Women and Work:

Prospects for Parity in the New Economy

A report of the

State Employment and Training Commission's
Council on Gender Parity in Labor and Education

Prepared by

Dr. Mary Gatta, Director of Research & Analysis
Center for Women and Work
Rutgers, The State University of New Jersey

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Donald T. DiFrancesco, Acting Governor

Dianne Mills McKay, Chair
Council on Gender Parity in Labor & Education

John J. Heldrich, Chairman
State Employment & Training Commission

Introduction

The New Jersey Council on Gender Parity in Labor and Education recognizes the underrepresentation of women in science and technology jobs and educational programs as a workforce issue that inhibits the full utilization of its potential workforce. The issues surrounding the exclusion of women from these occupations and training opportunities are explored in this report and recommendations are suggested to remedy the situation. This report and its recommendations were developed as an extension of the New Jersey State Employment and Training Commission's (SETC) *Unified State Plan for New Jersey's Workforce Readiness System*. The *Unified State Plan*, first introduced in 1992 and revised in 1996, is an effort to address the complexities of creating a unified high-quality workforce investment system. The Council strongly believes that this report will aid the State of New Jersey in meeting one of the core principles of the Unified State Plan: there must be full utilization of all potential workers.[1[1]]

This report should be seen as an initial step in recognizing workforce issues. Simply identifying the underrepresentation of women in science and technology fields is not enough - instead, the Council believes that strategies must be developed to increase the proportion of women in these fields. As early as 1985, the U.S. Office on Technology Assessment found that New Jersey would be facing a shortage of scientists and engineers. That Office encouraged recruiting women and minorities into the fields of science and technology. It was reasoned that doing so would alleviate the shortage of workers by the twenty-first century.[2[2]] However, because these recommendations were not followed, New Jersey is facing the workforce crisis that it was alerted to over fifteen years ago.

Gender parity in the educational and workforce training system is an economic necessity for the U.S. to remain globally competitive. Indeed, this issue is crucial for New Jersey to attract and maintain the industries such as information technology, telecommunications, pharmaceuticals, and biotechnology, which, among other science and high-technology industries, make up an essential component of the State's economic base. While increasing the representation of women in these fields and educational programs is clearly good for women, it is also good for business and good for the New Jersey economy.

[1[1]] New Jersey State Employment and Training Commission. 1992. *A Unified State Plan for New Jersey's Workforce Readiness System.*
[2[2]] Office of Technology Assessment. 1985. *Demographic Trends and the Scientific and Engineering Workforce.* Washington D.C.

New Jersey's Economic Future: Projected Job Growth and Skill Needs

As we enter the twenty-first century, New Jersey's economic base is shifting from an industrial goods-producing economy to a knowledge-based economy. Much of this recent transformation has been propelled by the State's rapid expansion in the sectors of science and technology. New Jersey's growth in this area has been so great that *The New York Times* has recently dubbed New Jersey the "Silicon Parkway." Northern New Jersey has 3,000 more high-technology firms than Silicon Valley; 30 of the fastest growing national high-technology companies are in New Jersey; and New Jersey ranks 5th among states with growing high-technology companies.[3[3]] New Jersey is quickly becoming a national and global leader in the science and technology sector, creating an increasingly large number of new jobs to fill each year. However, as New Jersey continues to grow in this field, the State is facing a potentially devastating labor crisis. Simply put, the labor demand is not being met by the current labor supply. If this situation is not addressed, significant labor shortages that will occur throughout the early part of the twenty-first century will hinder the State's economic growth.

New Jersey's shift to a knowledge-based economy has drastically reshaped the overall employment picture. New jobs and industries that require higher-level skills from workers are being created, while old ones are declining and disappearing. Indeed, economic success is highly dependent on the talents of the workforce at all occupational levels in the new economy. For example, since computers and machines currently perform much of the needed industrial labor, factory workers are now expected to possess the skills and leadership to manage the technology as opposed to merely engaging in physical work. This new relationship between workers and technology requires that the workforce possess high-level skills in computers, electronics, life sciences, mathematics, and engineering, along with various combinations of those skills. In addition, workers need flexible analytical and communication skills that will enable them to adapt their talents to changing labor market conditions.

As evidenced from data collected by the New Jersey Department of Labor, New Jersey's goods-producing industrial sectors are projected to decline by 2008 (see Figure 1). Manufacturing industries are expected to continue to decline as they have throughout the 1990s, falling 7.1 percent by 2008. This translates into a loss of 34,100 jobs in this sector. Within the manufacturing sector, the apparel and textile industries are projected to experience the greatest decline, a loss of approximately 31.4 percent or a loss of 7,600 jobs by 2008. Consistent with a shift to a knowledge-based economy, employment declines are predicted to be the greatest in industries that manufacture durable goods.

[3[3]] "Call it Silicon Parkway: Despite Problems, New Jersey's Place in the World of High-Tech is Secure." November 11, 2000. *The New York Times.*

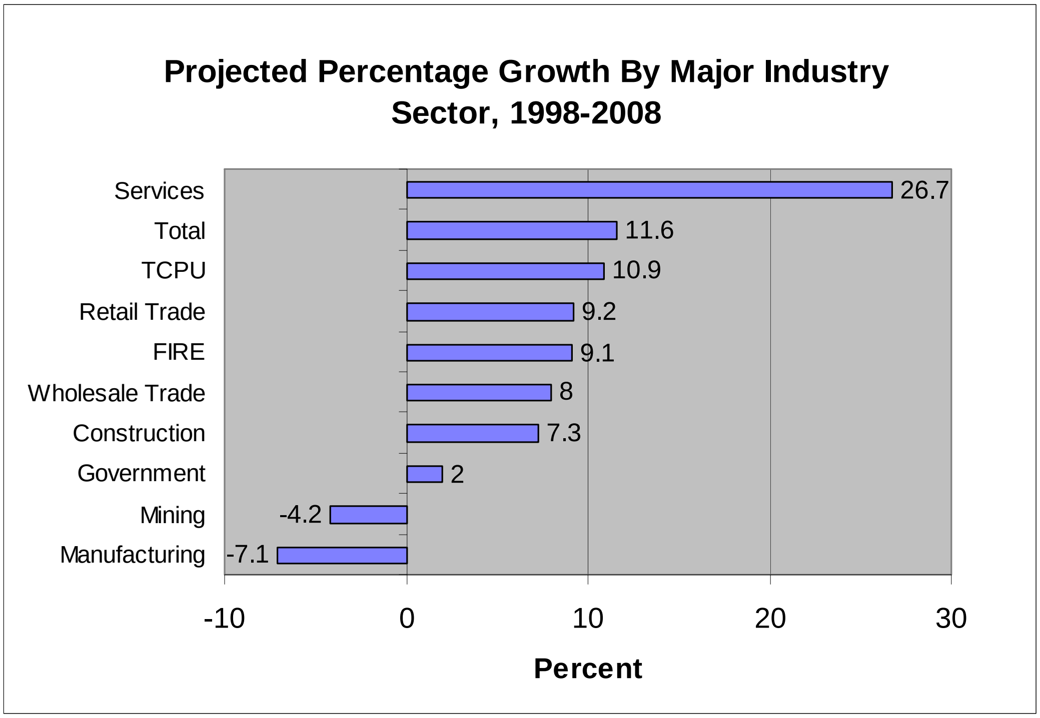

Figure 1:

