SALARY GAP IN THE NEXT MILLENIUM

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ABSTRACT

The Professional Engineers of Ontario Membership Salary Survey [1] released in March 1999 indicated that the salary gap between male and female engineers widened and stands now at approximately 11.4%. This is alarming, considering the publicity on equality and the general belief that the gap is closing. This paper will attempt to identify the organisations associated with the engineers, scientists and technologists across Canada, USA and European Union which carry out the member surveys and more specifically those with the regular surveys. The available salary data will be analysed with the focus on answering the following questions:

- Is there the same pattern for female engineers in other provinces, other countries? Compare the PEO survey to other provinces and countries.
- How do the salaries of women in science and technology compare to their counterparts?
- Are the trends the same for all females in engineering, science and technology?
- Are the surveys reliable? The surveys will be critically evaluated in order to identify any problems, which may result in their interpretation.

INTRODUCTION

The seventies saw the beginnings of the increased enrolment of female into science and engineering. The sharpest increase occurring in mid-eighties, settling down to the steady increase continuing to this day. In eighties, the number of women entering various disciplines of science, engineering and technology was around 15%. Although their numbers were still small but became statistically significant. The problems women faced in science, engineering and technology fields then, were not only those related to the salary but also the acceptance in the work place, working conditions, lack of confidence and very slow promotion. Early nineties were the years of "glass ceiling and can it be broken". This was the result of frustration about the lack of female promotions to the highest position and the sense of procrastination at the same level. At the same time, the Canadian government was promoting the equality in the work place. It appeared promising that the trend to close the gap between male and female salaries is happening.

Professional women should not need to be concern about the wage gap at this point in time. After all, women in Canada were granted in 1985 the sexual equality and equal opportunity in the Canadian Charter of Rights and Freedom. The Pay Equity Acts in the provinces followed this up; in Ontario the act has been effective since January 1, 1988. Women here are more fortunate than most of western women because theirs rights to equality without discrimination are the law. Does this make any difference to their

paycheques? This article will examine this question by exploring the salaries of professional women in Canada, USA and Europe with the intent to draw some conclusions.

GLOBAL SCENARIO

It is appropriate to start with some general statistics. Women exceeds 50% of the world's six billion population but receive only 10% of the global income and own only 1% of the global wealth. Fortunately, the statistics for Canada are much better as far as the distribution of income is concerned (37.7% of income in 1997 according to Statistic Canada was earned by women [2]) but at the same time the average income of a female in the full time employment was 27.5% (29% in USA [3]) lower than that of a male. In spite of the equality, the western women do not enjoy the equal award for their work. Very recent British study [4] indicated that on average it costs each British female $800,000 (this sum reduces to $405,000 for the professional women) over the lifetime for just being a woman. Similar situation is in the USA where the statistics put the monetary loss to up to $1.4 millions (in Canadian dollars). The PEO survey published in March 1999, the American Society of Professional Engineers' survey in 1999 [5], the British survey [6] of academics and the American Association of University Professors' survey in 1998 [7], all reported gender wage gap amongst the professionals and further, some warned about a recent tendency of gap widening.

Table 1 summarises the professional organisations that were studied and some results of their surveys may be quoted in this paper. As Table 1 indicates the professions covered include engineers, scientists, architects and engineering technicians. Many organisations carry their membership and employer surveys without any intent to report on gender issues. The salary survey seems to be common to all of them. Very few organisations make the survey results available to their membership. Usually there is a press release with a brief summary of the survey's highlights. The reports are available for purchase, cost varying from $100 to $250 and their copies are typically not available in the libraries. General criticism of most of the surveys is in their lack of the statistical information by gender. Number of professional organisations was contacted in search of the basic membership information by gender (total membership is easily available). The information was always released by the organisation when approached but when questioned on where on their web site or in which publication can this information be found, the answer usually was that "this information is for internal use". Most organisations may have some information to process the survey results by gender (e.g., salary comparison) but very few of them do. Often the surveys provide vast amount of information on the salaries in relationship to the highest degree earned, level of responsibility, industry, discipline, and region but there is not even a mention of the comparison between male and female salaries. It should be noted that the most comprehensive and useful surveys found are the PEO's survey and ETAN project. Other important statistical sources are the National Science Foundation (SESTAT), which carries the survey of college graduates in engineering, science and technology and census information for Canada and USA.

