

**Gender, Science, and Technology in Higher Education and Research in Sweden:
Five Years after National Policies Implementation**

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Abstract

This report summarizes the gender, science, and technology reform in higher education and research in Sweden. Findings indicate that over the last five years the national reforms in higher education and research coupled with the gender equality reforms have dramatically increased entry of women into postgraduate programs and the production of women doctorates and licentiate in S&E in Sweden.

Sweden differs from the United States in its approach to gender, science, and technology in higher education and research, including having a national science and engineering workforce development policy that includes mandated targets for new student recruitment and degree production and new faculty recruitment in higher education, including targets for gender balance.

A. Introduction

In *A Leading Research Nation: on the Government's Research Policy*, published in 2000, Thomas Ostros, Swedish Minister of Education and Science, writes:

For Sweden to develop as a research nation, Swedish research must become better at assigning priorities and carving out its own profile in key research fields. It is also essential to invest in young, talented researchers; to keep raising the proportion of women at all levels in the research community; and to establish competitive and dynamic research environments. To develop the quality of Swedish research, encouraging both national and international mobility in the research community is vital¹.

This research policy is a response to counteract the large number of people in higher education now approaching retirement and to meet the needs for individuals with postgraduate education in academia, business, and government. High priority science and engineering (S&E) areas include the biological sciences and biotechnology, information technology and IT research, and materials science and material technology.

As indicated by this vision statement, the government recognizes that increasing the participation of women in all levels of the research enterprise is one of the key elements for making Sweden a leading research nation. Towards this end, in the mid-1990s the government developed and implemented national policies related to gender, science, and

technology in higher education and research. This report summarizes the mid-1990s gender policy framework and takes a look at the progress that Sweden is making in bringing about gender equality in higher education and research. This report also summarizes how Sweden's approach to gender, science, and technology differs from the United States.

B. The Policy Framework for Gender, Science, and Technology in Higher Education and Research in Sweden

Gender, science, and technology issues in Sweden are rooted in the 1970s and 1980s gender equality movement, national policies that require active efforts on behalf of both men and women. However, specific policies to increase the participation and advancement of women in higher education and research were not put in place until the mid-1990s. These bills include the Equality between Women and Men, 1994/95:164 and Science and Society, 1996/97:5 and are based on reports commissioned by the Committee for Equal Opportunity in Higher Education and Research and the Ministry for Education and Science, including:

- *Documentation and Evaluation of Projects for the Establishment of Equal Opportunity at Universities and Colleges in Sweden* (1994). This report examined higher education equality projects carried out from 1985 to 1992.
- *The Desire to Know and the Desire to Understand: Gender, Power and the Challenge of Women's Studies in Higher Education: Report on the Investigation of Contributions to Women's Studies and Research on Equal Opportunity* (1995)².

The above mentioned 2001 research policy reinforces the mid-90s gender, science and technology mandates.

Between 1995 and the present, government instructions and measures to promote equality between men and women within higher education and research are aimed at changing practices and cultures within universities, research councils, and government agencies. Both the mainstreaming concept and special measures are being used to bring about gender equality in higher education and research.

Since 1997, universities and university colleges have been mandated to:

- Increase the proportion of women students in the natural sciences and technology fields and men students in teacher training and nursing. New student enrollments and degree award percentage targets are set for women in both undergraduate education and postgraduate levels. An even balance is at least 40% of either gender³.
- Meet percentage targets, negotiated with the government, related to gender distribution of newly recruited professors, particularly in departments where gender participation is uneven. This means in cases where there is little or no difference

between the qualifications of competing applicants, preference should be given to applicants of the underrepresented sex⁴.

Recruitment targets were set for each institution for 1997-1999 and 2000-2004 and the overall goal is to have women represent 25% of the professoriate by the year 2008. In election of faculty, both men and women must be on the committee and at least one third of the suggested members must come from the underrepresented sex. Failure of universities to reach percentage targets may have financial consequences².

- Conduct pay equity reviews, including monitoring patterns of funding for postgraduate students.
- Provide annual progress reports to the Ministry for Education and Science related to meeting targets for students and professors.

