citizen reported recently regarding the University of Ottawa and high-tech company giants such as Mitel Corporation , Newbridge Networks Corporation and Northern Telecom:

> "The University of Ottawa is planning a school of Information Technology and Engineering to train people for the region's red-hot computer-software job market. Citing the estimated 2,000 vacant jobs in the region's technology businesses, the dean of engineering, Gilles Patry, is calling for a major expansion of computer technology programs.
>
> [Gilles Patry] proposes to get companies directly involved with the university, having firms such as Northern Telecom, Mitel Corp., and Newbridge Networks Corp. on a steering committee for the school. The university will also build co-op work placements, of up to one year, into student's programs.[51]"

Mitel has also made similar arrangements with Carleton University. Algonquin College has already put programs in place which are not only direct results of a partnership arrangement but also address the current needs of many industries. The partnership, with SHL Systemhouse, has produced a thirty-two week intensive program called the *Systems Support*

---

51 Dare, Patrick. *U of O plans technology school.* The Ottawa Citizen, December 3, 1996. Ottawa, Ontario

Specialist Program. Consisting of twenty-six weeks of formal instruction with hands-on lab work, followed by six weeks of guaranteed work placement, the program attempts to fill the need of companies for individuals with advanced computer skills in areas currently being utilized in information technology. As stated in Algonquin College's program brochure:

> "This 32-week intensive FAST TRACK Systems Support Specialist Program is designed to provide basic to advanced computer skills and techniques in the most preferred Windows applications and programs required by support technicians, help desk analysts, systems and support technicians, administrators, trainers and consultants. Participants will achieve high-level competency in implementing, designing and developing support and help solution skills.[52] "

Another program developed by the college, in response to the needs of employers, is the *Year 2000 Enterprise Programmer* program. Ottawa-area companies, not unlike firms in the rest of the world, are faced with the challenge of making their applications century compliant when handling date fields. Currently date fields exist only as a two digit field in the affected applications. Therefore, 1999 is actually input as 99 but when the year changes to 2000, these computing systems will see their dates change to 00, or 1900. It is the absence of the first two-digits, the century value, within a program's data field that will prevent a computer system from distinguishing between the 20th and 21st centuries. The creation of this program is a direct result of business having a dialogue with an educational institution to address its needs. As stated in the brochure:

---

52 Algonquin College. *Systems Support Specialist Program*. Nepean, Ont.: Algonquin Publishing Centre, 1996.

> "This 18-week intensive program has been developed in response to requests from employers to address their immediate requirement for COBOL programmers...The sense of urgency now pervading the industry has made the COBOL programmer an extremely valuable resource and provides an opportunity for a person with a specific set of skills to gain entry into the ever-expanding field of Information Technology.
>
> This program will provide the student with these required skills. The work placement experience, integrated with formal classroom instruction and extensive hands-on lab sessions, ensures that the graduate of this program can function immediately as a contributing member of a Year 2000 team[53]."

As evidenced, the need for partnerships has been recognized by both the high-tech community and the educational institutions. This development is in its infancy and must be nurtured and developed to include more co-op initiatives relating to current computer technology skill requirements of the region's high-tech industry. Though many co-op positions are currently offered by the government, the private sector must also share some of the responsibility for providing the proper skill sets to computer graduates. This would be an ideal enterprise for the federal government to undertake if it is truly serious in promoting the proper environment for job creation. Since developing co-op positions would ultimately result in more area graduates being hired, this would be a positive step in maintaining and improving the area's economic situation (in terms of spin-off jobs, increased tax base, increased consumerism, etc.). All levels of government, whether it be municipal, regional,

---

53 Algonquin College. *Year 2000 Enterprise Programmer*. Nepean, Ont.: Algonquin Publishing Centre, 1996.

provincial, or federal, should take pro-active steps to provide assistance and incentives to Ottawa-Carleton's high-tech community in providing more co-op opportunities for post-secondary computer students. Recently, the federal government, instead of promoting an environment to nurture and tap the local employee resource, has responded to the demands of the high-tech community by instituting an immigration policy allowing job vacancies to be quickly filled by skilled personnel from outside the country. As stated in the March 12, 1997 article of The Ottawa Citizen entitled *Seeking high-tech help*:

> "The federal government has taken the first step to drastically reduce the time it takes for highly skilled foreigners to enter Canada.
>
> A six-month pilot project, to begin next month, will reduce the time from several months to several weeks for those with firm job offers in six specific high-technology categories...
>
> The project is the result of months of lobbying by the high-technology industry for immigration rule changes. It has blamed the shortage of qualified Canadians to fill key jobs for slowing the development of many new products and the creation of thousands of related spinoff jobs.[54]"

This policy initiative was criticized by the Bloc Québécois and Reform members of parliament who stated that it is helping immigrants take jobs from Canadians. The Liberal government responded that there were too few Canadians qualified for the positions. With the enactment of this immigration policy, the government has strained its credibility concerning its stated goal of facilitating an environment conducive to job creation, and

---

[54] Hill, B. *Seeking high-tech help*. The Ottawa Citizen, March 12, 1997, Ottawa, Ontario.

counteracted its mandate to reduce the unemployment rate. To further quote the same article: "...the government is rewarding companies that have failed to develop skilled staff."

Reform Strategy #7

Post-secondary institutions should modify current computer programs to accommodate more co-operative learning opportunities.

Reform Strategy #8

The Ottawa-Carleton high-tech community should increase its efforts in providing more co-op job positions.

Reform Strategy #9

All levels of government should take the necessary steps to ensure that the high-tech community exists in an environment which promotes and enables them to produce more co-op job vacancies.

Reform Strategy #10

Partnerships between Ottawa-Carleton's high-tech community and the college and universities should be expanded in order that current skill requirements of business are addressed by the institutions and practical experience is provided by the organizations.

During the previous three chapters this study has discussed conclusions and policy options based on the questionnaire filled out by the survey respondents. Displayed on the following pages are concise lists of all conclusions and policy options brought forward:

Summary of Questionnaire Conclusions

1. **The highest percentage of businesses responding to questionnaire was related to software companies followed by consulting firms.**

2. **The projected average number of jobs created annually by the Ottawa-Carleton high-tech community equals approximately 4200 (based on annual total from June 1995 to June 1996).**

3. **The largest number of responses came from small to medium size companies with the number of employees ranging between 6 and 50.**

4. **Software companies provide the most job vacancies, followed by consulting firms and the manufacturing industry.**

5. **The average number of applications received versus the average number of job applications accepted per job vacancy is approximately 15:1 (for every 15 applications received, only one is retained for further consideration).**

6. **The main reason job candidates were unsuccessful in obtaining employment was due to an inadequate skill set.**

7. **The second most important reason job candidates were unsuccessful in obtaining employment was due a lack of communication skills.**

8. **The third most important reason job candidates were unsuccessful in obtaining employment was due to three factors: i) lack of work experience (co-op); ii) lack of proper attitude; and iii) lack of team project skills (Question # 6).**

9. **The average percentage of successful job applicants who were educated mainly in the Ottawa area is approximately 40 percent (the software industry had the lowest percentage and retail had the highest).**

10. **Of those successful applicants who were educated mainly in the Ottawa area, 33% received their post-secondary education from Carleton University, 30% from Algonquin College and 27% from Ottawa University.**

11. **The majority of Ottawa-educated post-secondary graduates hired by the Communications, Education, and Software sectors of Ottawa-Carleton's high-tech community received their education from Algonquin College (followed by Carleton University).***

12. **The majority of Ottawa-educated post-secondary graduates hired by the Consulting sector received their education from Carleton University (followed closely by Algonquin College and Ottawa University).***

13. **The majority of Ottawa-educated post-secondary graduates hired by the Systems Integration sector received their education from Ottawa University (followed by Algonquin College and Carleton University equally).***

14. **The majority of Ottawa-educated post-secondary graduates hired by the Manufacturing and Hardware sectors were educated at either Carleton University or Ottawa University.***

15. **The retail sector hired equal numbers of graduates who received their education at either Algonquin College, Carleton University or Ottawa University.***

16. **Over three-quarters of the total number of high-tech businesses in the Ottawa-Carleton region do not have any discussions with the three main post-secondary institutions regarding computer curriculum issues.**

17. **Of the total number of high-tech businesses which are involved in curriculum issues, 43% have discussions with Algonquin College, 33% with Carleton University and 24% with Ottawa University.**

18. **Over half (56%) of the businesses surveyed responded that they experience difficulties in recruiting qualified graduates educated in the Ottawa area.**

19. **The sector having the most difficulty finding appropriate candidates for vacant job positions is the software sector followed by the consulting firms.**

20. **Businesses feel the most important change required in the computer curriculums of the area's post-secondary institutions is to provide current and appropriate technology teaching and training, followed by the need for increased co-op opportunities and the development of work skills and attitudes.**

- To view a more detailed representation of hiring patterns of the various information technology sectors, based on post-secondary institutions, please refer to Appendix I.