Science and engineering societies or academies are also included in Table 1. These organisations have appointed members who are elected into the organisation. The most distinguished scientists and engineers are being nominated. Science societies often have a long history and it appears that this is one of the barriers for the advancement of women scientists into their ranks. Engineering societies are lot younger but have even worse statistics of female members. The inclusion of these honorary organisations was considered important because their members are often invited to participate on the government commissions, committees and task groups which are determining the direction of advancement of science, engineering and technology.

FEMALE SALARIES

This section will deal with the salaries of female in engineering, science and technology, referred to by an acronym EST. The representation of female in all EST organisations is significantly less than 50%, at the university level it may be as high as 50% but in the current workforce in EST it is around 20% including social scientists. Table 2 summarises the information pertaining to the female salaries. It should be reiterated that out of all organisations summarised in Table 1only those listed in Table 2 provide the salary information based on gender. The conclusion that can be drawn from this table is very definite: salaries of female in EST are consistently less than male salaries in the same fields. There is not a profession, nor a country (English speaking or western) where this conclusion would not be true. Another disturbing scenario from Table 2

points out that the situation is not improving but on contrary it may be slightly worse. AAUP last published survey indicated that the wage gap got worse in half of the categories when compared to 1975 survey.

Unfortunately it was not possible to investigate and compare the wage gap even for those organisations in more details because there is not sufficient data available. The PEO survey has the most comprehensive information and therefore it was analysed in greater depth in attempt to identify if:

- the worsening wage gap can be explained from the vast statistical information resource available by processing the information in another way
- the information collected in the survey can be revised in order to provide clearer results in future.

PEO MEMBERSHIP SALARY SURVEY - FINDINGS

The population surveyed included 50% of male members randomly selected, 100% of female members and 100% of engineers-in-training (i.e., 57% of total active i.e. non-retired membership) [1]. The survey respondents in full-time employment represented only 13% of total membership. 790 female returned the survey, i.e., one third of all female members or 1.7% of total membership. The percentage of female respondents is 13.0% of the sample population (compare with female being 5.6% of the total membership). The reason for using 100% samples of groups with low percentage of total population is to obtain the statistically significant results. If the size of population in any category was less than five, the sample was considered too small to be statistically reliable and eliminated from the statistical analysis.

The wage gap quoted in Table 2 is based on those respondents who graduated between 1979 and 1998. The percentage of female in this group is considerably higher than 5.6%. The average percentage of female respondents in this 20-year cohort is 18.3%. The median age in this group is 30 years for women and 34 for men.

Each survey respondent has to identify the responsibility level. There is a detailed classification guide that allows for self-assessment of the level based on seven levels and five characteristics. Level A corresponds to an engineer-in-training and level F+ to a senior engineer in a managerial position, responsible for the technical and budgetary decision and the personnel. Level D is the first level of direct and sustained supervision of other professional engineers.

1997 salary survey [15] is used for comparison. The comparison indicates that the wage gap has increased by 2.4%. The population participating in this survey is comparable to the size of 1999 survey.

The following are the observations on the survey results:

- If the entire female respondent population were taken into account, the wage gap of approximately 20.7% would be more appropriate. This compares to NSPE survey results.
- Female engineers are typically four years of experience behind their male colleagues. This should be reflected in the level of responsibility. Figure 2A indicates higher proportion of female in lower responsibility levels, namely A to C. This trend agrees with the population distribution over 20 years, almost constant for male engineers and with greater density towards more recent graduating years for female engineers (see Figure 1). This would indicate that typically the women and men entering a particular responsibility level graduated roughly at the same time. However, Figure 2B indicates lower median salary for female, especially in more senior levels, namely D to F. This wage gap cannot be entirely explained by the difference in the median age.
- Alternative way to interpret Figure 2A is to say that women are not moving into senior positions as fast as theirs male colleagues. The population distribution does not indicate that this is the case.
- The widening of the gap from the previous survey in 1997 (22 years population) is attributed to the changes in the median age. In 1997 survey the median age of women was 32 and 35 years for men. It is suggested that there is an increase in the age difference of one year between 1997 and 1999 surveys and hence the increase in the gap. It may be that this is a contributory factor to the increase but it should be noted that the size of the female population in senior levels is important and significantly impacts the results. In 1999 there are 30% of female in senior positions (levels D to F+) amongst the respondents while in 1997 there were 34%.
- Female engineers are more likely to select industry sector such as utilities (18.6%), non-manufacturing (20.4%), consulting (20.5%), education (21.2%) and government (25.4%) over manufacturing (16%) and construction (10.3%). Each industry sector is associated with different range in salaries (see Figure 3A and 3B). Female engineers are often concentrated in the sectors, which show the highest wage gap.