Notes:
TCPU - Transportation, Communications, and Public Utilities
FIRE - Finance, Insurance and Real Estate

Source: Projections 2008 New Jersey Employment and Population in the 21st Century. Vol. 1 Industry and Occupational Employment Projections for New Jersey 1998-2008. Part A (State Projections, July 2000) NJ Department of Labor Market and Demographic Research.

Alternatively, New Jersey's growth throughout the first decade of the twenty-first century is expected to occur primarily in service-producing industries. This sector includes New Jersey's two largest industries, business services and health services. Business services industries are projected to be the fastest growing state industry, creating 135,500 new jobs to fill by 2008. The expansion of business services is primarily propelled by continued strong growth in computer and data processing services. Most significantly, this growth reflects the creation and expansion of information technology occupations. While there are many different ways to define information technology, the Council chose to adapt a definition used by the *Women and Minorities in Information Technology Forum*: Information technology jobs involve the creation, storage, exchange, and/or use of information through technological means. Specific information technology jobs include designing and developing software and hardware systems, providing technical support for computer systems, and creating and supporting network systems and databases.[4] As evident from the definition, information technology jobs are represented in all New Jersey industries, not just technical specialties. This requires workers in all industries to possess a general set of technical skills regardless of occupation.[5]

These projected industrial shifts, along with the proliferation of technology in all labor sectors, correspond to changes within New Jersey's occupational structure. By the year 2008, professional and technical specialty occupations are projected to experience the largest employment growth, at least double that of all other occupational categories. Specifically, from 1998 to 2008, two out of every five new jobs in New Jersey will be in the professional and technical occupational category (see Figure 2). This will create 193,000 new jobs in New Jersey including computer scientists, systems analysts, and engineers. Most of the occupations included within this category are high-skilled jobs in the service producing industries. In contrast, the occupational categories expected to experience relatively slow growth are: operators, fabricators, and laborers; and precision production, crafts, and repairers. These areas will create only 33,600 and 16,000 new jobs respectively.

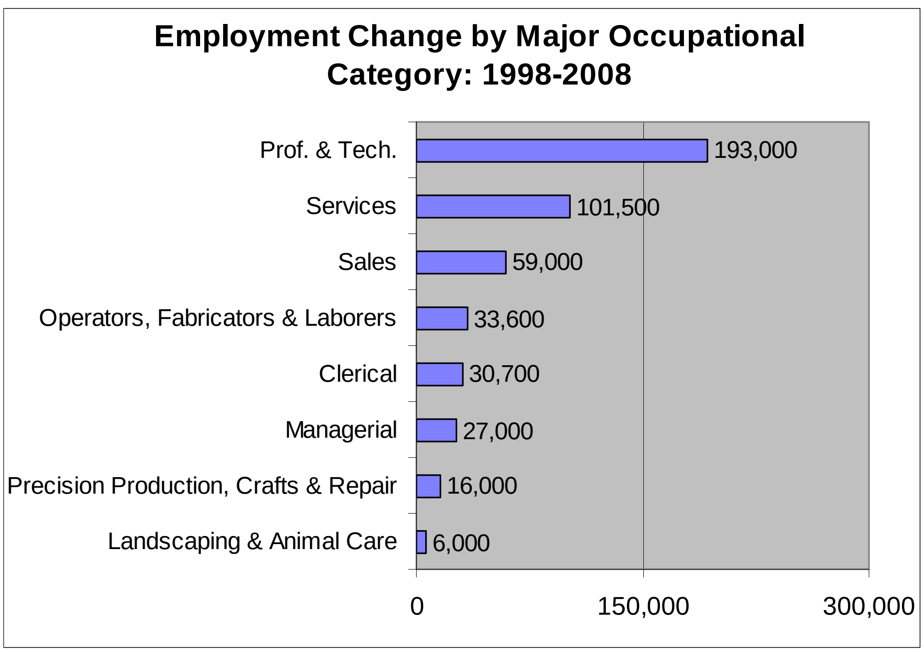

Figure 2:

[4] Sandy, M. and Burger, C. 1999. *Women and Minorities in Information Technology Forum: Causes and Solutions for Increasing the Numbers in the Information Technology Pipeline (The White Pages Report)* NSF: Virginia.
[5] Carnevale, A. and Fry, R. 2000. *Crossing the Great Divide: Can we Achieve Equity When Generation Y Goes to College?* New Jersey: Educational Testing Service.

Source: Projections 2008: New Jersey Employment and Population in the 21st Century, June 2000, NJ Department of Labor Market and Demographic Research.

Almost half a million new jobs are projected to be created by 2008, however, the total number of job openings in New Jersey is expected to be even greater. This results from the movement of workers out of the labor force (as a result of retirement, death, permanent disability and/or career change). In New Jersey, on average, 146,660 jobs will need to be filled each year, with approximately two-thirds of those jobs resulting from individuals leaving the workforce. In replacement jobs, as in new jobs, the most openings are projected to occur in the professional and technical occupations, approximately 38,000 jobs each year (see Figure 3).