Funds for measures have been provided by the government to ensure that universities attain these percentage targets. Measures include:

- Postgraduate studentships for women. These studentships are designed to increase the number of students who enter graduate school, particularly in research areas that include few women.
- Post-doctoral fellowships and guest professorships. Between 1995 and 2000, funds were available for doctoral fellowships and guest professorships for foreign female researchers within areas with few Swedish female researchers.
- Professorships. In 1995, the government created 32 full professorships (Tham-Professors) and the government, research councils, and universities shared funding of the professorships. Although men were allowed to apply for the Tham-professorships and could be given the job if no female candidate was suitable, after complaints, in 2000 the European court ruled the Tham-professorship to be unlawful^{2,5}.
- Changes in promotion policies for teaching positions in higher education institutions. In 1999, a new promotion policy was introduced to enable senior lecturers with the appropriate qualifications to be appointed as professors and for junior lecturers to be appointed to the position of senior lecturer, if suitably qualified.
- Development of 16 new research graduate schools in 2001, including one devoted to gender research. These new research schools are expected to award at least 25 doctorates by 2007 and thus produce 400 doctorates overall. Funds have been allocated for the enrollment of the first set of postgraduate studentships.

In addition to funds for higher education and research, resources were provided to continue gender research, studies, and professional development related to gender issues. In particular, a national secretariat and a national library for gender research were

established at Gothenburg University. Also, collaborative projects to increase the proportion of female engineers were funded.

From 1996-2001, a coordinating group on gender equality worked with the research councils to ensure equitable peer review and to provide gender equity professional development for staff and members of scientific boards within the council. Also, the 2001 research policy indicates that every higher education organizing postgraduate programs should provide courses in gender perspectives and the promotion of gender equality for research mentors⁴.

B. Findings on the Gender, Science, and Technology Reform in Higher Education and Research

This section of the report seeks to answer the question of how the gender, science, and technology reform is progressing five years after full policy implementation. Data and information collected is limited to data that could be found in English on the World Wide Web, including:

- Annual reports on Swedish universities and university colleges from the National Agency for Higher Education, a unit of the Ministry for Education and Science. Only the short versions of the annual reports are available in English³.
- Annual reports from selected universities in Sweden. The 2002 annual reports for the Royal Institute of Technology (KTH) and Chalmers University of Technology and the 2001 annual report for Lund University were reviewed. These institutions were selected because the annual reports included trend data or disaggregated data by gender about progress towards meeting their percentage targets in S&E.

KTH is responsible for one third of Sweden's capacity for technical research and training of engineers at the university level. In 2002 --- 11,503 full time students of which 1,490 are doctoral students were enrolled at KTH. Also this enrollment includes 7,641 postgraduate students. KTH has an architecture program and 14 engineering programs, double degree programs in engineering and teaching, 10 bachelors of science courses, and 14 international masters programs⁶.

With 35,000 students in 2001, Lund University is Swedish largest institution in higher education and research. Lund programs are included in Lund Institute of Technology (LTH) and other programs are in science, law, social sciences, medicine, performing arts, and arts and technology. Undergraduate enrollment in 2001 for LTH was 5,150 and for science it was over 1,600. Postgraduate student enrollment in technology was 832 and in science it was 444⁷.

Chalmers University of Technology had 8,750 students, of which 1,056 were doctoral students. Only 3.1% of students at Chalmers are in humanities and social sciences. Chalmers programs include a 3-year bachelors of science in engineering program and masters programs in architecture and engineering, as well as postgraduate programs⁸.

- European Commission reports, including the *Third European Report on Science and Technology Indicators* and *Women in Industrial Research: A wake up call for European Industry*^{9,10}.
- A joint U.S. Sweden focus group held at the 2002 annual meeting of the American Association for the Advancement of Science (AAAS). This focus group included presentations and participation by the Science Policy Advisor for the U.S. Swedish Embassy, college presidents from both KTH and Chalmers, U.S. women deans, faculty from both Sweden and the U.S., the head of the U.S. National Academy of Engineering, and representatives from Sweden and U.S. businesses, including a Vice President of a major U.S. business. Appendix A includes the agenda and participant list for the focus group meeting.

Using these sources information was compiled on women in undergraduate education and postgraduate programs and degrees awarded in S&E, as well as promotion patterns of women in the professoriate.

1. Undergraduate Education and Postgraduate Enrollments of Women in S&E

Sweden has two levels of higher education programs, undergraduate education and postgraduate programs. Undergraduate education programs include bachelors, masters, or professional degrees program. Postgraduate programs can lead to licentiate degrees or doctoral degrees. The licentiate degree is considered as the first stage in pursuit of a doctoral degree.

