



2002 National Survey of Professional Engineers

FINAL REPORT

Submitted to:

Canadian Council of Professional Engineers
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EXECUTIVE SUMMARY

The objective of the 2002 National Survey of Professional Engineers, sponsored by the Canadian Council of Professional Engineers (CCPE) and the Government of Canada, is to profile the basic demographics; the levels of education and skills; and, the employment and job characteristics of members of the engineering and geoscience professions. A parallel survey was also conducted with technicians and technologists, and this report provides some comparisons across both professions.

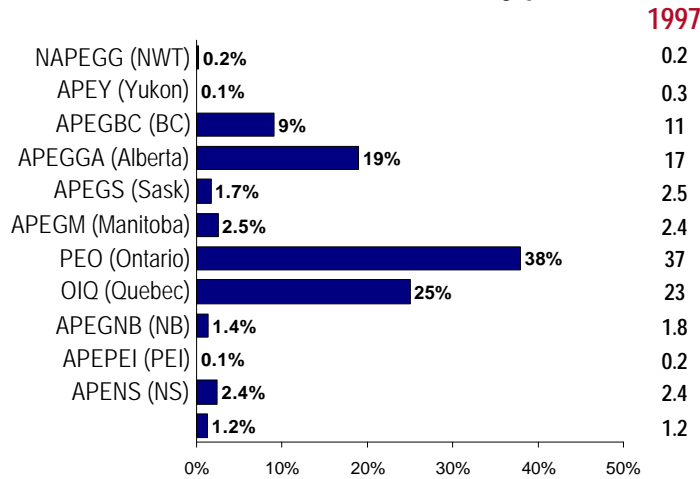
The survey design was based, in part, on the 1997 CCPE National Survey of Canadian Engineers. Considerably more questions were included in the 2002 survey (60 questions in 2002 vs. 20 questions in 1997). The 2002 survey was administered largely through the Internet, (while the 1997 survey was administered on paper) and the sample frame consisted of members from the 12 provincial/territorial associations/ordre under the Canadian Council of Professional Engineers (CCPE). A total of 96,280 CCPE members were invited to participate in the survey. This included all female members, as well as all members from most provinces and disciplines. Given the very large concentration of males in the disciplines of civil, electrical, mechanical and chemical engineering who are licensed in Ontario, Quebec and Alberta, however, it was decided to draw random samples of these members, rather than including all of them. The Internet and mail data collection period occurred from April to June 2002. A total of 27,120 members completed the survey either through the Internet or mail, for an overall response rate of just over 28 per cent. The final survey sample was considered to be largely representative of the initial sample drawn. The final responses were weighted by gender, discipline and province to restore the representativeness of the sample to the entire population of members (excluding students and retirees). As such, the findings are considered to be statistically valid and given the size of the overall sample, accurate to within less than one percentage point, 19 times out of 20.

Profile of Members of the Canadian Engineering Profession

In 2002 it was estimated that there were 172,000 members across the provincial/territorial engineering associations/ordre in Canada, compared with roughly 165,000 members in 1997 (excluding students and retired members from both samples). The distribution of members across provincial/territorial engineering associations/ordre in 2002 is virtually the same as in 1997. The number of members is proportionately highest in Ontario (38 per cent), Quebec (25 per cent) and Alberta (19 per cent). Technicians and technologists in Canada have a different membership distribution, with comparatively fewer members in Quebec and a higher representation in Alberta.

Association/Ordre Membership (2002)

Actual distribution of 151,992* members by province of residence



* This number of members serves as a truer population figure for survey purposes, since it includes students, retirees and members with multiple memberships across the country from the original 172,000 memberships.

Twelve per cent of members hold a membership from more than one provincial/territorial engineering association/ordre. These members are more apt to be older men (in their 60s), self-employed and in engineering management. Members from Yukon, Northwest Territories, PEI and Saskatchewan tend to hold multiple memberships, typically from adjacent provinces and/or territories.