- Each industry sector can then be divided into number of discipline, usually related to an engineering field. In some cases, females in higher paid fields are not represented in a specific sector. This can skew the means and medians. Selectively, few years of graduation were investigated by the discipline and mean salaries for men were based only on those disciplines that had female presence. It was found that the mean salary for women was closer to that for men in some cases but not conclusively. The problem is a small size of the population and the reliability of the results become questionable.
- Some engineering disciplines showed stronger presence of females, e.g. chemical (consistently most popular), industrial, environmental and electrical. The ranking of the later three disciplines varies from year to year. The results can not be considered consistent.
- Figures 4A and 4B give the median salary by gender for each year of graduation for 1999 and 1997 surveys. It is important to note that female salaries are consistently lower with few exceptions of recent graduates and with more significant difference for years of graduation 1977 to 1984.
- What would the survey results be if the participation was significantly greater and with the numbers truly representing the membership proportions? This is a very interesting question but difficult to predict the answer. The statistical validity should certainly increase and the data which, are now eliminated from the statistical processing may well be included and impact the outcome.

The statistical results can be analysed and interpreted in different ways. It does not matter how the statistical data are processed; the wage gap between male and female salaries is indisputable. The question is how big and what is happening to it. The size of the wage gap can be determined (11.4% to 20.7% depending on the size of the population) from current information. Even with a very comprehensive survey such as this one, it is difficult to interpret the results in order to explain the reasons for the wage gap and why is it possibly widening. The following areas merit further investigation:

- The size of the surveyed population.
- The social and biological differences between the sexes currently not included in the survey.
- Tracking of female and male graduates following similar career path.

RECOMMENDATIONS

Only very few surveys provide information by gender. It is likely that most of the statistical data collection is compiled without giving the consideration to report on gender issues. This may be due to ignorance or fear of those who carry out the surveys that the direct or indirect discrimination can be revealed. The recent changes towards equality adopted by various governments are not sufficient to eliminate the gender differences. Even in Canada more than one decade after equality clause was added to the constitution, the gender gap still exists. It appears that the legal equality is relatively well developed but the achievement of economic equality is far more difficult.

- It is very important that the collection, processing and dissemination of gender specific statistics are legislated. Such statistics would give clear pictures of current situation and make it much easier to compare and share the survey results on systematic basis. The information would be useful in monitoring the progress of women in engineering, science and technology and would assist the governments and organisations in the decision making process. The increase in the volume of information collected would result in statistically valid data. The employer participation in this statistical data collection is essential and this why the whole process needs to be legislated.
- The preparation of information to be included in the data collection requires a statistical model with a clear vision of the published statistics from the survey. This model is essential if the information is to be shared in the pursuit of establishment of gender indicators in EST.
- The women play an important part in engineering, science and technology. It has been recognised that their contributions in essential especially in the areas where their work is directly associated with the improvement of human conditions or surrounding. The numbers of young women studying science and engineering is increasing. It is economically very important that these young women stay in their respective professions and younger women are still interested to

enter the university courses. Therefore the working environment including the salary is of great importance and must be resolved based on gender equality.

- The biological differences between men and women have to be recognised and incorporated in the statistics. The fact that woman's career takes off towards the later part of her child-bearing age means that only significant results can be obtained if the data which are collected and evaluated by comparing her to a male who entered the university at the same time and pursued similar career. The shift in woman's career few years "back" due to children is not reflected in any surveys.
- The social differences between men and women are ignored by all current statistics. It is a well-established fact that the division of domestic duties is not equal. Many studies support the fact that women contribute much greater share to care giving of children and elderly [8, 13] as well as to the domestic duties. Another social difference between sexes is that women are more accommodating and trying to make "the things work". The result is that women often give up the career advancement, settle for lower paid positions and take care of the family. In order to improve this, it is necessary to provide the support mechanism that is suitable to woman' s profession and economically viable for her.
- There is a need for a government recommendation stating the minimum percentage of female members (say one third) on any committee or task force at any level dealing with the current and future issues impacting women in EST. This is very important for the implementation of the above three issues because they require programmes, policies and practices in order to progress on the gender integration.