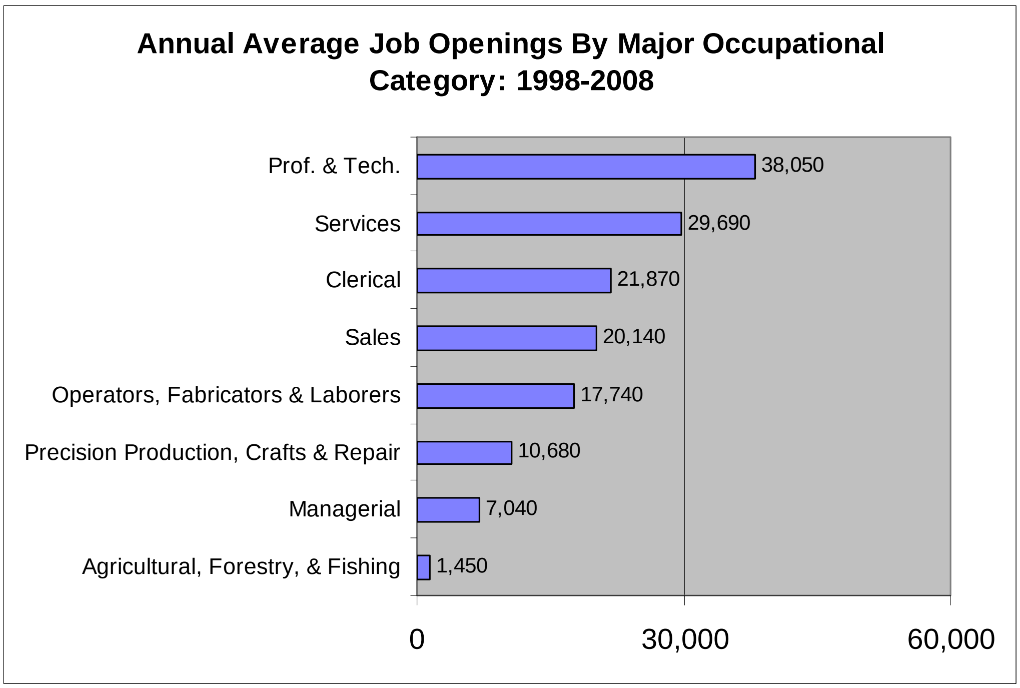

Figure 3:

Source: Projections 2008: New Jersey Employment and Population in the 21st Century, June 2000, NJ Department of Labor Market and Demographic Research.

These occupational categories include many sets of occupations that represent specific employee skills needs. For example, the top five occupations that will experience the greatest percentage growth between 1998 and 2008 are in science, engineering, and technology fields. In contrast, the occupations that are expected to decline are concentrated in industrial sectors (see Table 1).

Table 1:

State of New Jersey Occupations With The Greatest Percentage Change*, 1998-2008

	1998	2008	Change: 1998-2008		Annual Average Job Openings		
Occupation	**Number**	**Number**	**Number**	**Percent**	**Total**	**Growth**	**Replacements**
Computer Support Specialists	18,600	35,500	16,800	**90.4**	1,800	1,680	120
Systems Analysts	28,800	52,500	23,700	**82.0**	2,540	2,370	180
Computer Engineers	13,400	24,400	10,900	**81.2**	1,180	1,090	80
Medical Assistants	8,400	13,800	5,400	**63.9**	750	540	210
Home Health Aides	22,000	35,900	13,700	**61.8**	1,680	1,370	310
Social/Human Service Assistants	7,500	11,600	4,100	**54.0**	600	410	190
Teachers & Instructors, NEC	5,600	8,600	3,000	**53.3**	360	300	60
Dental Assistants	8,000	11,900	3,900	**48.0**	510	390	120
Telmktrs/Door Sales/Related Wkrs	24,500	34,500	9,900	**40.4**	1,620	990	630
Teachers, Preschool	9,600	13,400	3,800	**39.5**	590	380	210
Sewing Machine Opers, Garment	9,700	5,700	-4,000	**-41.7**	130	0	130
Word Processors & Typists	18,500	13,100	-5,400	**-29.4**	360	0	360
Computer Oprs, Ex Peripheral Eq	7,300	5,300	-1,900	**-26.7**	100	0	100
Bank Tellers	16,200	13,000	-3,200	**-19.8**	690	0	690
Switchboard Operators	6,800	5,500	-1,300	**-18.8**	150	0	150
Electrical/Electronic Assemblers	6,100	5,300	-700	**-12.4**	110	0	110
Crossing Guards	5,800	5,100	-600	**-10.7**	170	0	170
Insptrs/Tstrs/Grdrs/Smplrs/Wghrs	12,500	11,100	-1,300	**-10.7**	340	0	340
Payroll & Timekeeping Clerks	5,800	5,300	-600	**-9.5**	120	0	120
Parts Salespersons	6,100	5,600	-500	**-8.2**	170	0	170

Notes:
*1998 Employment of 5,000+
Totals may not add across due to rounding. Employment is rounded to nearest hundred. Percent changes based on unrounded data.

Job openings are rounded to the nearest ten.

Source: Projections 2008 New Jersey Employment and Population in the 21st Century. Vol. 1 Industry and Occupational Employment Projections for New Jersey 1998-2008. Part A (State Projections, July 2000) NJ Department of Labor Market and Demographic Research.

The occupations with the greatest percentage increase demand workers with advanced skill levels. As such, this shift in growing jobs corresponds to a shift in training requirements. Occupations that demand higher levels of education and more specialized higher-level training requirements are expected to grow at more than twice the rate of occupations that require lower educational training needs (see Table 2). In addition, the industrial factory jobs that will remain in the twenty-first century will demand more skills and education than previously required. As stated earlier, this reflects the need for workers to manage technology systems. For example, nationally, in 1959, only about eight percent of factory workers had attended college. By 1997, that figure has grown to 34 percent. Advanced skills training in technology, science, and process management is then essential for the New Jersey workforce.[6[6]]

Table 2:

New Jersey Estimated and Projected Employment by Education and Training Requirements, 1998-2008