Approximately five per cent of members are licensed outside of Canada, primarily in Europe, the United States and Asia. Engineering/geoscience profession members who received their undergraduate education outside of Canada are also more likely to hold a license to practice engineering outside of Canada. Of those licensed to work in the U.S., most are working in the fields of civil, geological, mining engineering and geoscience.

Occupational Areas

The top employment occupations among members are civil (20 per cent), electrical/electronics and mechanical engineering (16 per cent in each), which is similar to results from the 1997 survey. No province or territory has fewer than 45 per cent of its members across these three occupational areas (Alberta is the lowest at 45 per cent) and some provinces have as many as 75 to 87 per cent of their membership in these three occupations alone (including Manitoba, Prince Edward Island and Yukon with the highest concentrations across the country). The 2002 survey shows a reduced number of the various "other" specialties, however, the 2002 survey also featured new categories including software and biosystems engineering, education and engineering management.

Industries of Employment

It is difficult to compare the current results regarding industrial representation to 1997 because different industry classification systems were utilized in the two surveys. Generally, however, there has been an increase in private sector engineering services and a decline in public sector engineers over the past five years. The major industries where members are employed are: professional, scientific and technical services (24 per cent); manufacturing (22 per cent); resources (12 per cent); utilities (nine per cent); and, construction (nine per cent). Technicians and technologists are more likely to be working in construction and public administration than engineering/geoscience members and less likely to work in manufacturing and professional and scientific services areas.

Age Distribution of Members

Over half of members are below the age of 43, with fewer than one in six under 30 years of age and one in four who are over 50. There was a similar age distribution in the 1997 survey, although the age distribution of members has increased marginally in the past five years.

The average age of female members of the engineering profession is considerably lower than it is for male members. Members in Quebec and those in the field of software engineering also tend to be considerably younger than other members. (In Quebec this is partially due to increased numbers of graduates from university engineering programs in Quebec in the last 15 years.) Older members are more apt to be self-employed or working on contract and to have managerial responsibilities and experience. Members working in the field of education and geoscience, as well as those in the territories, are typically much older.

Employment/Experience

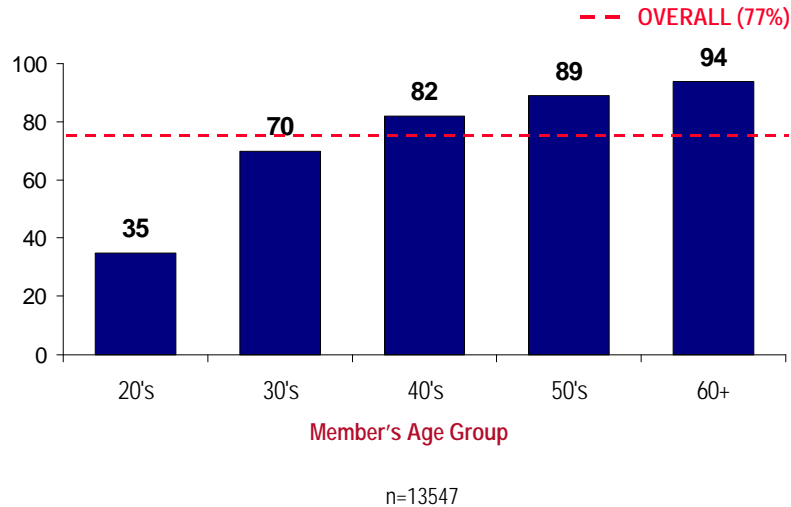
Just over four in five members are employed in permanent positions and almost one in ten are self-employed. Very few members (three per cent) are currently unemployed (compared to 4.8 per cent in 1997 and 7.5 per cent in the broader Canadian labour force in 2002). The pattern for technicians and technologists is virtually the same. There has been growth in both permanent and self-employment, with little change in contract/term employment since 1997.

Half of members have been in the labour force for 15 or more years. The pattern of engineering/geoscience experience follows the same patterns seen for the age distribution of the membership overall. For example, female members have fewer years of management experience, on average.

Three in four members (77 per cent) have managerial experience. Among these, the median number of years of management experience is five. Overall, members spend approximately 40 per cent of their years working in the engineering profession in a management capacity. The median number of years of management experience among technicians and technologists is similar.