CONCLUSIONS

The glass ceiling might have been broken. The professional women are very successfully climbing the steps on the way to the top of the pyramid but sadly the wage gap and gender discrimination are still with us. The next millennium may not be about the recognition of the importance of women engineers, scientists and technologists but about a constant pressure on the governments and organisations to collect and release information by gender. The processed statistical information from a well-designed survey would clearly identify the current situation and can be used to pressure for relevant changes and supports. The constant education of public about the gender issues and discrimination is essential. The demand for ongoing pilot project with a well-developed evaluation mechanism to support women in EST will be very important over next few decades. Also, it is very important that senior women in EST get involved in the participation on the committees and the task groups dealing with the future of their profession and this way contribute to the ongoing process of change. The networking of women on international scale is very important, again by applying pressure on the governments to implement the relevant policies. It remains to be mentioned that although the gender issues were specifically mentioned in this paragraph, generally the same would apply to the problems impacting minorities. Sadly, but realistically the wage will be with us for at least few more decades.

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ABREVIATIONS

Professional Engineers Ontario (PEO)
Ontario Association of Architects (OAA)
Ordre des Ingénieurs du Québec (OIQ)
The Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
The Association of Professional Engineers and Geoscientists of B.C. (APEGBC)
National Society of Professional Engineers (NSPE)
American Association of University Professors (AAUP)

The American Institute of Architects (AIA)
The Engineering Council (ECUK)
European technology Assessment Network (ETAN)
Engineering, Science and Technology (EST)
Scientists and Engineers Statistical Data System (SESTAT)
Women in Engineering Advisory Committee (WEAC) – advisory to PEO

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Websites

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http://www.statcan.ca	Statistics Canada information
http://www.census.gov	U.S. Statitistics
http://www.nspe.org	NSPE site
http://www.aaup.org	AAUP site
http://www.apegga.com	APEGGA site
http://www.oiq.qc.ca	OIQ site
http://www.apens.ns.ca	APENS (Association of Professional Engineers of Nova Scotia) site
http://ww.wswc-cfc.gc.ca	Status of Women Canada site
http://www.engc.org.uk	Engineering Council site
http://www.e-architect.com	AIA site
http://www.carleton.ca/wise/	NSERC/Nortel Joint Chair for Women in Science and Engineering in Ontario
http://www.nsf.gov/sbe/srs/seind98	National Science Foundation

TABLE 1 – ORGANISATIONS STUDIED: FACTS & FIGURES

Organisation	Total membership	Female membership	Country	Comments
Professional Engineers Ontario (PEO)	46,690	5.6%	Ontario Canada	Engineers
Ontario Association of Architects	3,171	16%	Ontario Canada	Architects
Ordre des Ingénieurs du Québec (OIQ)	42,759	9.3%	Québec Canada	Engineers
The Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)	32,752	7.8%	Alberta Canada	Engineers, Geologists & Geophysicists
The Association of Professional Engineers and Geoscientists of B.C. (APEGBC)	18,000	5.0%	British Columbia Canada	Engineers & Geoscientists
Academy III (Science) of the Royal Society of Canada	899	5.3%	Canada	Scientists
National Society of Professional Engineers (NSPE)	60,000	11%	United States	Engineers
American Association of University Professors (AAUP)	550,822	34.6%	United States	All Academics
US National Academy of Science	1,904	6.2%	United States	All Scientists (incl. Social science)
US National Academy of Engineering	1,984	2.3%	United States	Engineers
The American Institute of Architects (AIA)	66,500	18%	United States	Architects
The Engineering Council (ECUK)	280,000	2%	United Kingdom	Registered Engineers & Technicians
Royal Society of London	1,185	3.6%	United Kingdom	All Scientists
Royal Academy of Engineering	1,117	1.2%	United Kingdom	Engineers