	1998		2008		Change 1998-2008		Annual Average New Jobs		
Educational and Training Requirements	**Number**	**Pct.**	**Number**	**Pct.**	**Number**	**Pct.**	**Total**	**Growth**	**Replacements**
Total, All Occupations	**4,004,400**	**100.0**	**4,471,000**	**100.0**	**466,600**	**11.7**	**146,660**	**52,290**	**94,370**
Total High Requirements	**1,029,900**	**25.7**	**1,231,200**	**27.6**	**201,200**	**19.5**	**40,490**	**20,390**	**20,100**
First Professional Degree	62,900	1.6	72,900	1.6	10,000	15.9	2,020	1,000	1,020
Doctoral Degree	28,200	0.7	33,400	0.8	5,300	18.7	1,280	540	750
Master's Degree	41,700	1.1	48,600	1.1	7,000	16.7	1,590	720	870
Work experience plus Bachelor's or higher Degree	191,000	4.8	216,100	4.9	25,000	13.1	5,900	2,550	3,350
Bachelor's Degree	549,900	13.7	661,900	14.8	112,000	20.4	22,840	11,350	11,490
Associate's Degree	156,300	3.9	198,200	4.4	41,900	26.8	6,870	4,250	2,620
Total Moderate Requirements	**780,900**	**19.4**	**845,800**	**18.9**	**64,900**	**8.3**	**24,460**	**7,380**	**17,070**
Postsecondary vocational training	140,400	3.5	154,100	3.5	13,800	9.8	4,660	1,490	3,160
Work experience in a related occupation	356,800	8.9	385,700	8.6	29,000	8.1	10,620	3,280	7,350
Long-term on-the-job training	283,700	7.0	305,900	6.8	22,200	7.8	9,180	2,610	6,570
Total Low Requirements	**2,193,600**	**54.8**	**2,394,000**	**53.5**	**200,400**	**9.1**	**81,710**	**24,510**	**57,200**
Moderate-term on-the-job training	650,300	16.2	675,800	15.1	25,600	3.9	19,100	5,550	13,550
Short-term on-the-job training	1,543,300	38.6	1,718,200	38.4	174,800	11.3	62,610	18,960	43,650

Notes:

For "Total All Occupations" the "Average Annual New Jobs" will not equal annualized "Employment Change" since, for declining occupations, new jobs are tabulated as zero since no net job growth is projected, while the employment change is based solely on the difference between 1998 and 2008 employment totals. Note that occupational data include estimates of self-employed and unpaid family workers and are not directly comparable to the industry employment total

Totals may not add due to rounding. Employment data are rounded to nearest hundred. Percentages and percent changes are based on unrounded data.

Source: Projections 2008 New Jersey Employment and Population in the 21st Century. Vol. 1 Industry and Occupational Employment
Projections for New Jersey 1998-2008. Part A (State Projections, July 2000) NJ Department of Labor Market and Demographic Research

As a result of the economic changes, many experts agree that the labor force shortages that New Jersey employers faced throughout the 1990s will continue to persist during the first decade of the new century. These labor force shortages are inextricably related to the demographic makeup of the New Jersey workforce. The occupational shift from an industrial to an information-based economy has not been matched with a corresponding shift in skills training of the workforce. While this skills-

[6[6]] Carnevale, A. and Fry, R. 2000. *Crossing the Great Divide: Can we Achieve Equity When Generation Y Goes to College?* New Jersey: Educational Testing Service.

job disparity is most drastically felt in professional and technical specialty occupations, it is also characteristic of workers at lower levels of the occupational structure. As such, employers are finding it quite difficult to fill their job demands. A 1998 study conducted by the Council on Competitiveness found that 70 percent of American CEOs state that skill shortages among workers is the greatest barrier to the growth of their companies. Indeed, this Council identified an "acute skills shortage in every part of the country that threatens the foundation of American competitiveness."[7[7]] The workforce does not possess the skills necessary to keep pace with New Jersey's science and technology growth in all industrials sectors. Clearly, New Jersey will continue to experience the transformation from an industrial to an information economy. However, the success of this new economy will be predicated on the skills of its workforce. New Jersey's ability to hold on to its status as a leader in science and technology will be dependent on the ability to supply and retain educated skilled workers in science and technology.

The Status of Women in New Jersey's Economy

The changing base of New Jersey's economy has an impact on labor force participation by women. While New Jersey does not collect data that allows us to detail the occupational participation of women within the State, national data sources indicate that women are severely underrepresented in both science and technology jobs and educational programs. It is widely recognized by labor researchers that the inclusion of women in this field would have a drastic labor market effect. Peter Freeman and William Asprey, in *The Supply of Information Technology Workers in the United States,* state that if the number of women in the information technology workforce increased to equal the number of men, the huge demand for labor in these jobs could be met.[8[8]] It is then essential that policymakers address the status of women in the economy and, specifically, in nontraditional sectors and training programs, such as science and technology.

While women have made notable inroads in the workforce and educational training programs, significant barriers for women continue to persist. Although women comprise approximately 46 percent of the total American workforce, women fill only 19 percent of the science, engineering, and technology jobs,[9[9]] and women hold only 10 percent of the highest level information technology jobs.[10[10]] However, attracting women to jobs in science and technology is only part of the problem. Studies find that

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[7[7]] Council on Competitiveness. 1998. *Winning the Skills Race*. Washington D.C.: Council on Competitiveness.
[8[8]] Freeman, P. and Aspray, W. 1999. *The Supply of Information Technology Workers in the United States.* Computing Research Association: Washington, DC.
[9[9]] Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development. 2000. *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*. Washington, D.C.: National Science Foundation.
[10[10]] Sandy, M. and Burger, C. 1999. *Women and Minorities in Information Technology Forum: Causes and Solutions for Increasing the Numbers in the Information Technology Pipeline (The White Pages Report)* NSF: Virginia.

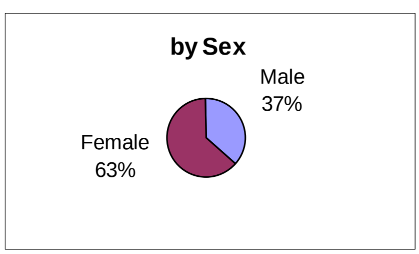
women leave these careers twice as frequently as men.[11[11]] As such, addressing issues of retaining women once they choose science and technology jobs is also needed.

While women have made advances into nontraditional fields, these advances have not been in the growing fields of science and technology and, instead, tend to be concentrated in declining industrial fields. Nationally, women continue to make up less than 25 percent of the labor force in many detailed occupations in science and technology (Appendix A). As the table indicates, the nontraditional jobs in which women have currently made the greatest inroads are in industrial goods production. These jobs are the ones that are projected to decline in the upcoming decade. For example, in 1999, women made up at least 20 percent of the workforce in: precision production occupations; printing machine operators; operators, fabricators, and laborers; precision inspectors, testers and related workers; metal and plastic processing machine operators; and non-construction laborers. However, women made up less than 20 percent in: drafting occupations; architects; data processing equipment repairers; electrical and electronic technicians; and surveying mapping technicians. Furthermore, women made up ten percent or less in: engineers; electronic, communication and industrial equipment repairers; and stationary engineers. These data illustrate that, and there is some irony here, women have advanced in nontraditional fields precisely at the points when the occupations are declining.