Summary of Reform Strategies

1. **The college and universities of the Ottawa-Carleton region should revamp their curriculums in order that courses offering instruction in outdated technology are removed and replaced with courses offering instruction in varied current technology, based on the needs of the high-tech community.**

2. **The area's college and universities should create a dialogue with a much greater percentage of Ottawa-Carleton's high-tech companies in order to identify the more important skill requirements of the industry.**

3. **The area's college and universities should upgrade the technology skills of their professors in order to provide instruction in the most current technology.**

4. **The high-tech community should provide financial assistance, over what is currently being offered, to help offset the costs of installing new hardware and software.**

5. **The provincial and federal governments should take steps which will allow the college and universities to provide and maintain instruction of up-to-date technology skills.**

6. **Ottawa-Carleton's college and university curriculums should include, as part of their mandatory requirements, courses which involve the teaching of communication skills as they relate to researching, listening, writing and speaking in a business environment. These courses should focus on all of these aspects and deliver different levels of instruction (i.e. introduction to advanced).**

7. **Post-secondary institutions should modify current computer programs to accommodate more co-operative learning opportunities.**

8. **The Ottawa-Carleton high-tech community should increase its efforts in providing more co-op job positions.**

9. **All levels of government should take the necessary steps to ensure that the high-tech community exists in an environment which promotes and enables them to produce more co-op job vacancies.**

10. **Partnerships between Ottawa-Carleton's high-tech community and the college and universities should be expanded in order that current skill requirements of business are addressed by the institutions and practical experience is provided by the organizations.**

The shortage of skilled graduates in the Ottawa-Carleton area is a serious problem which can only be resolved through much effort, time and money. Because there is a lapse between the time when a new course is developed and implemented and when the first

graduates begin to emerge, it is of paramount importance that the problem be addressed as quickly as possible.

Failure to act in a concentrated period of time may have negative ramifications to the area's high-tech industry. If the shortage of skilled labour continues to be a problem, the possibility exists that talent will continue to be garnered in large numbers elsewhere, thus further eroding job prospects from local graduates. As John Millard, chief executive of Mitel, states:

> "Our growth here is constrained by the number of people we can hire. [We would] like to see our local universities and colleges produce more graduates that will help the industry. We can hire the skills we need from elsewhere, but it's better to develop talent locally.[55]"

A more damaging consequence would be if the industry began not only searching for skilled workers elsewhere, but deciding it may be advantageous to move the company itself to other locations. In fact, this alarming development has already begun to take place. One company has moved its entire operations to the east coast. Media interviews with company officials revealed that a lack of skilled employees in the Ottawa-Carleton region was the incentive for the move. It was later discovered, however, that the government of the province to which the company had moved provided them with financial incentives to encourage the

---

55 Chianello, Joanne. *Groups battle skill shortage in high-tech*, The Ottawa Citizen, June 8, 1996, Ottawa, Ontario

company's relocation, this giving credence to the role of the government in providing an environment conducive to job creation. Another local high-tech firm has set up a research and development effort on the west coast while still another set up its operations entirely outside the country. In fact, no less than seven of the area's high-tech giants have purchased foreign properties in an attempt to access skilled workers[56].

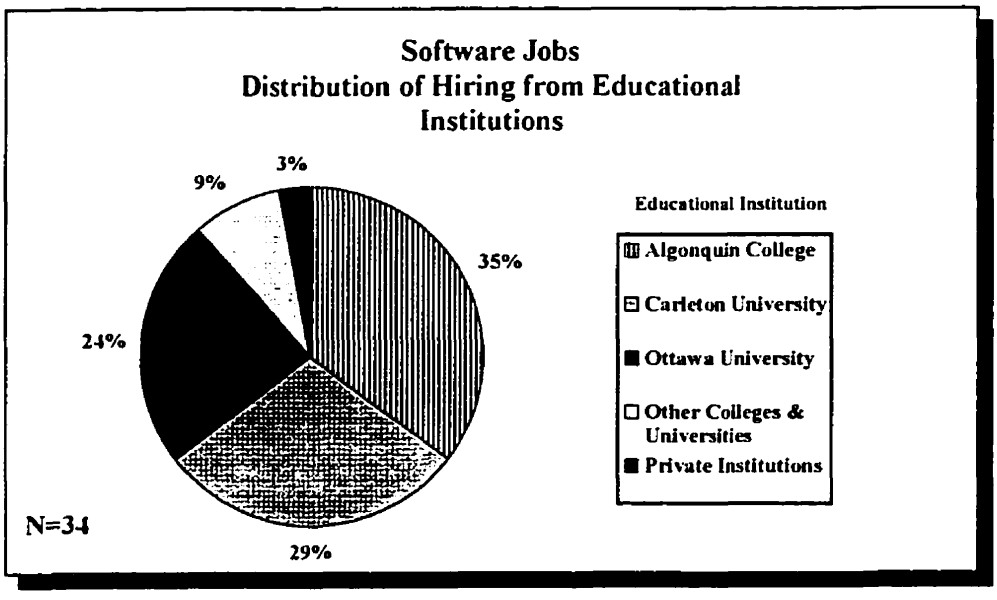
If this development becomes a trend it could lead to the erosion of the region's efforts to diversify its economy from government-based to high-tech based. The challenge to provide Ottawa-Carleton's high-tech community with skilled employees is real, serious and immediate. The region's fiscal foundation has become increasingly dependent on the success of its high-tech community. Consequently, the failure of the area's post-secondary institutions, government, and high-tech companies to meet the challenge could potentially result in the economic collapse of the Ottawa-Carleton region.