- **New women higher education students in S&E**

From 1995/96 to 2000/01, the percent of new women higher education students in Sweden has ranged from 56% to 59% (Table 1). Given the increase in the number of new students in higher education since 1995/96, the number of new women students in higher education has increased dramatically by a little over 78% (Table 2).

Information from two universities indicates a decline in the percentage of new women entering engineering undergraduate education programs.

At Chalmers, in 2002, the first year female enrollment in the bachelors of science in engineering program fell to 17% and the Masters of Engineering programs remained at 25%. Trend data indicated that the number of women increased in programs that already had a large proportion of women and fell in electrical engineering and computer engineering.

At KTH from 1999 to 2002, the percentage and number of new students in undergraduate education programs has decreased in every program except the Masters program (60

credits). Since 1999, the number of new women enrolled in this program has almost tripled (Tables 3 A and B).

- **Overall enrollment of women in undergraduate education programs in S&E**

Since 1995/96, the percent of women registered in all undergraduate education programs has ranged from 57% to 60% (Table 1). For women registered in engineering programs, the National Higher Education Agency reports a notable rise in the percent registered in shorter engineering programs (60 credits). Specifically, in 1990/91 only 16 percent of the students enrolled in the shorter engineering programs were women, and this has risen to 26 percent for the 2000/01 academic year. However, increases in the number of women in these programs appear to have reached a plateau.

At KTH, from 1999 to 2002, the percentage of women in the longer masters of architecture and engineering programs has remained around 30% and the percentage of women in the longer bachelors of science in engineering programs has remained at 24%. The percentage of women in all KTH undergraduate education programs has remained at 28%. From 1999 to 2002, the percentage of women in the shorter Masters program has increased by 140% and only by 10% in the longer Masters program (Table 4).

In 2001, at Lund University, of 5,150 students enrolled in undergraduate education programs in LTH, 27% were women. Of 1,600 students enrolled in undergraduate science programs, 25% were women. Compared to 2000, each of these programs had an increased enrollment of only 2%.

In 2002, women were about 30% of the undergraduate enrollment at Chalmers.

- **New women in postgraduate programs in S&E**

In 1999/2000, women were about 45% of new enrollees beginning postgraduate programs (Table 1). The proportion of women among first time postgraduate students in engineering was 26% and in natural sciences it was 40%.

At KTH, the proportion of new research students rose from 23% in 1999 to 33% in 2002. Thus from 1999-2002, the number of new women in research training courses increased by about 47%, from 75 to 110 and the total number of students registered increased by 10% (Table 5).

In 2002, at Chalmers, of 234 students admitted to the doctoral program, women were 26%. From 1998 to 2002, the number of women admits to the doctoral program has stayed in 60s, except for 2001 when it was 49. The proportion of women in doctoral programs is highest in chemistry, chemical engineering, environmental science, and architecture (Table 6).

- **Overall postgraduate enrollment of women in S&E**

The percentage of women active postgraduate students rose from 38% in 1995/1996 to 44% in 1999 and remained at 44% for 2000/01 (Table 1). Since 1995/96, this represents an increase of nearly 30% women postgraduate students (Table 2).

In graduate engineering programs in 2001, women represented 26% of the students. The largest proportion of women in postgraduate programs was found in medicine (58%).

At LTH in 2001, women were 26% of the doctoral students and at KTH women were 26% of the total number of registered students in research training programs in 2002. Since, 1999, this represents a 10% increase in the number of doctoral students in research training at KTH (Table 6).

In 2002, women were 25% of the doctoral student enrollment at Chalmers.

2. Degrees Awarded to Women in S&E

- **Undergraduate education program degrees awarded to women in S&E**

The number of undergraduate education program degrees awarded to women in all fields in Sweden increased from 58% in 1995/96 to 61% in 2000/01 (Table 1). This represents about a 32% increase in the number of undergraduate education degrees awarded to women since 1995/1996 (Table 2).

At KTH in 2002, of 543 bachelors degrees of science engineering awarded in the longer engineering program, women received 28% or 152 of these degrees. Given that the number of degrees awarded in this category was 256 and women represented 27% or 69 of the awards in 1999, the number of women awarded the longer bachelors of S&E degree at KTH has increased by 120% (Table 7).

In the masters of science in engineering program, women earned 30% of the 1,178 degrees awarded or about 353 of these degrees. This is pretty much the same number of degrees earned in 1999 (Table 7).