In addition, while women make up a growing percentage of college students, they are severely underrepresented in the academic majors that typically prepare workers with science and technology skills. For example, in 1999, women earned only 20 percent of the degrees in engineering and earned less than one-third of all degrees in computer science and physical sciences in New Jersey. Alternatively, women earned over 75 percent of all degrees in marketing, education, and library science.

The issue of women's participation in science and technology jobs and educational training programs is critical for New Jersey's economic success. Women are projected to account for two-thirds (or 63 percent) of the State's labor force growth by 2008 (see Figure 4). It is further predicted that this trend will continue through 2015.

Shares of Labor Force Growth by Sex, New Jersey, 1998-2008



[11[11]] Advocates for Women in Science, Engineering and Math. 1997. “Gender Equity and Mentorship in Science, Engineering and Mathematics”. http://www.awsem.com.

Figure 4:

Source: Projections 2008: New Jersey Employment and Population in the 21st Century, Vol. 2, Industry and Occupational Employment Projections for New Jersey, 1998-2008. Part A (State Projections, July 2000). NJ Department of Labor Market and Demographic Research.

In addition to increasing their labor force growth, women are making up a large portion of the State's college student population. Trends indicate that the number of white males entering college will decrease throughout the early part of this century. As such, women will continue to make up a significant portion of New Jersey's college population.[12[12]] It is essential to tap this potential labor source while still in an educational setting if the State is to succeed in the science and technology area.

New Jersey *Council on Gender Parity in Labor and Education's Mini-Conference "Gender Equity and Technology in the New Jersey Workplace: Setting the Agenda"*

Based on the preliminary findings and discussions among Council members, the New Jersey Council on Gender Parity in Labor and Education set forth to define the problem of gender inequities in science, math, and technology. The Council attempted to integrate both the educational and business aspects of this problem. The Council views these aspects as interrelated to the definition of the overall problem and proposed recommendations to address it. In doing so, the Council defined eight areas of inquiry:

1. *Gender Gap: Strategies to motivate girls to take science, math, and technology courses on K-12 level.*

2. *Bridging the Gap: Educational policy to ensure gender equity in science, math, and technology programs.*

3. *Closing the Gap: College programs to attract and retain women in science, math, and technology.*

4. *Gender Parity Partnerships: Enhancing school-business collaboration*

5. *Business Successes: Corporate programs to develop a technologically-trained workforce*

6. *Business Strategies: Attracting and retaining women in science, math, and technology jobs*

[12[12]] Carnevale, A. and Fry, R. 2000. *Crossing the Great Divide: Can we Achieve Equity When Generation Y Goes to College?* New Jersey: Educational Testing Service.

7. *Business Models: Technological training of certified and non-college educated workforce*

8. *On Their Own: Women entrepreneurs*

To help collect information about these areas of inquiry, the Council held a mini-conference, *Gender Equity and Technology in the New Jersey Workplace: Setting the Agenda*, to which it invited experts in science and technology fields from academia, business, and government. During intense roundtable discussions, conference participants brainstormed on issues of gender equity in relation to each of the topics. Each roundtable was charged with two main objectives: first, to define the issues and/or problems in reaching gender equity for its topic; and second, to present strategies, models, and resources to minimize, remove, or identify gender barriers for its topic. The first charge of the roundtable discussion helped the Council outline the issue of gender equity in science, math, and technology in New Jersey, while the second charge helped to inform the recommendations that the Council sets forth in this report. Thus, each roundtable discussion contributed to the overall framework that the Council used in this report to define and address gender equity in science, math, and technology.

The following represents a synopsis of the main problems and/or issues in reaching gender equity that emerged from each roundtable discussion.

Pre-College Education

Background

Ninety percent of the jobs in which kindergartners will be working when they reach adulthood do not yet exist.[13[13]] These jobs will require flexible analytical skills that have a strong foundation in science, math, and technological studies. It is imperative that all children receive such skills in order to be adequately prepared to enter into our workforce. However, girls are being turned away from science, math, and technology courses at a very early age.

The 1998 report by the American Association of University Women (AAUW), *Gender Gaps: Where Our Schools Fail Our Children*, highlights alarming disparities between boys' and girls' educational attainment in technology, technology related fields, engineering, and science. Specifically, girls are less likely to take high level computing classes in high school and currently comprise only 11 percent of those taking Advanced Placement computer science exams. Girls outnumbered boys only in their enrollment in word processing classes, what the AAUW termed the 1990s version of typing classes.[14[14]]

[13[13]] "The Facts About Women and Work"

[14[14]] American Association of University Women. 1998. *Gender Gaps: Where Schools Still Fail Our Children.* Washington, D.C.: AAUW Educational Foundation.

These gender differences in educational training are detrimental to girls' preparedness for our technologically driven labor market. The AAUW defines being technologically literate as possessing a set of critical skills, concepts, and problem-solving abilities to apply information technology in sophisticated and innovative ways. This allows for problem solving across disciplines and subject areas, and an understanding of the basic principles of computer programming and science. Using this definition, the study found that girls usually are not in educational programs where they can acquire these skills. Further, when they are in technology classes, they tend to be concentrated in computer “tools” courses - such as databases, page layout programs, online publishing, and productivity software. As a result, many girls do not qualify for the ranks of the technologically literate.

Exclusion from computer literacy courses is not the only challenge that girls face in the technology area. The report *Tech-Savvy: Educating Girls in the New Computer Age* finds that girls face additional barriers to technology such as masculine cultural stereotypes of the isolated male computer geek; computer games that are geared toward boys; and teaching methods that discourage interest in applied computer work. Perhaps one of the most important findings is the link between educational socialization and future occupational choices. *Tech-Savvy* researchers found that often when "gender equity" in computer technology appears in school curriculums, many times it translates in practice into programs in which girls mastered the computer "tools" of PowerPoint, Email, Internet Search Engines, Word Processing, and Databases. This has not worked in girls' favor. These skills are demanded in many of the low paying, traditionally female jobs in the Sales, Clerical, and Retail sectors. In contrast, women are significantly underrepresented in Information Technology jobs, Systems Analyst, Programming, and Software Design positions-- all of which demand technological literacy, not simply tool mastery.