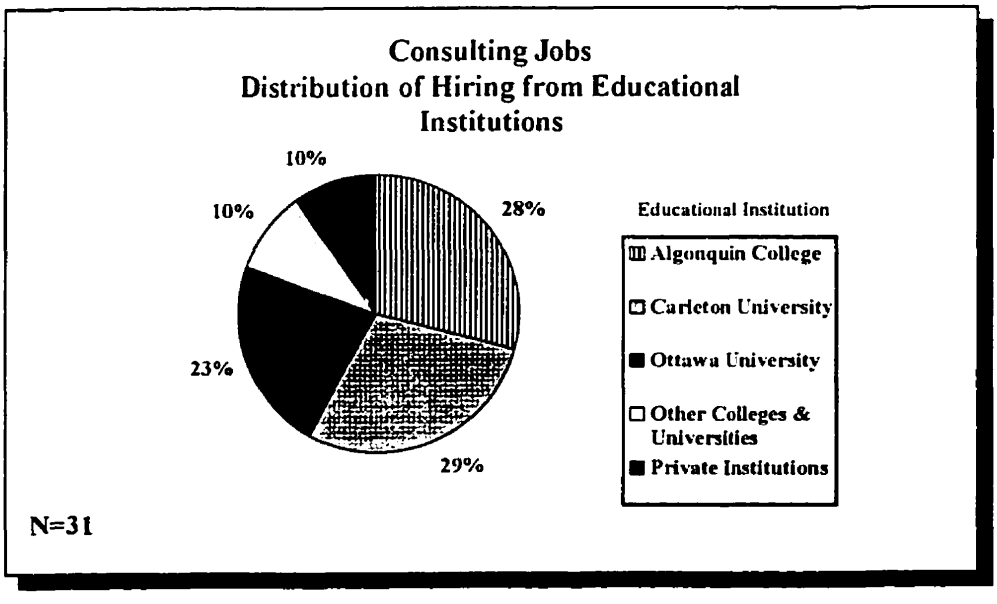
---

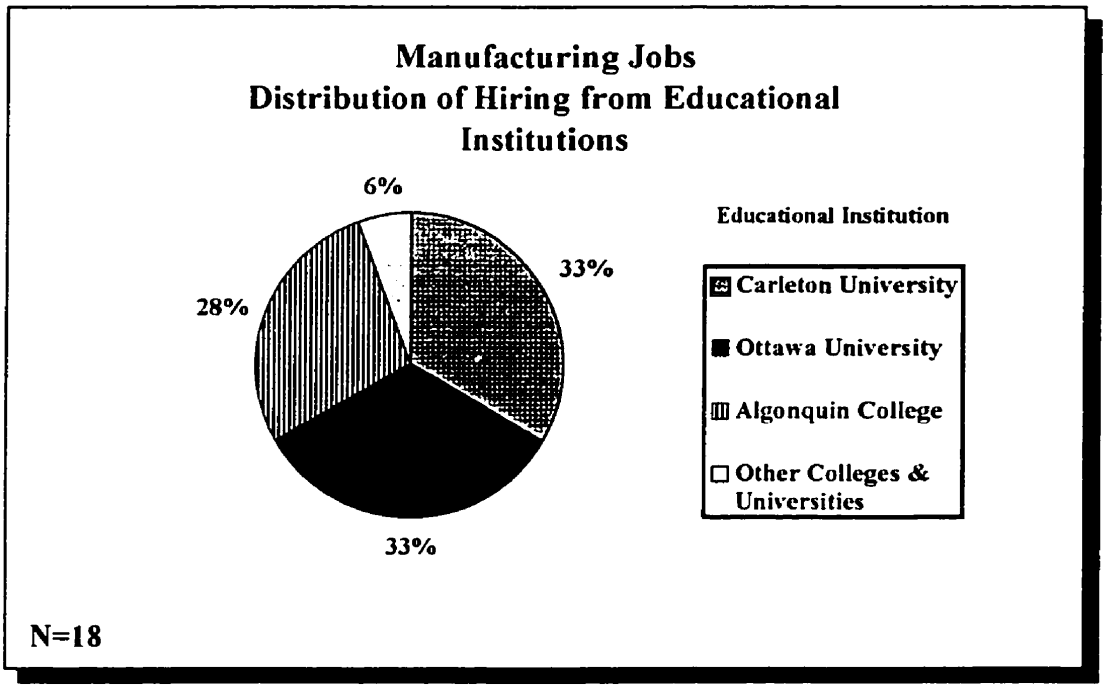
56 Bagnall, James. *Firms move out to find workers*. The Ottawa Citizen, February 10, 1997. Ottawa, Ontario.

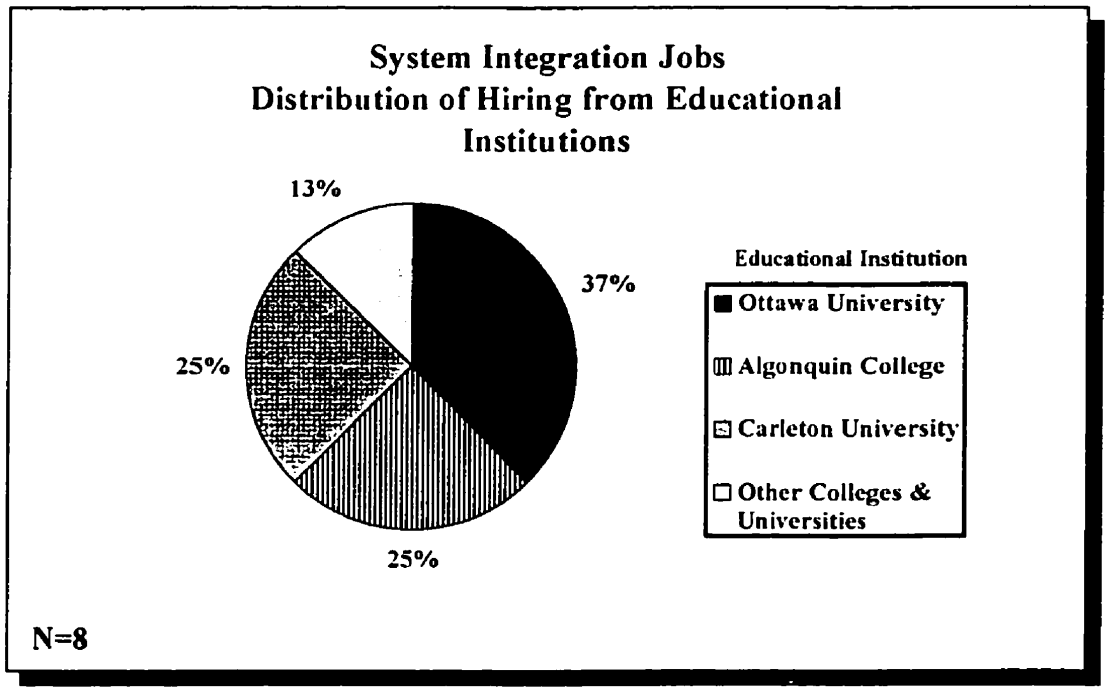
Appendix I:

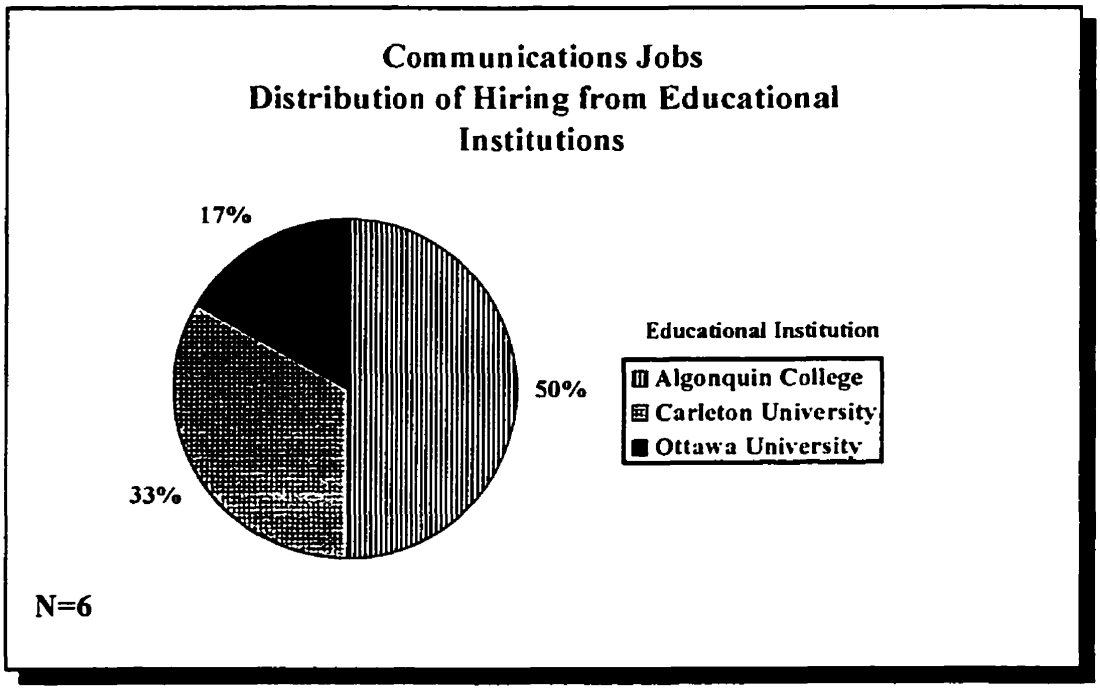
The Hiring Patterns of the Various Information Technology Sectors, Based on Post-Secondary Institutions