- **Graduate degrees awarded to women in S&E**

The most notable increases in degrees awarded to women are in the doctoral and licentiate categories. Licentiate degrees awarded to women increased from 30% in 1995/96 to 37% in 2001/2002 and doctoral degrees awarded to women increased from 32% to 39% (Table 1). Since 1995/96, for women this represents about a 92% increase in doctoral and 55% increase in licentiate awards (Table 2).

The number of degrees awarded to women in graduate engineering programs in all higher education institution for 2000/2001 was 24%. Reports from selected Sweden universities indicate that notable increases are taking place in the percentage of S&E postgraduate degrees awarded to women (Table 8A &B).

- At KTH, from 1999 to 2002, women were awarded 24% to 28% of the licentiate degrees and 19% to 25% of the doctorate degrees. In 2002, the highest percentages of licentiate degrees awarded to women were in engineering business management (42%), engineering physics (37%), chemical engineering (35%) and the lowest percentage was in engineering mechanics (5%). The highest percent of doctoral degrees awarded was in biotechnology (73%), chemistry (40%), and engineering/business management (38%) and the lowest percentages were in information technology (5%) and electrical engineering, electronics, and photonics (8%).
- At KTH women received 31 of the doctoral degrees in 1999 and 38 of the doctoral degrees in 2002. Since 1999, this represents a 22% increase in the number of doctoral degrees awarded to women. No change has occurred in the number of licentiate awarded to women (Table 8A and 8B).
- At Chalmers University of Technology, the percent of women awarded PhDs increased from 21.4% in 1998 to 29.2% in 2002. This represents an increase of 80.9% in the number of PhDs awarded to women. The percent of change for licentiate degrees from 1998 to 2002 was 61.5% (Table 9)

3. Sweden's degree production in the European Union

Data collected by the European Union Commission is reported using the International Standard Classification of Education (ISCED) categories 5 and 6 in S&E. Science includes natural science (life sciences and physical sciences—mathematics, statistics and computing). Engineering covers engineering and the engineering trade, manufacturing and processing, as well as architecture and building⁹.

The ISCED 1997 codes can be interpreted as follows: ISCED 5B is a tertiary level degree with practical, technical or occupational qualification. ISCED 5A is a tertiary level, theoretically based degree, which allows postdoctoral studies and prepares for further careers as researchers. Only ISCED 5A qualifies for ISCED 6, which comprises PhDs and other postgraduate diplomas.

Table 10 provides data on women graduates in tertiary education in the EU for International Standard Classification of Education (ISCED) categories 5 and 6 in S&E. In 2000, in the European Union, about 166,700 women graduated in S&E. Of this, women were 41.4% of all science, mathematics and computing graduates and 20.4% of all graduates in engineering, manufacturing, and construction graduates¹⁰.

In Sweden, women were 47.5% of the science, mathematics and computing graduates and 24.8% of the engineering, manufacturing, and construction graduates. Of all

European Union countries reporting data, Sweden had the third highest proportion of women graduates in science, mathematics and computing and the fourth highest proportion of women graduates in engineering, manufacturing, and construction.

Table 11 indicates that in terms of PhD degrees awarded to women in 2000, Sweden had the highest percentage of women PhDs in engineering, manufacturing and construction and the 7th highest percentage of women PhDs in science, mathematics and computing in the European Union.

4. Women Professors in S&E

The percent of women professors increased from 6% in 1990 to 14 percent in 2002. Part of this increase in women professors is due to the 1999 promotion reform in higher education institutions. Of 11,000 of these promotions to professors in 1999 and 2000, 18 percent were women.

In 1999, the percent of women professors in technology was 6.4% and in natural sciences the percent was 9.5% (Table 12). In 2002, at both KTH and Chalmers, women were about 7% of all professors.

The proportion of women professors, senior lectures, junior lectures and postdoctoral fellows with doctoral degrees has fluctuated between 1995/96 and 2000/01 from 21% to 32%, with a high of 32% in 1997/98 and a 2000/01 percentage of 25% (Table 13).

In addition, universities are monitoring pay equity for staff and faculty and funding patterns of postgraduates. In cases where pay or pattern differences have been found for women, appropriate steps are being taken to correct inequities.