Main Reasons for the Underrepresentation of Girls that were Identified by Mini-Conference Participants and Current Research

1. 1. There is a lack of attention to teacher training and certification in science and technology. Many teachers have some anxiety about technology and little knowledge about how to use it. In addition, many teachers do not possess the technical skills necessary to fully integrate technology into the classroom, and those that do have difficulty keeping their knowledge current.[15][15] Although a great deal of money is allotted to technology education, a very small percentage of that money addresses teachers' needs. For instance, during the 1999-2000 school year, approximately 5.67 billion dollars was spent on technology nationwide. Of that money, only 17 percent was spent on teacher training.[16][16] If teachers do not possess the skills in technology and science, they cannot encourage them in their students or act as role models in that respect.

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[15][15] Freeman, P. and Aspray, W. 1999. *The Supply of Information Technology Workers in the United States.* Computing Research Association: Washington, DC.
[16][16] “More Technology Training for Teachers.” November 22, 2000. *The New York Times.*

2. 2. Gender biases, defined as differential treatment based on gender, occur in many classrooms. Most commonly studies have found that boys may monopolize computer and science equipment without intervention by the teacher. For instance, the *Scholarly Communication Project* found growing evidence of biases in the classroom. In this study, researchers observed classroom interactions, and then interviewed teachers and students on their interpretations of the events. Researchers found that "…during classroom observations, the boys monopolized the computer tools. In focus groups conducted after the class, girls complained that boys often rushed to get supplies and made fun of girls trying to use the equipment. Further, the teachers allowed the boys to get away with it. Boys would criticize girls, resorting to stereotypes about girls' lack of skills."[17][17]

3. 3. Parents, teachers, and guidance counselors may subtly discourage girls from science, math, and technology. For instance, each time a teacher defers to a boy in the classroom to help with the computers or audio-visual materials, a negative message is sent to the girls in the room. In addition, socialization patterns continue to direct boys and girls onto gender appropriate career paths.

4. 4. Instances of sexual harassment occur in elementary and high school classrooms. The New Jersey Gender Equity Task Force, a forerunner of the Council, recognized sexual harassment as a gender barrier in education. In its report, *Balancing the Equation: A Report on Gender Equity in Education,* the Task Force found that sexual harassment significantly affects girls' experiences in all educational programs, but is particularly destructive in the nontraditional programs, such as science, math, and technology. Sexual harassment contributes to an environment of intimidation in these classrooms. After incidences of sexual harassment, girls often report that they will choose not to participate in science, math, and technology classes, clubs, after school activities, and eventually careers.[18][18]

5. 5. Gender harassment, although less publicly recognized, is quickly becoming a problem in many science, math, and technology classrooms. This refers to acts of verbal or physical aggression, intimations, and hostility, based on sex, but not involving sexual activity or language. The most prevalent forms of the harassment include teasing and bullying.[19][19] For instance, boys may make fun of girls or belittle girls' abilities in nontraditional classrooms. For example, the AAUW found that boys often refer to girls' femininity and appearance in computer science classrooms. This has the effect of making girls uncomfortable in these classrooms and distracts them from their work.[20][20]

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[17][17] Hitchcock, Corey. 1998. "Testing 1,2, 3; Technology to Girls: Hello?" http://www.sfgate.com/.
[18][18] New Jersey State Employment and Training Commission's Gender Equity Task Force. 1997. *Balancing the Equation: A Report on Gender Equity in Education.*
[19][19] Stein, Nancy. 1999. *Classrooms and Courtrooms: Facing Sexual Harassment in K-12 Schools.* New York: Teachers College Press.
[20][20] American Association of University Women. 2000*. Tech-Savvy: Educating Girls in the New Computer Age.* Washington, D.C.: AAUW Educational Foundation.

6. 6. Educational software and video games are geared toward boys. Most computer games and software packages are designed for men by men. They are geared toward traditionally male behaviors and activities. Specifically, these games and software packages are action packed, violent, sports oriented, and aggressive. The AAUW, in reviewing popular mathematics educational software used in kindergarten through sixth grade classrooms, found that only twelve percent of the characters were female or had female gender identifiable characteristics.[21[21]]

   Not only do women rarely appear in computer games and software, but when they do appear, they often are portrayed in very stereotypical and unhealthy ways. For instance, female characters tend to play passive traditional roles, such as the princess who must be saved by the male hero, as opposed to leadership roles. In addition, many female characters are physically portrayed in an unhealthy manner. A recent study of 24 of the top selling video games found that 85 percent of female characters were portrayed as having large breasts and unusually small waists and/or very thin bodies. In addition, 38 percent of female characters appeared in video games with a significant portion of their body exposed. Most commonly, researchers found that female video game characters tended to expose their thighs, stomachs, breasts and/or cleavage.[22[22]] This negative and unhealthy portrayal of women in video games may contribute to girls' overall rejection of video games.

7. 7. Girls face social isolation in science, math, and technology classrooms. Since many technology and science pursuits are directed to boys, girls find that when they choose to go against the "norm" and pursue nontraditional classes, they may feel like an uninvited guest. The AAUW reports that since girls are usually outnumbered in classes, they are unable to form peer support groups. These groups are essential to success in technology as they often encourage participation in advanced computer classes. Without a core group of girls in classes, female students are at risk for feelings of social isolation within the classroom.[23[23]]

8. 8. There are no core curriculum standards for technology education in New Jersey.

College Education

Background

Despite the need for workers with high-level technological skills, women make up only 15 to 20 percent of undergraduate computer science majors.[24[24]] These

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[21[21]] American Association of University Women. 2000*. Tech-Savvy: Educating Girls in the New Computer Age.* Washington, D.C.: AAUW Educational Foundation.
[22[22]] Children Now. 2000. *Girls and Gaming: A Console Video Game Content Analysis.* Oakland CA: Children Now.
[23[23]] American Association of University Women. 2000*. Tech-Savvy: Educating Girls in the New Computer Age.* Washington, D.C.: AAUW Educational Foundation.
[24[24]] Margolis, J., Fisher, A., and Miller, F. *Caring About Connections: Gender and Computing.* http://www.cs.cmu.edu.

percentages have actually decreased from the 1980s when women made up approximately 37 percent of computer science majors.[25[25]] Many experts attribute this decline to a change in the content of the computer science curriculum during the decade. Simply put, there was a movement away from word processing in the 1980s to computer programming and systems analysis in the 1990s. This movement shifted women out of the academic major, and men into it. Similarly, there has been a corresponding decrease in advanced degrees awarded to women from 1980s through the 1990s. In addition, women continue to earn an even smaller number of science and engineering degrees. The upshot is that women are not majoring in the academic fields in which there is a large future projected job growth and increased salary opportunities.