TABLE 2 – WAGE GAP

Organisation	Year of publication	Median salary	Wage gap	Change
PEO [3)] (ON, Canada)	1999	$72,254 (CDN)	11.4%	+ 2.1% (1997)
NSPE (USA)	1999	$72,842 (US)	25.8%	+1% (1995)
AAUP (USA)	1998	N/A	Professor 12.5% Associate 7.2% Assistant 6.4% Instructor 3.8%	+0.7% -0.2% -3.1% -3.6% (1988)
NSF (SESTAT) (USA)	1995	$52,000 (US)	19.2%	N/A
Bett Review (UK)	1998	£32,118	13.3%	N/A

Notes: 1) Wage gap is calculated as the percentage of male salary.
2) Change gives the percentage change in the wage gap from the previous survey. The year of the previous survey is given in the brackets. Positive (+) change means the increase in the wage gap.
3) The wage gap is based on the members who graduated over past 20 years, namely between 1979 and 1998.

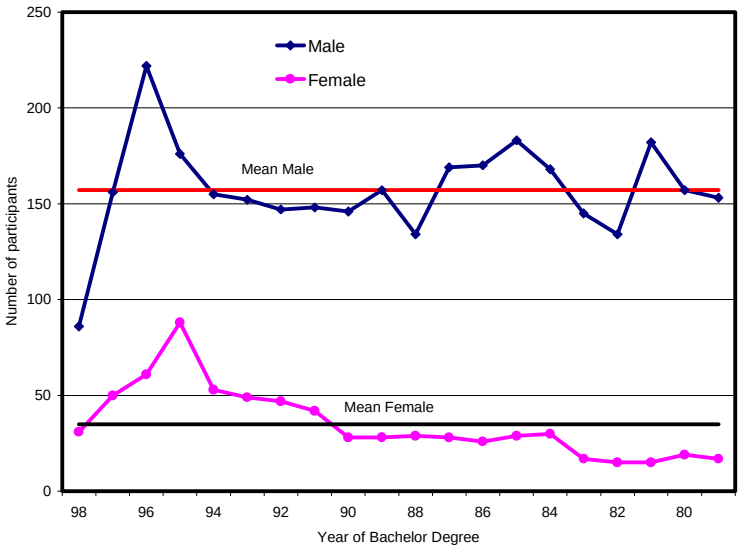

FIGURE 1 - Survey Participants Distribution Graduating Years 1979 –1999
Applicable to the following figures.

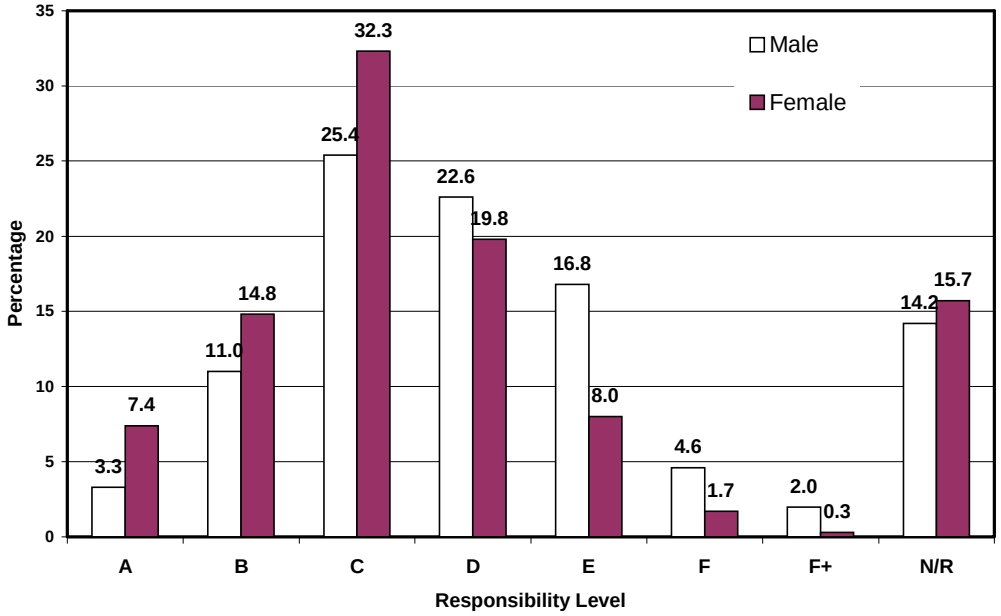

TABLE 2A – Distribution by Responsibility Level and Gender
Graduating Years 1979 to 1998 (Courtesy of PEO)