5. Programs to Increase Women Enrollment in S&E

The technical preparatory year, has been offered at KTH, since 1992. This program provides upper secondary level courses in mathematics, physics, and chemistry for students who have not studied these programs in the secondary education system. Passing courses offered in this program guarantees students a place in the KTH undergraduate education programs. Of those who participated in the program, 30 percent continued into a Masters of engineering course and 20 percent continued into bachelors of engineering program. Although data was not provided on women transferees to the undergraduate education programs, of 413 students participating in 2001 and 2002, 29% were women (Table 4).

However information on gender in similar technical preparatory projects is provided in a study of seven gender-inclusive degree programs launched in 1995 at five Swedish universities. These programs are designed to broaden recruitment to male-dominated programs within higher education¹¹. Findings from this study indicate the following:

- Three of the seven programs were very successful in recruiting and retaining female students (*Scientific Problem Solving* at Göteborg University, *Energy and Environmental Engineering*, and *Innovation and Design*, both at Karlstad University). In these programs, the proportion of female students was high (about 40-50 per cent); the drop-out rates were evenly distributed between the sexes; the examination rates were high compared to national statistics; and they all had a high proportion of female awarded higher education degrees as measured in October 2000, five years after the implementation of the programs.
- Four of the programs were not as successful. One of the programs was closed down in 2000. The other three, all within the field of computer science and engineering, encountered problems in raising the proportion of women above the national average. One of the IT programs was successful in the early stages with 40 to 49 percent female participation but the proportion of women at dropped drastically in the later years. The drop-out rates were found to be higher among female students at all of the computer programs compared to the male drop-out rates, and the credit productivity among women showed a negative development. These programs also showed a negative development in the recruitment of female students and students from non-traditional student groups, whereas the other programs increased their proportion of such students during the five-year period.
- Another characteristic of the program that were successful in recruiting and retaining female students was that they offered “an open entry” to male-dominated study programs, including (a) getting acquainted with various subject areas, such as mathematics, physics, and environmental science/mathematical statistics, without having to choose a single subject from the start and (b) projects to work on in co-operation with their peers and tutors who could inspire them and show them what it could mean to work within the areas in question.

The data used in this study is from a survey of 1,494 students, covering all students entering the seven programs in 1995, 1996, 1999 and 2000. The study was also based on interviews with teachers and students at the respective universities, 20 teachers and 14 students, revisited five years after the implementation of the programs.

6. Recommendations from the Joint US/Sweden Focus Group

After the 1-1/2 day focus group meeting on gender, science and technology in higher education and research, participants made the following recommendations:

- Government, foundations, and businesses that provide grants to colleges and universities and boards of colleges and universities should require grantees to:
 - (A) Provide data on students and faculty disaggregated by race/ethnicity, gender within race/ethnicity, and disabilities in both grant applications and interim and final reports.

- (B) Provide gender, science, and technology diversity workshops for college and university leaders, including presidents, vice presidents, provosts, deans, and department chairs.
 - (C) Provide gender, science, and technology diversity workshops for faculty recruitment and selection committees and student recruitment and selection committees, particularly student committees at the postgraduate or graduate school levels.
 - (D) Include gender, science, and technology questions into student classroom surveys and student and faculty climate surveys.
 - (E) Incorporate diversity concerns into staff and faculty performance assessments.
- S&E businesses should treat and measure diversity as a bottom-line issue that drives product development and improvement and sales improvement.
 - Corporations should ensure that product design teams are diverse and that testing and user information from both women and men are included in both the product design and improvement process.
 - Professional S&E societies should provide regional and national forums on gender, science, and technology for policymakers, boards of higher education, and college and university leaders.

C. Summary & Conclusions

Sweden differs from the United State in its approach to gender, science and technology in a number of critical ways, including:

- Having a national S&E workforce development policy that recognizes that gender is an important element in building research and technology capacity.
- Implementing national policies related to gender, science, and technology.
- Developing a policy framework for higher education and research that includes mandated goals for recruitment of new students in the undergraduate education and postgraduate levels; new faculty recruitment; promotion policy for the professoriate; pay equity reviews; and annual accountability.
- Involving higher education boards in the planning and monitoring of the gender, science, and technology reform, as well as in setting targets for recruitment of faculty and students and degree production.

- Using government research funding to encourage higher education institutions to provide gender equality courses for faculty mentor.
- Connecting and building the capacity of gender researchers to evaluate program, practices and document the transformation that is going on in higher education and research.