The New Jersey Commission on Higher Education recently recognized the gender disparity in technology and science workforce training in their *Fifth Annual Systemwide Accountability Report*. In this report, the Commission found that New Jersey colleges and universities have not been graduating a sufficient number of students trained in science and technology to fill the growing job demand. They found that entwined within this workforce issue was that, while both the labor force and the college population consist of a growing percentage of women, women are vastly underrepresented among science and technology degree recipients. As evident from Appendix B, there were differences in the educational attainment of New Jersey male and female college students in both degree level and academic major in 1999. In many cases these differences seem to reflect traditional gender socialization patterns. For example, the major with the highest percentage of women was Vocational Home Economics (95.2 percent female). In this major, the majority of the degrees were conferred at the Subbaccalaureate and Associate levels. Conversely, women received the lowest percentage of degrees in Engineering Technology (7.7 percent female) and Engineering (19.5 percent female). In these degree areas, students earned Bachelors, Masters, and Doctorate degrees, in addition to Subbaccalaureate and Associate degrees.

These findings demonstrate that, although there are some exceptions, generally women continue to graduate from gender-traditional educational programs. For instance, women earned over 75 percent of the degrees in Marketing, Education, and Library Sciences, all of which are traditionally associated with women. In contrast, only about one-third of all degrees in traditionally male fields (such as Computer Science, Physical Sciences, and Engineering) were earned by women. These are precisely the majors that are currently being heavily recruited for in New Jersey workplaces.

In academic fields where there is a more equitable overall distribution of men and women, there tend to be a considerably smaller percentage of women who graduate with the highest degree levels. For example, while women earned over half the degrees in the Life Sciences, overall they received less than 40 percent of the Doctorate

[25[25]] Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development. 2000. *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*. Washington, D.C.: National Science Foundation.

degrees. An even more noteworthy example is the field of mathematics. In this traditionally male field, women earned 51.9 percent of all the degrees conferred, yet they received only 9.1 percent of all Doctorate degrees. These very recent data demonstrate there are persistent gender differences in degrees awarded both within and between educational majors in New Jersey that continue to funnel women away from science, math, and technology fields of study.

As indicated in Appendix C, while there has been some improvement over the past decade, women have typically been underrepresented in computer science, engineering, engineering technology, mathematics, physical sciences, and science technologies from 1990 to 1999. In fact, over the ten-year period, the health sciences was the only science program in which women had earned an overwhelming majority of the degrees. However, the majority of these degrees were awarded in nursing and nursing specialties at the Associate, Baccalaureate, and Masters levels. In contrast, women earned less than 45 percent of the First Professional degrees in health sciences. These degrees are awarded in Medicine, Dentistry, and Pharmacy.

Main Reasons for the Underrepresentation of Women that were Identified by Mini-Conference Participants and Current Research

1. 1.   The academic environment in some science and technology programs is not friendly toward women. Women experience subtle forms of discrimination throughout their undergraduate and graduate careers such as: programming projects are designed for male students; a general devaluing of women's contributions by professors, especially attributing them to male students; hostile attitudes from a few male students; and classes that overwhelmingly use male language (for instance, "the user...he", or "suppose your wife"), and gender stereotyped examples. These cumulative behaviors can have negative effects on women's academic and career development by influencing their decisions to switch out of science, math, and technology majors or subspecialties within majors; minimizing the development of students' relationships with faculty members; lowering career aspirations and/or undermining women’s confidence.[26][26]

2. 2.   There is a lack of female mentors in colleges. Since women are underrepresented on science, math, and technology university faculties, it is difficult for female students to locate positive mentors. Many female students leave nontraditional majors because they were not able to form a mentoring relationship with a faculty member. This relationship is especially critical at the graduate level, where faculty mentors share with students information on research funding, avenues for publication, conferences, networking with other professionals, and potential opportunities for research collaborations. Such information is essential for success in graduate school and in helping to secure a professional job.

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[26][26] Pearl, A. Riskin, M. Thomas, B. Wolf, E. and Wu. 1990. A. “Becoming a Computer Scientist: A report by the ACM Committee on the Status of Women in Computing.” *Communications of the ACM*, 33:47-58.

3. 3. As a result of the lack of many female role models, many female college students are unaware of potential career options for women in nontraditional fields. Role models serve as evidence that a successful career in science and technology is not only a possibility but also a viable option for women. For instance, female faculty members prove by their very existence that obtaining a doctorate degree and a faculty position are possible. Similarly, gaining exposure to successful women in science and technology careers outside of academia increases female students' knowledge of the opportunities available to them in science, math, and technology fields.[27[27]] Of course, the largest barrier to female role models is that women are simply missing from science, math, and technology faculties and jobs. Women make up a small proportion of faculty in technical disciplines throughout the country, as well as in New Jersey. Thus, the potential pool of role models is quite small.

4. 4. Women who choose to major in science, math, and technology are more likely than their male counterparts to switch to a nonscience major.[28[28]] This "leak" in the pipeline is attributed to such factors as poor quality of teaching; inflexible curriculums; lack of role models and faculty advice; the competitive nature of science, math, and technology classrooms; and feelings of isolation.

Business

Women continue to hold a small proportion of science and technology jobs. We found that the underrepresentation of women in these fields is detrimental to both women and employers. Women who choose non-traditional careers can expect lifetime earnings of 150 percent more than women who choose traditional careers.[29[29]] In addition, corporations also realize that attracting women to nontraditional careers helps to create a competitive market advantage. A survey of Fortune 100 human resource executives found that diversity in the workplace brings about better utilization of talents, creativity, team problem solving, and increased marketplace and leadership understanding.[30[30]] This sentiment was echoed by William Wulf, President of the National Academy of Engineering, during a talk in which he clearly referenced the positive role of women in engineering jobs. As he states, "Every time we approach an engineering problem with a pale, male design team, we may not find the best solution. We may not understand the design options or know how to evaluate the constraints…there is a real economic cost to that. It is measured in design options not

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[27[27]] Pearl, A. Riskin, M. Thomas, B. Wolf, E. and Wu. 1990. A. "Becoming a Computer Scientist: A report by the ACM Committee on the Status of Women in Computing." *Communications of the ACM*, 33:47-58
[28[28]] Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development. 2000. *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*. Washington, D.C.: National Science Foundation.
[29[29]] "The Facts About Women and Work" http://www.academic.org/work.html.
[30[30]] Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development. 2000. *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*. Washington, D.C.: National Science Foundation.

considered, in needs unsatisfied…It is that a product that serves a broad…customer base may not be found."[31[31]]

Main Reasons for the Underrepresentation of Women that were Identified by Mini-Conference Participants and Current Research

1. 1. There is a lack of role models and mentors for women in science and technology careers. The Catalyst 1998 *Census of Women Corporate Officers and Top Earners* found that only eleven percent of all corporate officers were women. Further investigation of corporate officers who held senior research titles indicated only two women and 38 men.[32[32]] Clearly, women are underrepresented at the highest levels of industrial management. The glass ceiling that still operates in corporate jobs not only prevents women from reaching the top tiers of management but also contributes to the absence of senior level female role models and mentors. Role models and mentors are vital to women's self-image as legitimate members of the profession. Furthermore, workplace mentors and role models serve as a career link, which helps advance individuals through management careers. However, since women work in predominately male environments, it can be very difficult for women to find supportive mentors to help advance them through their careers.