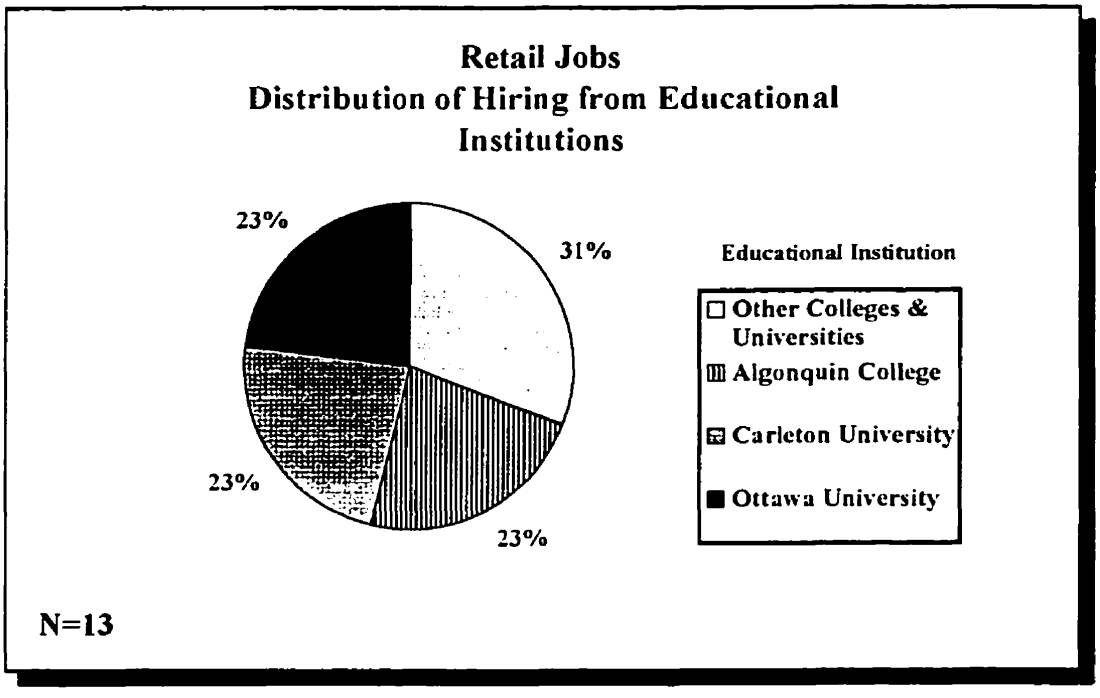


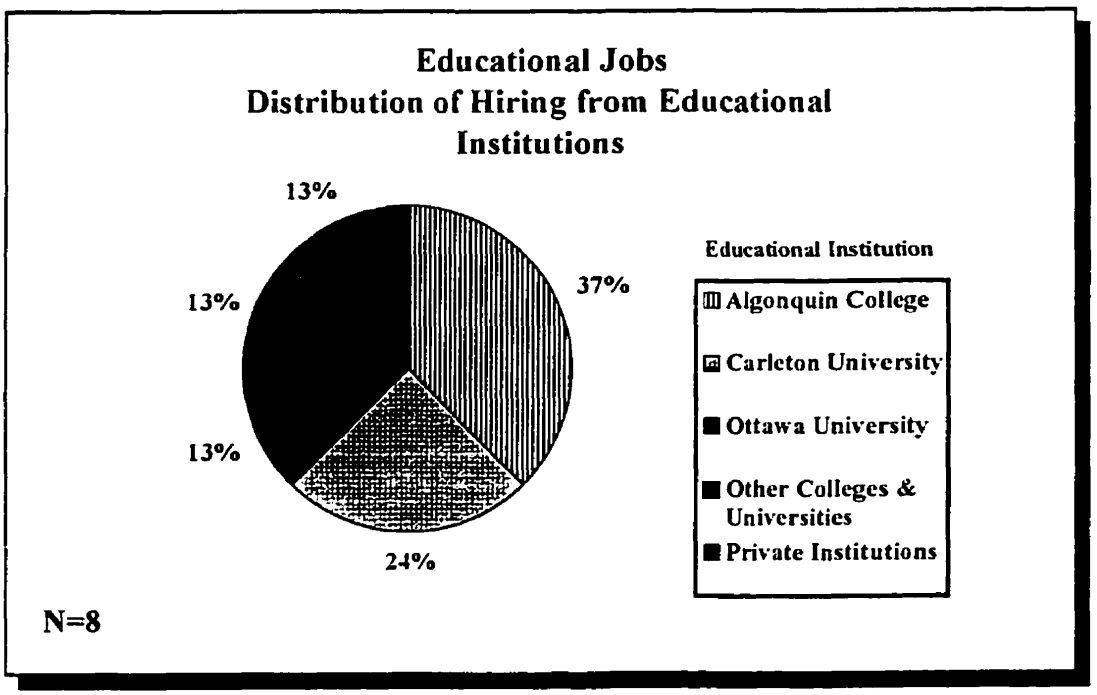


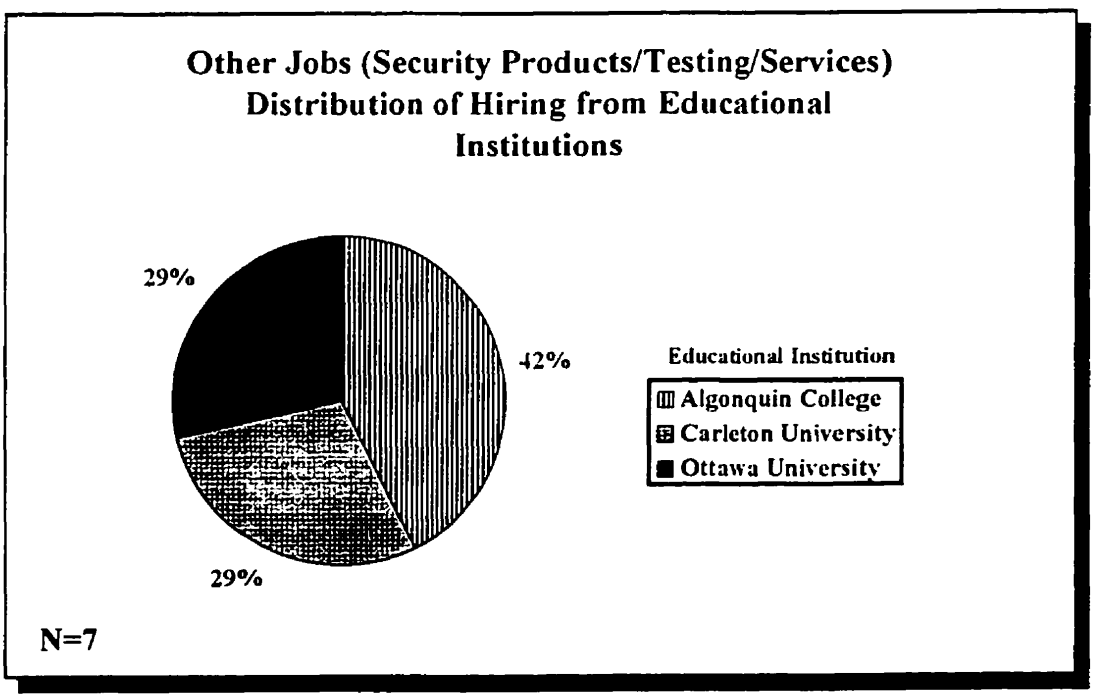

Manufacturing Jobs
Distribution of Hiring from Educational Institutions
6%
33%
28%
33%
Educational Institution
Carleton University
Ottawa University
Algonquin College
Other Colleges & Universities
N=18