Even with the downturn in the economy and human adjustment associated with radical changes, the gender, science, and technology reforms in higher education and research are moving in a positive direction. For S&E, the most dramatic changes are in the number of women entering postgraduate programs and earning licentiate and doctoral degrees. The increases in the doctoral degrees are particular important for women, since it can lead to the professoriate, where the number of women are very low. Universities leaders realized that if they are going to sustain this movement, they are going to have developed new ways to attract and prepare all students to S&E undergraduate education programs that prepare them to pursue doctoral degrees, particularly women.

Table 1 --- Number and (proportion of women) enrolled in higher education institutions and degrees awarded In Sweden

	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
New higher education students	66,330 (56%)	65,700 (57%)	64,510 (57%)	66,690 (57%)	70,100 (58%)	72,100 (59%)
Registered undergraduates	285,800 (57%)	300,380 (58%)	305,580 (58%)	310,140 (59%)	319,100 (60%)	300,800 (60%)
Undergraduate degrees	31,570 (58%)	35,000 (60%)	34,650 (60%)	36,450 (60%)	39,200 (60%)	39,700 (61%)
New postgraduate students	3,120 (40%)	3,390 (44%)	3,700 (44%)	3,200 (43%)	3,100 (45%)	3,200 (44%)
Active postgraduate students	15,580 (38%)	16,550 (39%)	18,500 (42%)	18,100 (43%)	18,100 (44%)	18,100 (44%)
Doctoral degrees	1,600 (32%)	1,720 (33%)	1,880 (32%)	2,120 (37%)	2,200 (39%)	2,400 (41%)
Licentiate degrees	825 (30%)	840 (33%)	850 (32%)	970 (32%)	1,000 (37%)	1,040 (37%)

Compiled from annual reports by the National Agency for Higher Educations

Table 2 --- Number and Percentage of Change for Women in Higher Education in Sweden

	1995/96	Number of Women in 1995/1996	2000/01	Number of Women in 2000/2001	Number and Percent of Change for Women from 1995/96 to 2000/2001
New higher education students	66,330 (56%)	23,868	72,100 (59%)	42,539	18,671 (78.2%)
Registered undergraduates	285,800 (57%)	162,906	300,800 (60%)	180,480	17,574 (10.8%)
Undergraduate degrees	31,570 (58%)	31,570	39,700 (61%)	39,700	24,217 (32.3%)
New postgraduate students	3,120 (40%)	1,248	3,200 (44%)	1,408	160 (12.8%)
Active postgraduate students	15,580 (38%)	5,920	18,100 (44%)	18,100	7,694 (29.9%)
Doctoral degrees	1,600 (32%)	512	2,400 (41%)	984	472 (92.2%)
Licentiate degrees	825 (30%)	247	1,040 (37%)	384	137 (55.5%)

Compiled from annual reports by the National Agency for Higher Educations

Table 3 A - Number of New Undergraduate and Proportion of Women by Discipline, 1999-2002 at KTH

Master of Science in Engineering and Master of Architecture. Degree program 180 credits								
	2002		2001		2000		1999	
	Total	Of which women	Total	Of which women	Total	Of which women	Total	Of which women
Architecture	104	57%	119	52%	93	65%	93	53%
Biotechnology	71	63%	68	69%	70	56%	37	59%
Computer Science and Engineering	171	14%	196	14%	154	13%	157	19%
Electrical Engineering	150	15%	179	13%	156	13%	290	17%
Vehicle Engineering	125	10%	149	12%	117	12%	127	18%
Engineering and Business Management	127	26%	132	23%	110	28%	110	33%
Information and Communication Technology	122	7%	206	16%	158	14%		
Chemical Engineering	76	63%	114	62%	119	61%	116	54%
Surveying	77	44%	105	55%	107	55%	93	54%
Mechanical Engineering	204	16%	269	21%	235	26%	224	29%
Materials Engineering	30	20%	44	32%	73	38%	108	30%
Media Technology	66	30%	75	43%	68	40%	33	48%
Microelectronics	37	24%						
Engineering Physics	132	16%	161	25%	136	31%	129	22%
Civil Engineering	78	23%	95	24%	123	28%	106	35%
Open entrance	100	28%						
Sub-total	1,670	25%	1,912	28%	1,719	31%	1,623	31%

Master of Science in Engineering/Teacher Training. Degree program 200 credits								
	2002		2001		2000		1999	
	Total	Of which women	Total	Of which women	Total	Of which women	Total	Of which women
Specialization IT/Computers	16	31%						
Specialization Mathematics/Physics	15	40%						
Specialization Mathematics/Chemistry	5	60%						
Sub-total	36	39%						