2. 2. There is a lack of female friendly science and technology worksites. The research organization, Catalyst's study *Women Scientists in Industry: A Winning Formula for Companies*, among other studies, reports that women often leave science and technology jobs (and similarly may not enter them at all) because of the cultural climate of their workplaces.[33[33]] Many of the science, math, and technology workplaces do not provide an environment that is "female friendly." Central to a female friendly environment are formal and informal practices that promote a feeling among female workers that they are respected and valued within the company.

3. 3. Women experience exclusion and marginalization in science and technology firms. Many women feel that they are left out of the important decision making meetings and opportunities. They feel that these decisions occur in very informal and exclusionary settings, such as in hallway conversations, on the golf course and tennis courts, and in "invitation-only" meetings.[34[34]] As such women may feel they are not part of the organization and that their input is unimportant. This mentality of the "old boys club" is a long-standing tradition in science and technology jobs that has served to minimize women's roles in these organizations and justify their exclusion and marginalization.

[31[31]] Wulf, W. 1998. "Diversity in Engineering". *The Bridge.* 28:1-11.
[32[32]] Catalyst. 1998. *Census of Women Corporate Officers and Top Earners.* Catalyst: NY.
[33[33]] Catalyst. 1999. *Women Scientists in Industry: A Winning Formula for Companies.* Catalyst: NY.
[34[34]] Women in Technology International. 1997. *Business Impact by Women in Science and Technology.* WITI.

4. 4. Gender discrimination continues in pay and resources in science and technology jobs. Women continue to earn less than do men in comparable jobs. For instance, in 1999, women earned on average only 85 percent of men's salaries in the field of information technology.[35[35]] The gender wage gap contributes to women's overall feeling that their work effort is being undervalued. Furthermore, the MIT report, *A Study on the Status of Women Faculty in Science at MIT*, found that women have differential access to laboratory equipment, space, and resources.[36[36]] As women experience fewer labor market rewards because of their gender, they are more likely to leave these fields in pursuit of more equitable work environments.

5. 5. There are problems with integrating family and work responsibilities. Often, women feel that the greatest barriers to their success in information technology careers are long work weeks (50-60 hours per week), expectations to work late hours, and a high stress job environment.[37[37]] Fifty-four percent of mothers with infants under the age of one are in the workforce. In addition, an estimated 85 percent of women in the workforce will become pregnant at some point during their tenure. However, pregnancy and infant childcare are not the only family issues facing women. Women are twice as likely to stay home with a sick child than are men. Along with childcare responsibilities, many women provide care to older relatives and parents. It is estimated that it is women who will bear the burden of providing care for both their children and aging parents/relatives.[38[38]] Work-family integration not only requires companies to provide flexible work arrangements, on-site childcare, and parental leave policies, but also to move away from the cultural belief that women should be the primary caregivers in the family.

6. 6. Corporations often do not focus on the employee resource of displaced homemakers and women returning to the workplace. The report *Women and Minorities in Information Technology Forum* found that some information technology companies are tapping into many nontraditional sources of labor to fill in the job shortage. Common sources of workers are individuals who are pursuing second careers or are reentering the workforce.[39[39]] Often, these employees are enrolled in distance education and certification courses, employer training, and self-study. Women make up a large portion of the workers reentering the labor force. Many times these women are displaced homemakers and possess a general skill set that can be cultivated for a career in science, math, and technology. This creates a

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[35[35]]American Association of University Women. 2000*. Tech-Savvy: Educating Girls in the New Computer Age.* Washington, D.C.: AAUW Educational Foundation.
[36[36]] Committees on Women Faculty. 1999. *A Study on the Status of Women Faculty in Science at MIT*. MIT: Massachusetts.
[37[37]] Sandy, M. and Burger, C. 1999. *Women and Minorities in Information Technology Forum: Causes and Solutions for Increasing the Numbers in the Information Technology Pipeline (The White Pages Report)* NSF: Virginia.
[38[38]] New York State Alliance for Girls and Women in Technology. 1995. *Girls and Women in Technology: A call to action: Preparing girls and women for a technological workforce.* NYS Alliance for Girls and Women in Technology: New York.
[39[39]] Sandy, M. and Burger, C. 1999. *Women and Minorities in Information Technology Forum: Causes and Solutions for Increasing the Numbers in the Information Technology Pipeline (The White Pages Report)* NSF: Virginia.

potential pool of workers that needs to be recognized. However, much of the challenge surrounding the reentry of women into the science, math, and technology workforce involves changing women's perceptions of technology itself. For example, researchers find that since women are overrepresented in clerical jobs, they do not have the opportunity to understand the real potential of computers. Instead, for some displaced homemakers the computer is simply the next generation typewriter.[40][40]

[40][40] Corely, R. 1994. "Women, Technology and the Internet: How Will the Three Get Along?" Working Papers in Communication Technology and Culture. http//www.carleton.ca/~jweston/papers.corley.94

Conclusion

The Council on Gender Parity's mini conference, *Gender Equity and Technology in the New Jersey Workplace: Setting the Agenda*, and this report were undertaken to identify and highlight issues relevant to gender parity in New Jersey. The issues raised indicate that there are specific problem areas in linking women with educational and occupational opportunities in the growing fields of science and technology.

To that purpose the Council will be issuing a follow up report in the next few months which will chronicle best practices in education and industry, and will put forth recommendations to address the issues and barriers that women face in science and technology. This report will emerge from the Council's second conference, *A Women's Place: Her Role in the New Economy*.

Unless we address issues of gender inequity within our Science, Engineering and Technology labor force, we will not be able to compete globally. Women are expected to make up over half the workforce by 2020. If we do not address these issues now, when will we?