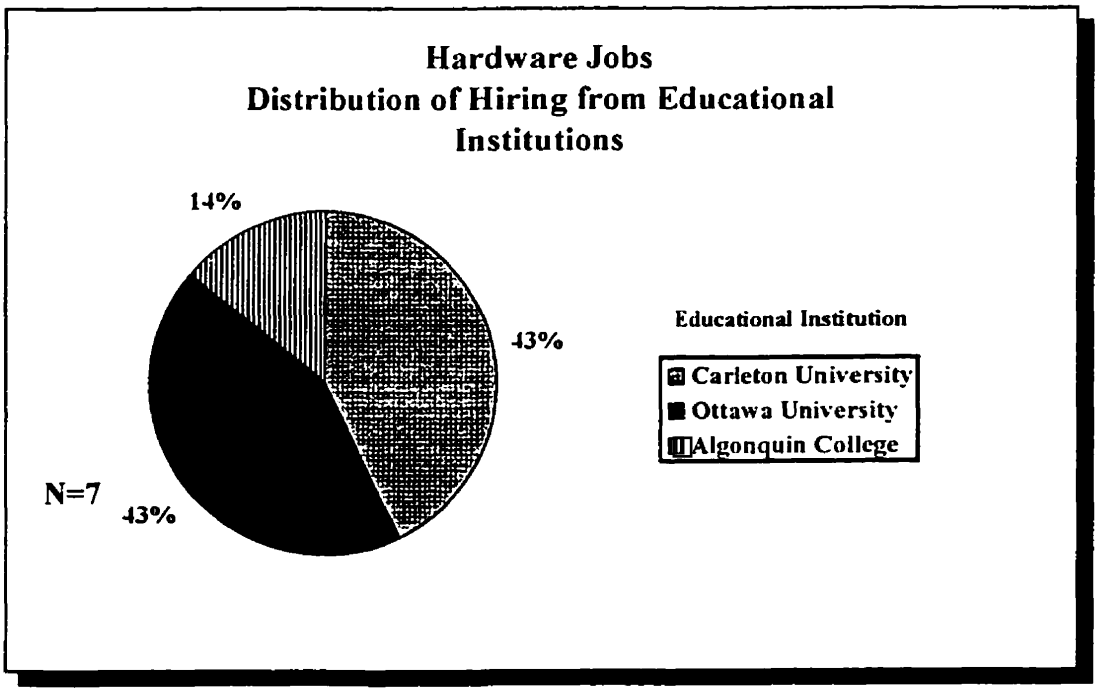

System Integration Jobs
Distribution of Hiring from Educational Institutions
13%
37%
25%
25%
Educational Institution
Ottawa University
Algonquin College
Carleton University
Other Colleges & Universities
N=8

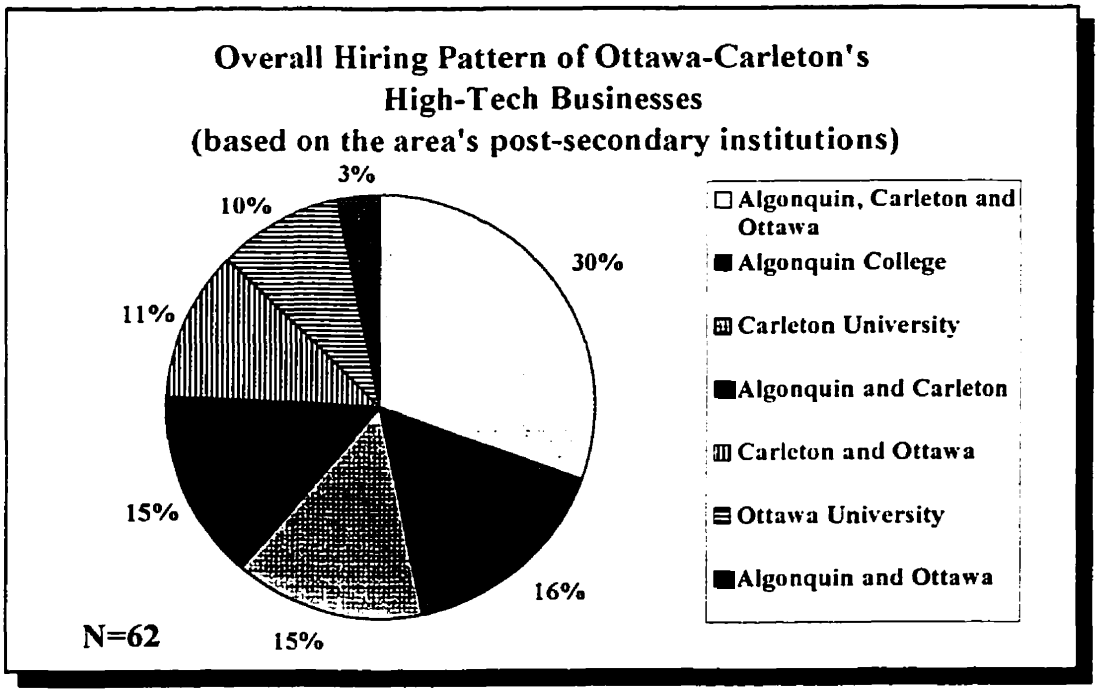

Communications Jobs
Distribution of Hiring from Educational Institutions
17%
50%
33%
Educational Institution
Algonquin College
Carleton University
Ottawa University
N=6


Retail Jobs
Distribution of Hiring from Educational Institutions
23%
31%
23%
23%
Educational Institution
Other Colleges & Universities
Algonquin College
Carleton University
Ottawa University
N=13


Educational Jobs
Distribution of Hiring from Educational Institutions
13%
37%
13%
13%
24%
Educational Institution
Algonquin College
Carleton University
Ottawa University
Other Colleges & Universities
Private Institutions
N=8


Other Jobs (Security Products/Testing/Services)
Distribution of Hiring from Educational Institutions
29%
42%
29%
Educational Institution
Algonquin College
Carleton University
Ottawa University
N=7


Hardware Jobs
Distribution of Hiring from Educational Institutions
14%
43%
43%
N=7
Educational Institution
Carleton University
Ottawa University
Algonquin College


Overall Hiring Pattern of Ottawa-Carleton's High-Tech Businesses
(based on the area's post-secondary institutions)
3%
10%
30%
11%
15%
16%
15%
N=62
Algonquin, Carleton and Ottawa
Algonquin College
Carleton University
Algonquin and Carleton
Carleton and Ottawa
Ottawa University
Algonquin and Ottawa

Appendix II:

Curriculums of information technology programs at Algonquin College.[57]

Automated Office Techniques (1 year - Certificate)

Level: 01

English I
Wordprocessing Operations I
Information Procedures I
Production Techniques

Elective: choose 1

Microcomputers I
Introduction to Accounting

Level: 02

Creative Supervision
Information Procedures II

Elective: choose 1

Word Processing Operations II
Computerized Accounting

Elective: choose 1

Microcomputers I
Desktop Publishing Applications

English General Education Elective: choose 1

Problem-Solving in the Workplace
Business Etiquette and Professional Conduct
Plain English

Business - Information Systems (2 years -Diploma)

Level: 01

Introduction to Accounting
Microcomputer Applications
Computer Concepts
English I
Basic Business Mathematics

Level: 02

Accounting - Computer Apps
Spreadsheet Applications
Database Applications
Introduction to MS_DOS
English II

57 *Algonquin College Calendar, 1996-1998.* Nepean, Ont.: Registrar's Office, Algonquin College, August, 1996.

Level: 03

Marketing
Wordprocessing Applications
Comparative Microcomputer Hardware
Data Networking

English General Education Elective: choose 1

Interpersonal Communication Skills
Literature
Science Fiction
Science and Technology in the Media
Effective Problem Solving Strategies
Level: 04

Economic Issues
Data Communications

Elective: 1 with departmental approval

Network Generation
Comparative Micro Software

Elective: 1 with departmental approval

Network Administration
Electronic Publishing

<u>Business Administration - Information Systems (3 years - Diploma of Business)</u>

Level: 01

Accounting I
Microcomputer Applications I
Introduction to Microeconomics
English 1

Choose one of the following two courses:

Management Principles
Marketing Principles

Level: 02

Accounting II
Microcomputer Applications II
English II
Quantitative Methods I

Choose one of the following two courses:

Management Principles
Marketing Principles
Level: 03

Computer Programming I
Introduction to Operating Systems
Quantitative Methods II

Choose one of the following two courses:

Introduction to Macroeconomics

Business Finance

Choose one of the following two courses:

English General Education Elective (See choices below)

Business Law

English General Education Elective: choose 1

Interpersonal Communication Skills
Literature
Science Fiction
Science and Technology in the Media
Effective Problem Solving Strategies

Level: 04

Computer Programming II
Data Communications and Networking
International Marketing Management

Choose one of the following two courses:

Introduction to Macroeconomics
Business Finance

Choose one of the following two courses:

English General Education Elective (See choices above in level 3)
Business Law

Level: 05

Systems Analysis and Design
C++ Programming
COBOL
Management Operations

One elective course (See choices at end of listing)

Level: 06

Information Systems Project Course
Database Systems
Computer Systems Architecture
Elective Course (See choices at end of listing)
Elective Course (See choices at end of listing)

Students are required to complete three courses from the groupings listed below. No more than two courses may be taken from any one grouping. Two courses must be taken from those indicated by a (G), usually one in each of the last two levels of the program.