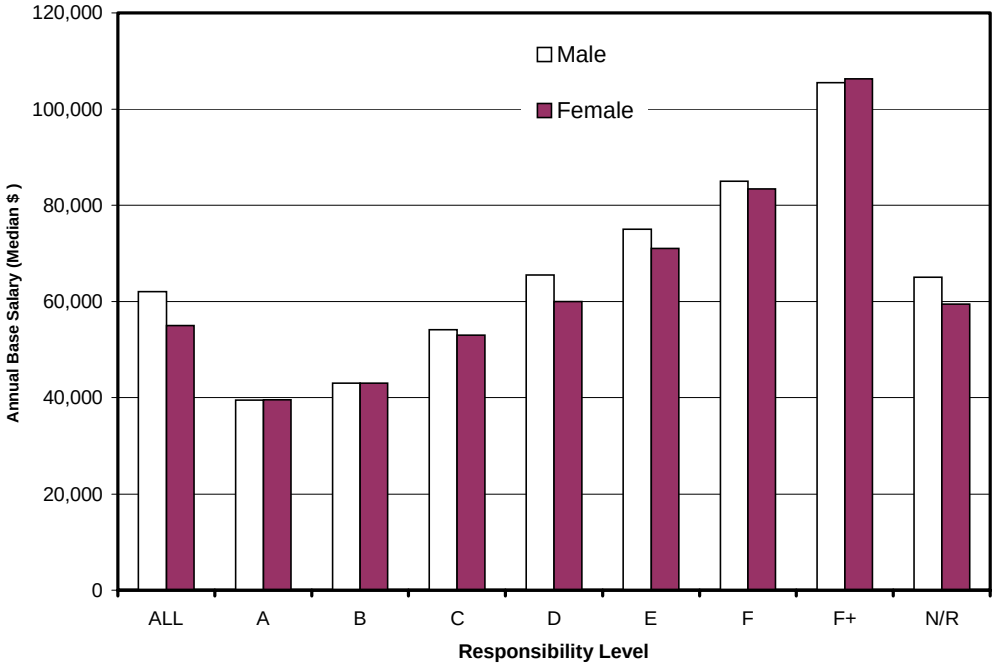

FIGURE 2B – Median Salaries by Responsibility Level and Gender
Graduating Years 1979 to 1998 (Courtesy of PEO)