Age and Managerial Experience

Those indicating at least some managerial experience



Naturally, the proportion having managerial experience increases with the member's age and years in the profession. Only one in three members (35 per cent) in their 20s report having managerial experience. For those in their 30s this figure has doubled to two in three (70 per cent). Experience continues to expand such that more than nine in ten (94 per cent) of those in the upper age groups, those aged 60 or more, have at least some experience in management.

Women

The overall proportion of female members is nine per cent, an increase from just under seven per cent in the 1997 survey. The fields where women had the highest representation are similar to 1997. Women represent 18 per cent of those working in the field of environmental engineering; and over ten per cent of those in the fields of chemical engineering and education. They continue to not be well represented in the field of mining engineering (with only three per cent of this field made up by women which is similar to 1997). In terms of work-family balance, half of women with children report that they are given a great deal of flexibility by their employers to balance work and family when conflicts arise, and another 39 per cent report that they are given at least some flexibility in this regard.

Job Characteristics of Members of the Engineering Profession

Size of Employer

Members of the engineering/geoscience profession tend to work for very large companies. In fact, 42 per cent of members work for firms with over 1,000 employees around the world. There was a similar proportion in 1997 (although the trend is towards even larger employers in 2002). This is much higher than typically found in the broader Canadian labour force, where only ten per cent of workers are employed by organizations this large. Members working in the fields of computer, aerospace, electrical and manufacturing engineering work for the largest firms, as do members licensed in Ontario and Quebec.

Intensity of Work

On average, members work 43 hours a week compared with 37 hours per week reported in the broader Canadian labour force. One in eight members (13 per cent) of the engineering profession report working more than 50 hours per week. The longest weeks of work are typically found among members in the fields of engineering management, manufacturing and mining engineering, as well as among members licensed in Prince Edward Island and New Brunswick.

Location of Work

Eighty-five per cent of members spend at least some of their working day in an office. One in five also spend time working at their client/job site, a plant or at home. The pattern is similar for technicians and technologists, although they are somewhat more likely to work at their client/job site and less apt to work in an office or at home. Most members (92 per cent) work predominately in the province where they live although three per cent work in another province and five per cent reported working predominantly outside Canada.

Job Tenure

Half of members have worked with their current organization for less than six years, and one-third of members have been with their current organization for more than ten years. This shows a trend towards shorter relationships with employers, when compared to the 1997 results. Self-employed members report working on their own for slightly longer than those employed in formal employer/employee arrangements. Employment relationships tend to be longer in larger organizations, for those working in the field of biosystems engineering or education, and among members licensed in Newfoundland and Yukon.

Job Responsibility and Reporting Relationship

The greatest proportion of members (36 per cent) hold positions as engineers/geoscientists. Another one in five are engineering managers and 17 per cent are engineering executives. Members with management responsibilities tend to be older and have more years in the engineering profession, and they are more likely to have a graduate degree, particularly a second, non-engineering degree. Women are not well represented in the management ranks because, on average, women are younger — and younger members report proportionately less management experience. Six per cent of members characterize themselves as members in training and just under one in five (18 per cent) describe their job responsibilities as non-engineering. Although the overall pattern for technicians and technologists is similar, they are less likely to be in non-technology positions.

In terms of reporting relationships, three in ten members who are currently working (in any capacity) report directly to their organization's President or Vice-President (or equivalent). This provides an indication of how strategically placed members are in many of Canada's engineering and related organizations. Almost half of members (44 per cent) report to a department head or director and one in five report to a project manager or team leader.

Primary Functions

Management/administration is a primary job function (in which respondents report spending at least one-quarter of their time) for the largest proportion of members (42 per cent), particularly older members and those with graduate degrees. This is followed by design tasks and technical support (each reported by one in three members), functions that are more often reported by younger members, with a single, undergraduate degree. One in four members spend at least one-quarter of their time in a consulting engineering role. In 1997, the same proportion of engineers reported design tasks as a key function, but the results indicate a growth in technical support (from 16 to 32 per cent) and specification/technical writing (from eight to 17 per cent). Technicians and technologists are less likely to be involved in management/administration (only 28 per cent) and consulting (15 per cent), by comparison.