Economics Electives

International Trade
Managerial Economics
Money and Banking
Labour economics (G)

Finance Electives

Personal Finance (G)

Other Electives

Occupational Health and Safety

Quantitative Methods Electives

Mathematics of Finance
Calculus with Business Applications
Operations Research
Forecasting Techniques

Social Sciences Electives

Business Law II (G)
Government of Canada (G)
Psychology of the Workplace (G)
Introduction to Social Psychology (G)

Computer aided Drafting and Design Technician (2 year - Diploma)

Level: 01

Autocad I - Mechanical
Drafting Theory I - Mechanical
Material Science in Society
English I
Mathematics 'A'

Level: 02

Autocad II - Mechanical
Drafting Theory II - Mechanical
Measurement Principles
Mathematics 'B'

Level: 03

Autocad III - Electronics
Drafting Theory III - Electronics
Electricity
Engineering Mechanics II
Reporting Technical Information

Level: 04

Autocad IV - Electronic Packaging
Drafting Theory IV - Electronic Packaging
Electronics
Mathematics 'C' - Three Dimensional Geometry

Computer Engineering Technology (3 year - Diploma of Technology)

Level: 01

Introduction to Computing
Computer Skills
Electricity
English I
Mathematics I

Physics - Kinematics and Dynamics

Level: 02

Computer Applications
C Language
Logic I
Passive Circuits
Introduction to Calculus

English General Education
Elective: choose 1

Workplace Organization and Communication
Communication Dynamics
Customer Relations
Critical Thinking
Intercultural Communication
Workplace Protocol
Working Through Workplace Issues

Level: 03

Data Structures
Assembly Language
Electronics I
Logic II
Reporting Technical Information
Integration: Techniques and Applications

Level: 04

Real-Time Programming
Compilers
Microprocessor Interfacing
Electronics II

Differential Equations - Electronics

Level: 05

Software Engineering
Operating Systems I
Communications and Networks I
Database Systems
Logic III

Level: 06

Graphics Software
Project
Operating Systems II
Communications and Networks II

English General Education
Elective: choose 1

Forms and Shapes
Technology and the Global Economy
Entrepreneurship
Ethics and Law
Production Planning
Operations Management
Business Fundamentals
Ergonomics
Psychosociology
Occupational Health and Safety

Computer Programmer (2 years - Diploma)

Level: 01

Introduction to Accounting

Computer Fundamentals
Microcomputer Applications
Computer Programming I
Mathematics for Computer Programmers

Level: 02

Computer Programming II
Data Communication and Networking
Operating Systems Use
English for Computer Programmers
Management Concepts and Issues

Level: 03

Systems Analysis and Design
Cobol
Computer Systems Architecture
C++ Language Programming

English General Education
Elective: choose 1

Interpersonal Communication Skills
Literature
Science Fiction
Science and Technology in the Media
Effective Problem Solving Strategies

Level: 04

Information Systems Project
Database Systems
High Level Languages
Statistics for Computer Programmers

Computer Systems Technician (2 years - Diploma)

Level: 01

Introduction to Computing
Microcomputer Operating Systems I
Microcomputer Applications I
Computer Technology Basics
Introduction to Modern Electronics
English I
Numbers and Logic

Level: 02

Systems Programming
Microcomputer Applications II
Microcomputer Operating Systems II
Microcomputer Architecture
Assembly Language

English General Education
Elective: choose 1

Workplace Organization and Communication
Communication Dynamics
Customer Relations
Critical Thinking
Intercultural Communication

Workplace Protocol
Working Through Workplace Issues

Level: 03

Unix Operating System
Microcomputer Applications Iii
Computer Communication
Peripheral Devices

General Education Elective:
Choose 1

Forms and Shapes
Technology and the Global Economy
Entrepreneurship
Ethics and Law
Production Planning
Operations Management
Business Fundamentals
Ergonomics
Psychosociology
Occupational Health and Safety

Level: 04

Application Development
Computer Networking
Pc Troubleshooting
Unix System Administration
Reporting Technical Information

Computer Technology - Computing Science (3 years - Diploma of Technology)

Level: 01

Introduction to Computing
Computer Skills
Electricity
English I
Mathematics I
Physics - Kinematics and Dynamics

Level: 02

Computer Applications
C Language
Computer Logic for Computing Science
Introduction to Calculus
Physics - Optics and Nuclear

English General Education Elective: choose 1

Workplace Organization and Communication
Communication Dynamics
Customer Relations
Critical Thinking
Intercultural Communication
Workplace Protocol
Working Through Workplace

Level: 03

Data Structures
Assembly Language
Cobol

Computer Architecture for Computing Science
Reporting Technical Information
Integration: Techniques and Applications

Level: 04

Fortran 77
Real-Time Programming
File Structures
Compilers
Differential Equations - Computer Science
Linear Algebra

General Education Elective: Choose 1

Forms and Shapes
Technology and the Global Economy
Entrepreneurship
Ethics and Law
Production Planning
Operations Management
Business Fundamentals
Ergonomics
Psychosociology
Occupational Health and Safety

Level: 05

Software Engineering
Operating Systems
Communications and Networks
Database Systems
Numerical Analysis
Statistical Methods - Computer Science

Level: 06

Project
Graphics Software
Operating Systems II
Communications and Networks II
Object-Oriented Programming

Desktop Publishing Techniques (16 week - Certificate)

Level: 01

English I
Desktop Publishing Applications
Integrated Administrative Techniques
Graphic Arts - Page Layout Fundamentals

Geographic Information systems Technologist (3 year - Diploma of Technology)

Level: 01

English I
Map Fundamentals I
Geographic Information I
CAD Mapping
Algebra, Trigonometry, Analytical Geometry
Surveying Fundamental

Level: 02

Map Fundamentals II
Geographic Information II
Map Production Techniques
Desktop Mapping
Spherical Trigonometry and Matrices

Level: 03

Map Design
Vector GIS Fundamentals
Topographic Mapping
Digital Mapping I
Introductory Statistics
Operations Management

Level: 04

Reporting Technical Information
GIS Applications
Digital Mapping II
Raster GIS Applications
Applied Statistics for Geographic Information Systems
Business Fundamentals

Level: 05

Project Management
Quadtree/Raster GIS
Image Analysis
Applications Management I

Level: 06

Applied Project
GIS Data Integration
Applications Management II
GIS Issues

Graphic Design (2 year - Diploma)

Level: 01

Visual Dynamics
Typography I
Graphic Design I
Computer Graphics I
Creative Thinking: Problem Solving I
English I

Level: 02

Graphic Design II
Words and Images
Typography II
Computer Graphics II
Business Ethics and Strategies
English II

Level: 03

Graphic Design III
Clients and Contracts II
Graphic Illustration I
Electronic Integration I
Prepress Production I

Level: 04

Graphic Design IV
Graphic Illustration II
Clients and Contracts II
Field Work
Electronic Integration II
Prepress Production II

Technical Writer (3 years - Diploma of Technology)

This three year diploma program is designed to produce technical writers who possess a sound technical education and superior communication skills.

Students from high school follow a regular electronics, mechanical or computing science program for the first three levels before entering the program. Students then follow a specialized curriculum that continues technical education in electronics, computer science and telecommunications, while learning to write clear technical reports and proposals, technical and consumer manuals, catalogues, brochures and specifications; convey technical information using a wide selection of media, including graphs, charts, tables, blueprints and computer designs; and work as part of a team involved with every aspect of a technical writing operation, from the initial design to the marketing of the final product.