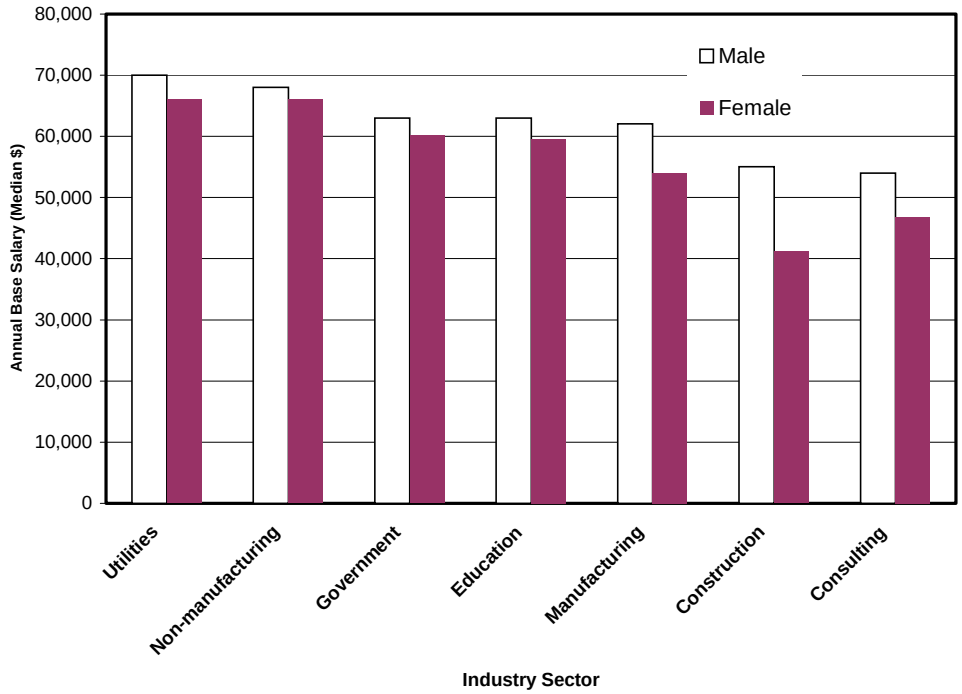

FIGURE 3A – Median Salaries by Industry Sector and Gender Graduating Year 1979 to 1998 (Courtesy of PEO)

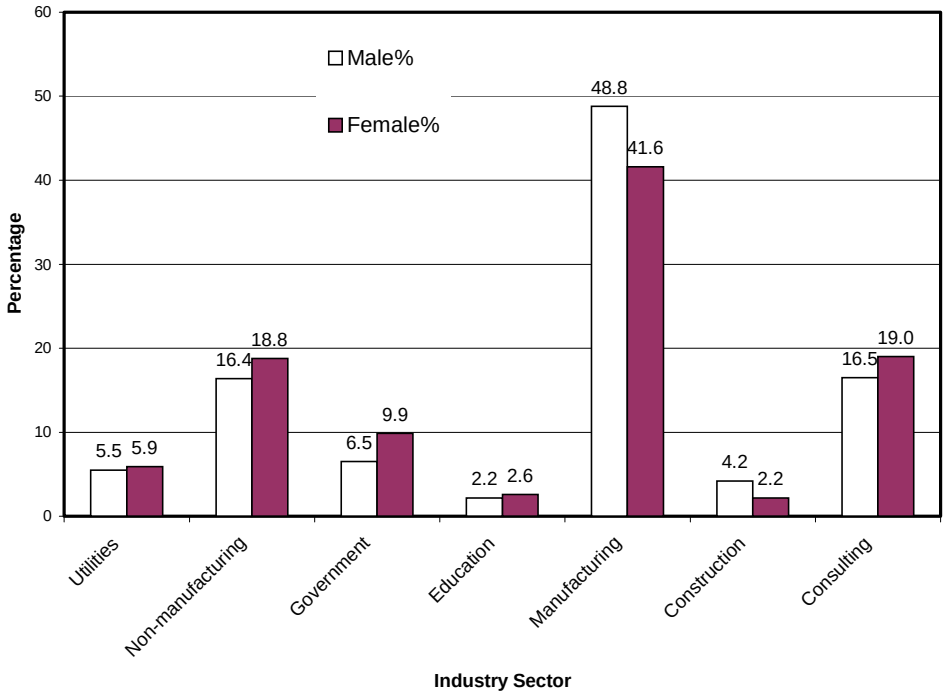

FIGURE 3B – Industry Sector Distribution by Gender Graduating Years 1979 to 1998 (Courtesy of PEO)

Note: Manufacturing can further be divided into the following fields: petroleum products, heavy electrical, electronics/electrical prods., chemical & pharmaceutical, food/ beverages/ tobacco, pulp & paper / wood prods., transportation e.g., metals, aerospace & aircraft prods., machinery, plastics & rubber, other manufacturing.