Sub-total 180, 200 credits	1,706	25%	1,912	28%	1,719	31%	1,623	31%
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Table 3 B - Number of New Undergraduate and Proportion of Women by Discipline, 1999-2002 at KTH

Bachelor of Science in Engineering. Degree program 120 credits.								
	2002		2001		2000		1999	
	Total	Of which women	Total	Of which women	Total	Of which women	Total	Of which women
Constructional Engineering			35	40%	38	16%	30	37%
Constructional Engineering and Design	98	34%						
Constructional Engineering and Economics			26	27%	30	20%	41	27%
Computer Engineering	120	12%	316	18%	268	16%	250	24%
Computer Engineering and Electronics	223	9%						
Electronics and Communication Engineering	38	21%						
Electrical Engineering			159	13%	267	15%	257	17%
Electrical Engineering and Economics			40	15%	40	28%	60	20%
Business IT Engineering	56	25%	71	30%	50	38%		
IT Engineering	46	9%						
Chemical Engineering	25	64%	33	58%	49	55%	49	69%
Mechanical Engineering	99	37%	91	30%	125	17%	141	21%
Media Technology	47	43%	54	50%	50	58%		
Mechatronics and Industrial IT Engineering	38	13%						
Sub-total	790	22%	825	24%	917	22%	828	25%
Masters Programs 60 credits	409	29%	273	27%	185	29%	142	30%
Technical Preparatory Year, Technical Preparatory Semester	437	29%	433	28%	416	29%	417	36%
Post Secondary Vocational Training	39	0%	63	8%	91	3%	56	16%
Total	3,381	25%	3,506	27%	3,328	27%	3,066	30%

Table 4 - Full Year Students by Number of All Students and Percent of Women 1999-2002 at KTH

	2002		2001		2000		1999	
	FYS	Of which awarded to women	FYS	Of which awarded to women	FYS	Of which awarded to women	FYS	Of which awarded to women
Master of Architecture, Master of Science in Engineering 180 and 200 credits	7,222	30%	6,917	30%	6,828	29%	7,043	28%
Bachelor of Science in Engineering 120 credits	2,307	24%	2,425	24%	2,408	24%	2,230	24%
Masters Programs 60 credits	419	25%	243	27%	184	25%	168	26%
Technical Preparatory Year, Technical Preparatory Semester	413	29%	413	29%	382	32%	388	38%
Post Secondary Vocational Training	70	4%	108	5%	108	10%	102	12%
Exchange Students	555	29%	453	31%	351	30%	335	35%
Other*	517	30%	298	32%	308	35%	365	30%
TOTAL	11,503	28%	10,857	28%	10,569	28%	10,631	28%
Of which Net University courses	73	26%						
Of which summer courses	118	30%						

*Further training, continuous education and continuation courses

Table 5 - Newly Accepted/Registered Research Students by Number and Percent Women, 1999-2002 at KTH

New Students Per Research Field	2002		2001		2000		1999	
	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women
Mathematics	12	25%	8	0%	12	8%	14	7%
Chemistry	13	54%	23	39%	20	40%	28	29%
Information Technology	41	15%	34	12%	37	14%	39	18%
Engineering Physics	22	32%	39	33%	19	26%	25	12%
Electrical Engineering, Electronics and Photonics	28	11%	24	17%	22	5%	38	11%
Chemical Engineering	28	71%	27	33%	34	53%	43	37%
Biotechnology	31	45%	17	29%	5	80%	18	61%
Engineering Mechanics	45	13%	64	16%	65	11%	43	9%
Materials Science	25	28%	13	31%	16	19%	24	17%
Civil Engineering and Architecture	26	42%	14	43%	32	28%	17	24%
Engineering and Business Management	55	38%	31	52%	26	23%	30	37%
Environmental Engineering	4	50%	6	33%	2	50%	1	0%
Engineering Science (other)	5	80%	6	50%			5	40%
Total New Research Students	335	33%	306	28%	290	23%	325	23%
Total Number of Students Registered	1,884	26%	1,906	24%	1,855	24%	1,853	24%

Table 6 – Number of Student Admits and Percent Women Admits at Chalmers University of Technology

	Number of Students	Number of Women	Percent of Women
1998	231	64	28%
1999	265	60	23%
2000	226	66	29%
2001	187	49	26%
2002	234	61	26%