Other Job Characteristics

Most members (87 per cent) rely heavily on computers and new technology in their job. This is particularly the case for younger members, and those in the fields of software and computer engineering.

Attitudes About Job

“To what extent do you agree or disagree with the following statements?”

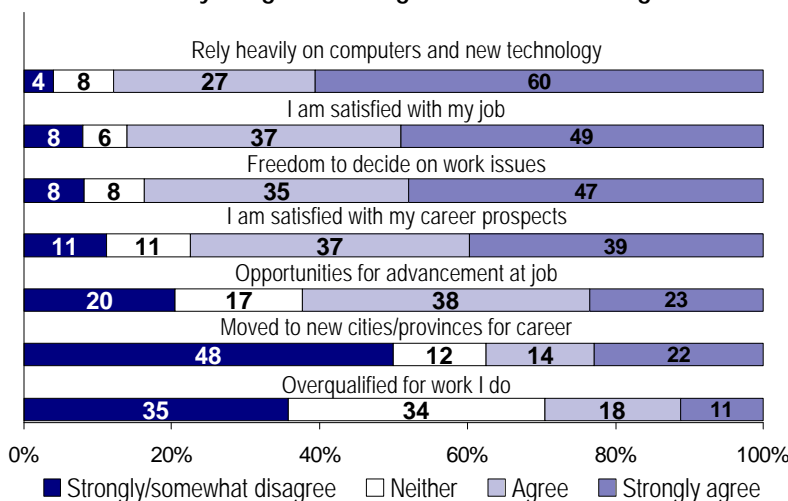


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The vast majority of members (86 per cent) are satisfied with their job (and half report that they are very satisfied). A strong majority (82 per cent) also indicate that they are given the freedom to decide on major issues affecting how they do their work. Three in four members are also happy with their career prospects. In each of these cases, older members, those with managerial responsibilities, and individuals who are self-employed are the most positive. Members working for the largest organizations are less positive.

Sixty per cent believe there are opportunities for advancement in their job. In this case, younger members and women are the most positive, since they are at an earlier stage in their career, with much of their potential to be realized.

One in three members have had to move to new cities or provinces to fulfill their career aspirations. Those in the largest firms report this more often.

Fewer than one in three (29 per cent) report that they are over-qualified for their job, while another one in three (35 per cent) indicate that this is not the case. Engineering/geoscience members who are most apt to report being underemployed also have a non-engineering degree, are more likely to have obtained their undergraduate degrees abroad, and have non-engineering staff responsibilities at work.

Personal Income

The median income for members in 2001 is \$78,000 (with an average of \$87,100), which is almost \$20,000 more than reported by technicians and technologists (where the median is \$56,000 and average is \$61,500). It should be noted that the personal income data collected through this survey includes not only the core salary, but also other income that members may earn from the primary job, as well as income from other (sideline) sources, and income from self-employment.

Personal income for members in engineering/geoscience increases with age and years of experience in engineering and management, as well as with the level of their highest degree and number of degrees obtained, and is particularly high for members with a graduate degree outside of engineering (such as an MBA). The highest incomes are reported among members working in petroleum engineering and engineering management, as well as by members in the Yukon.

Prevalence of Work Teams

The survey examined incidence and type of working teams as well as concentration of engineering work and composition of teams. Eight in ten (79 per cent) reported that they have worked on teams in the past few years. There is a greater propensity for engineers and geoscientists to work on teams compared with technicians and technologists (69 per cent worked on teams in the past three years).

Members who are more apt to report working on teams are usually older and have managerial responsibilities. Individuals who hold several degrees also tend to work on teams (often because they are managers). Teamwork is most prevalent in larger organizations and in environmental and petroleum engineering, as well as among those living in the Northwest Territories.

Three out of four members report teams that are formed on a project-by-project basis. The amount of engineering content reported on working teams is quite high, with an average of 59 per cent of work being engineering-related. Engineers represent most (69 per cent) of the working team. Almost one in two teams (46 per cent) include a technician or technologist and 25 per cent include a non-engineering technical person.