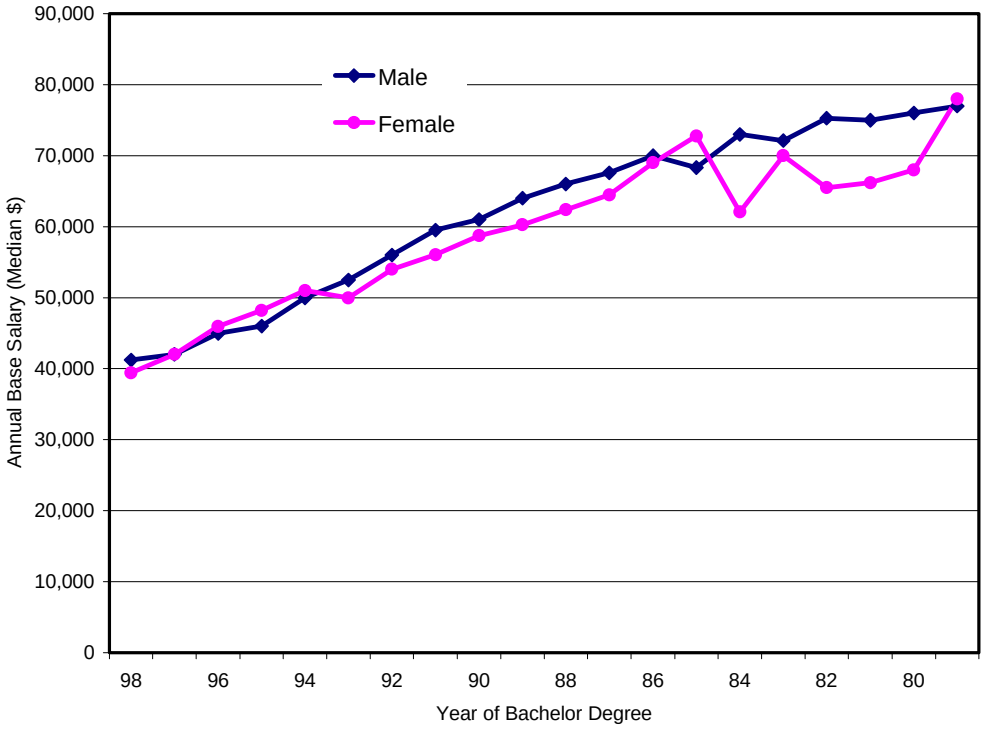

FIGURE 4A – Median Salary by Gender – 1999 Survey
Graduating Year 1979 – 1998 (Courtesy of PEO)

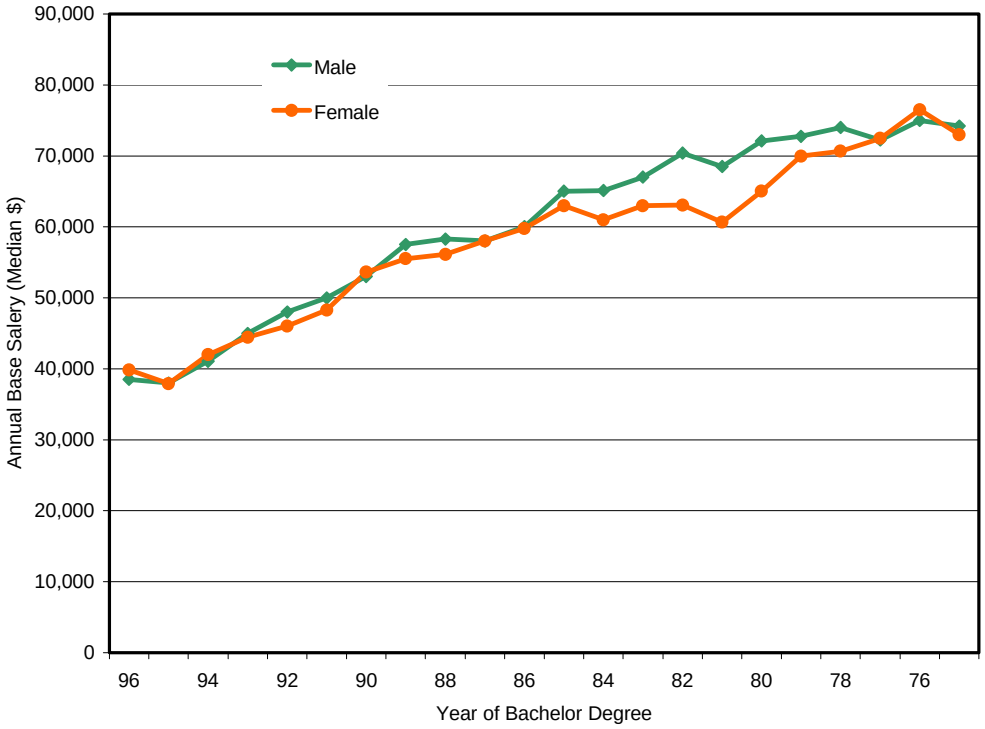

FIGURE 4B – Median Salary by Gender – 1997 Survey
Graduating Year 1975 – **1996** (Courtesy of PEO)