Level: 04

Microcomputer Applications
Microprocessing for Technical Writers
Computer Architecture
Graphics I
Statistics I Industrial
Technical Writing I

Level: 05

Computer Graphics
Computer Systems for Technical Writers
Telecommunications for Technical Writers
Technical Writing II
Project Planning
Document Planning and Management I

Level: 06

Information Systems Development
Law and the Technical Writer
Technical Writing III
Project
Document Planning and Management II

Appendix III:

Curriculums of information technology programs at Carleton University.[58]

School of Computing Science

Core Courses:

First Year:

Elementary Calculus I
Linear Algebra for Engineering and Computer Science Students
Introduction to Programming
Introduction to Discrete Structures
Introduction to Systems Programming
Computer Applications

Second Year:

Linear Algebra II
Data Structures and Data Types
Computer Organization
Programming in the Large

Third Year:

Algebraic Structures with Computer Applications
Operating Systems
Software Systems Design
Database Management Systems
Data Structures and Algorithm Analysis
Discrete Structures and Applications

Fourth Year:

Honours Project

Software Option:

First Year:

1 credit in an experimental science

Second Year:

Elementary Calculus II
Probability Models
Programming Language concepts

Third and Fourth Years:

Compiler Construction
Concurrent Programming
Design and Analysis of Algorithms

---

58 Carleton University. *1996-1997 Undergraduate Calendar.* Ottawa: Office of the Registrar, 1996. Ottawa, Ontario

1 Computer credit at 300 level or above
1 Computer Science credit at 400 level

Hardware Option:

First Year:

Introductory Physics I
Introductory Physics II

Second Year:

Elementary Calculus II
Intermediate Calculus
Probability Models
Digital Logic
Circuits and Signals
Third Year:

Microprocessor Interfacing
Electronics I

Fourth Year:

.5 Engineering or Computer Science credit at 300 level or above
1.5 Engineering or Computer Science credits at 400 level or above

Theory of Computing Option

First Year:

1 credit in an experimental science

Second Year:

Elementary Calculus II
Probability Models
Digital Logic or Programming Language Concepts

Third and Fourth Years:

Introduction to Mathematical Logic or Computable Functions or Numerical Linear Algebra
Two of Compiler Construction, Numerical Analysis or Concurrent Programming
Design and Analysis of Algorithms
Theory of Automata
.5 Computer Science credit at 200 level or above
1 Computer Science credit at 300 level or above

Scientific Applications Option

First Year:

1 credit in an experimental science
Second Year:

Elementary Calculus II
Digital Logic
1 experimental Science credit

Third Year:

Probability Models
Numerical Analysis

1 experimental science credit at 200 level or above

Fourth Year:

Microprocessor Interfacing
Two of Discrete Simulation and its Applications, Design and Analysis of Algorithms or Numerical Linear Algebra
.5 Computer Science credit at 400 level or above

Management and Business Systems Option

First Year:

Principles of Financial Accounting
Management Accounting
Introduction to Economics

Second Year:

Management and Organizational Behaviour
Introduction to Management Science
Introduction to Business Finance
Introduction to Statistics

Third Year:

Information Systems Analysis
Information Systems Design or

Programming Language Concepts

Fourth Year:

1 credit in Business at 300 level or above
.5 credit in Business at 400 level Computational Statistics or .5 credit in Mathematics at 200 level or above
.5 Computer Science credit at 400 level

Appendix IV:

Curriculums of information technology programs at the University of Ottawa.[59]

Requirements for the B.Sc. With Major in Computer Science 1)

Introduction to Computer Science I
Introduction to Computer Science II

Calculus I
Calculus II
Introduction to Linear Algebra
Elements of Mathematical Logic

Principles of Physics I
Principles of Physics II

Science electives: six credits of 1000 level

Computer Architecture I
Data Structures
Concepts in Programming Languages
Computer Architecture Ii
File Management
Prolog Concepts Laboratory
C Concepts Laboratory
Design and Analysis of Algorithms I

Software Engineering I
Operating System Principles
Database Management Systems

Technical Report Writing

Electives:

Computer Science (CSI): six credits (3000 level)
Science: six credits (2000 level) (non CSI)

Non-science electives:

Nine credits outside the Faculties of Science and Engineering.

Requirements for the B.SC. With Honours in Computer Science

In addition to the requirements for the B.Sc. with Major

[59] University of Ottawa. *Ottawa University Computer Science Department.* Web site: (http://www.csi.uottawa.ca/dept/about/).

Compulsory courses:

Data Transmission and Computer Networks
Introduction to Formal Languages
Topics in Programming Languages
Computational Methods for Numerical Problems
Project

Electives:

six credits in Computer Science (4000 level)
nine credits (2000 level) (non-CSI) in other departments of the Faculty of Science.

Information and Management Systems Option Requirements for the B.SC. (IMS Option) with Major in Computer Science

Introduction to Business Management
The Socio-Political Environment of Business

Introduction to Computer Science I
Introduction to Computer Science II

Introduction to Macroeconomics
Introduction to Microeconomics

Calculus I
Calculus II

Introduction to Linear Algebra
Elements of Mathematical Logic
Introduction to Management Science
Marketing
Organizational Behaviour
Introduction to Financial Accounting
Financial Management
Management Information Systems: Management Perspective

Computer Architecture I
Data Structures
Concepts in Programming Languages
Computer Architecture Ii
File Management
Prolog Concepts Laboratory
C Concepts Laboratory
Design and Analysis of Algorithms I
Software Engineering I
Operating System Principles
Database Management Systems

Technical Report Writing

Elements of Discrete Mathematics
Introduction to Probability
Introduction to Statistics

Science electives (2000-level) (non-CSI):

Non-science electives:

Three credits outside the Faculties of Science, Engineering and Administration.

Requirements for the B.Sc. (IMS Option) with Honours in Computer Science

In addition to the requirements for the B.Sc. with major:

Managerial Economics
Forecasting Techniques
Optimization Methods

Topics in Programming Languages
Project

Electives:

Nine credits in Computer Science (4000 level) must be completed. The three other credits may be completed in any department of the Faculty of Science(non-CSI)

Requirements For The B.A.Sc. In Computer Engineering

First Year (Threshold courses)

Principles of Chemistry
Laboratory of General Chemistry
Problem Solving and Software Design
Engineering Economics
Introduction to Electrical and Computer Engineering
Test of Proficiency in French as a Second Language
Engineering Mechanics
Calculus I
Calculus II
Introduction to Linear Algebra
Fundamentals of Physics I
Fundamentals of Physics II
Physics Laboratory

Second Year

Computing Concepts and Data Structures
Analog and Digital Electronics I
Circuit Theory I
Circuit Theory II
Digital Computer Organization
English
Technical Report Writing
Calculus III for Engineers
Ordinary Differential Equations and Numerical Methods
Elements of Discrete Mathematics
Electricity and Magnetism I
Electricity and Magnetism II
One complementary studies elective

Third Year

Microprocessor-Based Systems
Concepts in Programming Languages I
Prolog Concepts Laboratory
Operating System Principles
Signal and System Analysis
Solid-State Electronics

Analog and Digital Electronics II
Introduction to Control Systems
Introduction to Communication Systems
Probability and Statistics for Engineers
Technology and Society in North America
or
Scientific Thought and Social Values
Two complementary studies electives

Fourth Year

Compulsory Courses:

Real-Time Systems Design
Computer Systems Design Project
Computer Structures
Software Engineering
Computer Communications

Electives - Three courses chosen from:

Thesis and Seminar
Computer Control in Robotics Project
Linear and Non-Linear Electronics
Principles and Applications of LSI Design
Digital Signal Processing

BIBLIOGRAPHY

Algonquin College. *Algonquin College Calendar, 1996-1998*. Nepean, Ont.: Registrar's Office, Algonquin College, August, 1996.

_____ *Systems Support Specialist Program*. Nepean, Ont.: Algonquin Publishing Centre, 1996.

_____ *Year 2000 Enterprise Programmer*. Nepean, Ont.: Algonquin Publishing Centre, 1996.

Bagnall, James. *Citizen turns page to region's high-tech future*. The Ottawa Citizen, August 26, 1996.

_____ *The New Economy of Software Valley*. The Ottawa Citizen, October 10, 1996, Ottawa, Ontario

_____ *High-tech drives torrid Ottawa-Hull job market*. Ottawa, The Ottawa Citizen, November 9, 1996, Ottawa, Ontario.

_____ *Firms move out to find workers*. The Ottawa Citizen, February 10, 1997. Ottawa, Ontario.

Balsley, H. and Clover, V.T. *Business Research Methods*. Columbus, Ohio: Grid, Inc., 1974.

Bell Canada. *Yellow Pages*. Ottawa: Tele-Direct Publications Inc., 1997.

Carleton University. *Undergraduate Program Course Requirements Web Site* (http://www.scs.carleton.ca/scs/ug2.html)

_____ 1996-1997 Undergraduate Calendar. Carleton University: Ottawa, Ont.

Chianello, Joanne. *Newbridge plans to hire 900, build new Kanata office tower*. The Ottawa Citizen, June 7, 1996.