Education, Training and Skill Acquisition and Requirements

Education

Virtually all members (98.9 per cent) report a university education (a very small percentage of members have a background in engineering technology and have completed entrance technical examinations of the engineering profession). As in 1997, almost two in three have one university degree, 27 per cent have two degrees and eight per cent have three degrees. Most members have an undergraduate degree in engineering, and some have also obtained non-engineering degrees (either

concurrent with or after their engineering degree). Members who have a second or third university degree have typically obtained them later in their professional careers. Members who work in the fields of biosystems, chemical, environmental, or geological engineering and geoscience are considerably more likely to hold several university degrees.

Nine in ten members hold their highest degree in engineering, while one in ten have a non-engineering degree that is higher than their engineering degree. Of all members reporting education that is outside of engineering, one in three indicate having a certificate, one in four report education at the undergraduate level and almost half (43 per cent) report it at the graduate level. Most second or third non-engineering graduate degrees are in business administration (MBAs).

While the majority of members have obtained their undergraduate degree in Canada, another 12 per cent have obtained it elsewhere. Among engineering/geoscience members, those with undergraduate degrees from abroad are older, more likely to have obtained subsequent graduate degrees and report management responsibilities in their jobs.

Continuing Professional Development/Additional Training

Two in three members (64 per cent) reported taking additional training in the past three years to maintain or upgrade professional competencies. This is down from 80 per cent in 1997, although that survey did not specify a timeframe for the training, which likely accounts for the difference. Almost half of the training taken was in the same field, one-quarter was in a related field and one-tenth was in another technical area. One in five members who took training obtained it in a non-technical area (which is similar to the 1997 results).

Members taking training are more likely to be in their 30s and 40s, as opposed to the youngest and oldest members. Those employed by larger organizations report a higher incidence of training. Those who have pursued second or third degrees or additional education in non-engineering areas, or those whose primary job functions are essentially non-engineering are less apt to have taken additional training. Additional training is most often pursued by members who are working in the fields of petroleum or biosystems engineering and geoscience.

Of those who pursued training, four in five members were supported financially by their employer and another half were supported with time off. Almost all of those whose employers supported their training with time off also received financial support. Among engineering/geoscience members who took training, younger members were more likely to be supported financially. The smallest organizations were less apt to support training (at all, and in particular, in terms of financial support). On the other hand, the mid-sized organizations are more likely to support employees financially and the largest organizations typically support training with both time off and financing.

Three in four members (77 per cent) indicate that they are working in an area that they were trained for, particularly older members, geoscientists, individuals reporting a graduate degree and workers in

smaller organizations, as well as members working in mining, geological, or civil engineering and geoscience. Younger members and those working in the largest organizations are less likely to report this.

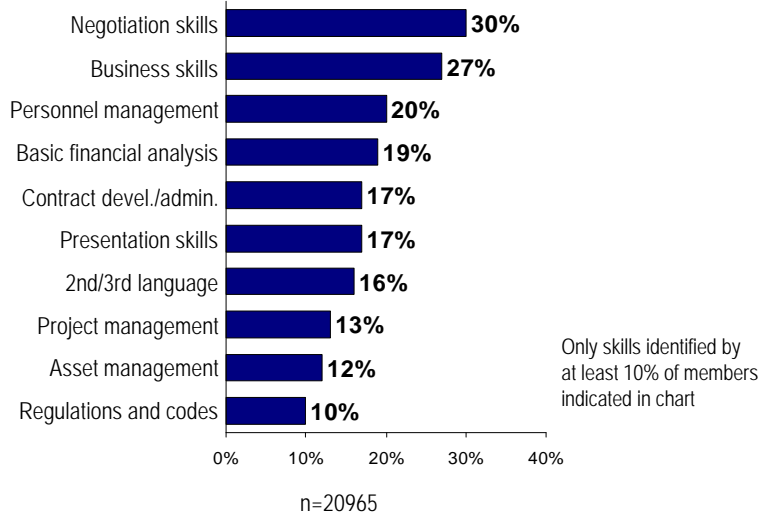
Seven in ten members believe that their education adequately prepared them for their current work or career (with just over half of these providing a strongly positive rating of their education in this regard). Younger members are less likely to believe this about their education. On the other hand, older members, those with managerial responsibilities, graduate degrees, those educated outside of Canada and those who report a highest degree outside of engineering are all more positive about their education.

Skill Attainment and Requirements

Members were asked to identify skills they believe they need to acquire in order to be successful in their careers. Negotiation, business and personnel management skills were identified most often (by 20 to 30 per cent of members). These are followed by basic financial analysis, contract development/administration and presentation skills (identified by 17 to 19 per cent of members). Members were also asked what skills they currently have. Members report less proficiency overall in asset management and contract development/administration.

Needed Skills

“Are there any skills which you do not currently have, which you believe that you should acquire to maximize your success in your occupation?”



Skills attainment and needs are largely driven by the age and experience of members. Fewer older members report possessing technology-related skills and fewer younger members report negotiation, business, financial, or personnel management skills. Not surprisingly, the greatest demand for a variety of enhanced skills can be found among the youngest members. These results are similar to the findings of, under CCPE's Engineering Work in Canada program over the last several years. Many employers in a variety of industry sectors across Canada have indicated that they are very happy with the technical skills of professional engineers and they would like to see professional engineers continue to improve their non-technical skills.

Conclusions

In 2002, the membership is showing a somewhat older profile than it did in 1997. There are proportionately fewer members under 40 and more between the ages of 40 and 55 in 2002. Given the general trend towards an aging workforce, it will be important for the engineering and geoscience professions to attract new, younger members in the future.

The incidence of female members is rising, as women comprise a relatively high proportion of the younger members. It will be important to continue to attract women to the professions and to the associations in the future. At the same time, the current results also indicate that women are earning less than men, even taking age and experience into account.

There is a very high employment rate in the membership and members are very satisfied with their jobs compared to the broader Canadian labour force. Personal incomes among members are also high on average and members report a significant amount of management experience. Three in four report some level of managerial experience and 42 per cent described their primary job responsibilities as an executive or manager. Given that members work for some of the largest companies in the world, these results highlight the degree of influence that members have in today's workplace.

Members are highly educated, with virtually everyone reporting at least one university degree and almost a third reporting graduate degrees. Three in four report that their education adequately prepared them for their work and that they are currently working in areas that they trained for.

Those educated abroad (with an undergraduate degree) represent 12 per cent of members. Given the aging workforce, they will begin to comprise increasing shares of the workforce in these and other professions in the future.

In terms of licensure status abroad, the primary areas where members are licensed are Europe, U.S. and Asia. This information will potentially provide the engineering profession with some guidance in terms of where to focus international negotiation efforts.

Members have reported a need for business-related skills, in areas such as negotiation, personnel management, delivery of presentations and contract development to be successful in their

careers. These results point to a strong need for engineering association emphasis on improving these non-technical skills among members of all ages. Lifelong learning is becoming increasingly important for the engineering profession, as is the case in the broader Canadian labour force.

Findings from the current study have some implications for future research. From a methodological stand-point, it is possible that a national survey could be taken somewhat more frequently (perhaps every three years) depending on the changes that occur in the broader Canadian labour force and economy and to the extent that new and emerging areas of engineering are becoming more prevalent.

The following issue areas could be considered for further investigation:

- New areas of engineering that are emerging (that members were not trained for);
- The mechanics of teams and how they are influenced by changing employer relationships (e.g., the participation and role of people working as independent contractors);
- Specific elements of jobs, employer relationships and/or working conditions that shape satisfaction (or dissatisfaction);
- Retirement plans of the older professional;
- The perceived steps or path in the careers of younger members, particularly women;
- It will be important to understand more about members who are educated abroad and how they are different in terms of their training and other requirements, so that the engineering profession may attract and help integrate these individuals as much as possible;
- More research to define needed skills; and
- A comparison with other professions (such as law, etc.).