_____ *Groups battle skill shortage in high-tech*, The Ottawa Citizen, June 8, 1996, Ottawa, Ontario.

_____ *Boost to research funding comes with strings attached.* The Ottawa Citizen, February 19, 1997. Ottawa, Ontario

Chrétien, Jean. *Routine Proceedings*. Hansard, House of Commons debates. Ottawa: February 28, 1996. (web site: http://www.parl.gc.ca)

Department of Finance. *Innovation and Technology: Keys to Job Creation.* Federal Budget, February 18,1997.(website: 'http://www.fin.gc.ca/budget97/jobe/job2e.html#innov)

Dare, Patrick. *Programmed for Success*. Ottawa: The Ottawa Citizen, May 18, 1996, Ottawa, Ontario.

_____ *Carleton must think big to survive, says incoming president Van Loon.* The Ottawa Citizen, July 11, 1996. Ottawa, Ontario.

_____ *U of O plans technology school.* The Ottawa Citizen, December 3, 1996. Ottawa, Ontario.

Doern, G. and Phidd, R. *Canadian Public Policy - Ideas, Structures, Process.* Scarborough, Ont: Thomson Canada Limited, 1992.

Evenson, Brad. *Youth work ethic needs improvement, survey shows*. Ottawa: The Ottawa Citizen, October 25, 1996, Ottawa, Ontario.

Ferber, Robert. *Readings in Survey Research*. Chicago: American Marketing Association, 1978.

Goff, Kristin and Hill, Bert. *High-technology sector leads economic revival*. The Ottawa Citizen, September 7, 1996.

Global-X-Change Communications Inc. *Silicon Valley North High Tech Directory*. Ottawa, 1995. (web site: http://www.globalx.net/svn/directory/index.html)

Harb, Mac. *Government Orders - The Budget*. Hansard, House of Commons debates. Ottawa: March 7, 1996. (web site: http://www.parl.gc.ca)

Hill, Bert. *Telecom industry to address skill shortage*. Ottawa: The Ottawa Citizen, Sept. 18, 1996.

_____ *Region suffers record job loss*. The Ottawa Citizen, February 8, 1997, Ottawa, Ontario.

_____ *Wooing the best takes effort*. The Ottawa Citizen, February 12, 1997. Ottawa, Ontario.

_____ *Seeking high-tech help*. The Ottawa Citizen, March 12, 1997. Ottawa, Ontario.

Jenkins, W. *Policy Analysis - A Political and Organizational Perspective*. Suffolk, Britain: The Chaucer Press, 1978.

Lininger, Charles A. and Warwick, Donald P. *The Sample Survey: Theory and Practice*. New York: McGraw-Hill Inc., 1975.

Mayers, Adam. *Oh, say can you see the BRAIN DRAIN?*. The Ottawa Citizen, August 31, 1996. Ottawa, Ontario.

OCEDCO. *High Technology Related Companies*. Ottawa: Ottawa-Carleton Economic Development Corporation, 1995.

O'Connor, B. and Regan, E. *End User Information Systems*. Toronto: Macmillan, 1994.

Proud, George. House of Commons - *The Budget*. Hansard, House of Commons debates. Ottawa: March 18, 1996. (web site: http://www.parl.gc.ca)

Ripley, R. *Policy Analysis in Political Science*. Chicago: Nelson-Hall, Inc., 1985.

Shoesmith, John. *Wanted: Qualified software engineers*. Computing Canada, Vol. 22 No. 18, September 3, 1996.

Software Human Resource Council. *Software and National Competitiveness Report*, 1995.

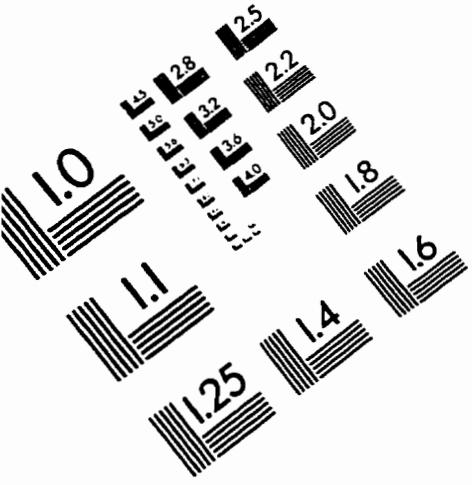
Strathdee, Mike. *Canadian firms fear brain-drain as students look to U.S. for jobs*. Ottawa: The Ottawa Citizen, October 10, 1996, Ottawa, Ontario.

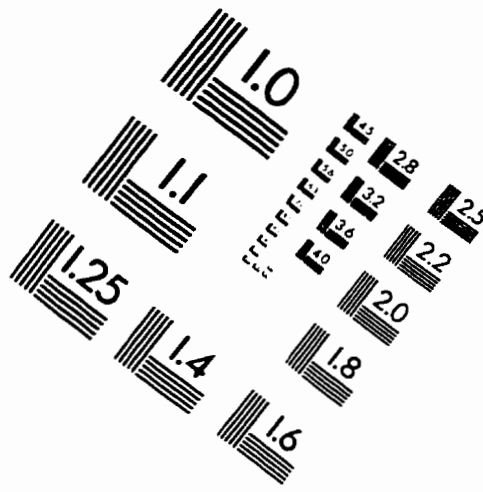
University of Ottawa. *Ottawa University Computer Science Department*. Web site: (http://www.csi.uottawa.ca/dept/about/).

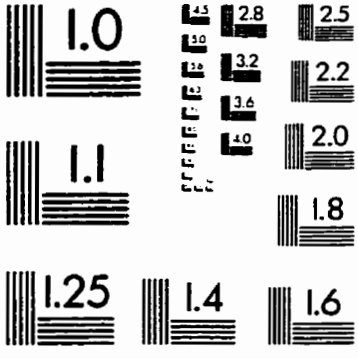
Weimer, D. and Vining, A. *Policy Analysis - Concepts and Practice (Second Edition)*. New Jersey: Prentice-Hall, Inc., 1992.

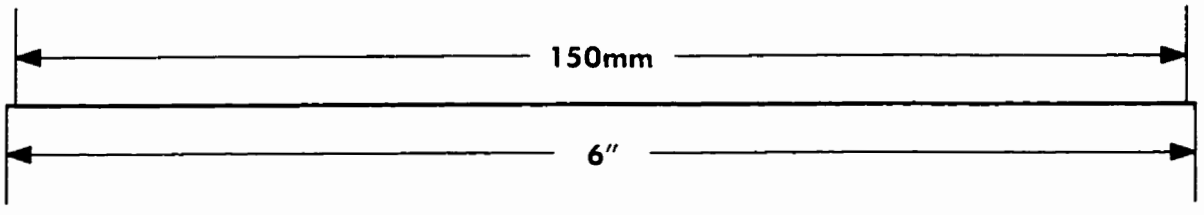
Williamson, Margaret. *No quick fixes for IT skills shortage.* Computing Canada.Volume 23, No.2 Willowdale, Ont.: Plesman Publications Ltd., February 3, 1997.

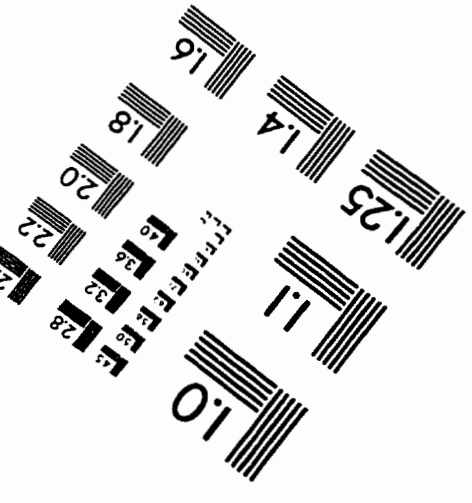
IMAGE EVALUATION TEST TARGET (QA-3)

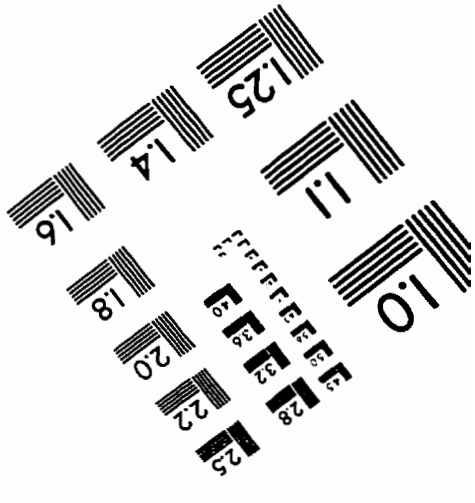












APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989