Table 7 - First Degrees, 1999 to 2002 by Number and Percent Women at KTH

	2002		2001		2000		1999	
	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women
Degree of Master of Architecture 180 credits	68	54%	57	37%	101	49%	118	48%
Degree of Master of Science in Engineering 180 credits	1,178	30%	1,089	28%	1,275	25%	1,362	26%
Computer Science and Engineering	77	16%	76	24%	89	15%	78	9%
Electrical Engineering	172	17%	171	15%	198	14%	210	14%
Vehicle Engineering	82	17%	78	14%	95	12%	91	11%
Engineering and Business Management	57	30%	65	34%	42	31%	46	26%
Chemical Engineering	148	55%	97	56%	119	51%	141	58%
Surveying	81	58%	109	57%	139	45%	127	56%
Mechanical Engineering	283	22%	234	21%	269	16%	303	17%
Materials Engineering	60	40%	63	30%	66	44%	59	31%
Engineering Physics	92	25%	111	17%	102	22%	147	16%
Civil Engineering	126	33%	85	31%	149	23%	160	15%
Degree of Bachelor of Science in Engineering 120 credits	543	28%	430	26%	389	23%	256	27%
University Diploma in Engineering 80 credits	11	9%	16	13%	21	24%	38	37%
Degree of Bachelor of Science 120 credits	9	22%	12	25%	25	16%	94	15%
Degree of Master of Science 160 credits	109	30%	88	33%	104	36%	72	33%
Master Degree 60 credits	9	44%						
Master of Philosophy 160 credits	1	0%						
University Diploma in Applied Technology 60 credits	63	10%	74	4%	61	11%	46	20%

Table 8 A – Number of All Students and Percent of Women Awarded Licentiate, 1999-2002

Licentiate Degrees per Research Field	2002		2001		2000		1999	
	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women
Mathematics	4	50%	3	0%	7	14%	6	33%
Physics	1	0%	1	0%			2	50%
Chemistry	3	33%	1	0%	5	60%	8	25%
Information Technology	15	20%	13	0%	17	24%	19	16%
Engineering Physics	19	37%	14	29%	28	25%	5	40%
Electrical Engineering, Electronics and Photonics	9	33%	16	6%	13	31%	13	15%
Chemical Engineering	20	35%	31	26%	18	67%	16	56%
Biotechnology	4	25%	3	100%	2	0%	2	50%
Engineering Mechanics	41	5%	36	14%	44	11%	44	11%
Materials Science	13	15%	22	32%	14	14%	17	6%
Civil Engineering and Architecture	15	33%	17	18%	33	36%	23	30%
Engineering and Business Management	12	42%	12	58%	16	25%	6	17%
Environmental Engineering			5	40%	2	50%	3	33%
Engineering Science (other)			2	0%	1	100%	1	100%
Total	156	24%	176	23%	200	28%	165	23%

Table 8 B – Number of All Students and Percent of Women Awarded Doctorates, 1999-2002

Doctorates per Research Field	2002		2001		2000		1999	
	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women	Total	Of which awarded to women
Mathematics	4	0%	12	8%	8	13%	5	0%
Physics	2	0%	1	100%	3	33%	3	0%
Chemistry	15	40%	14	43%	16	44%	12	25%
Information Technology	20	5%	22	32%	17	6%	6	17%
Engineering Physics	17	12%	17	29%	16	13%	11	0%
Electrical Engineering, Electronics and Photonics	24	8%	20	5%	22	0%	23	9%
Chemical Engineering	19	21%	25	52%	16	44%	20	30%
Biotechnology	11	73%	14	29%	1	0%	15	27%
Engineering Mechanics	26	15%	33	6%	29	14%	25	8%
Materials Science	13	15%	10	30%	16	25%	15	27%
Civil Engineering and Architecture	7	29%	20	25%	16	31%	15	33%
Engineering and Business Management	16	38%	11	18%	10	30%	9	11%
Environmental Engineering	1	100%	3	33%			2	100%
Engineering Science (other)					1	100%	2	50%
Total	175	22%	202	25%	171	21%	163	19%

Table 9 - Number and Percent of PhDs and Licentiatees Awarded to Women at Chalmers University of Technology 1998-2002)

	1998	1999	2000	2001	2002	Number and Percent Change for Women 1998 and 2002
Number of all PhDs awarded	98	104	94	115	130	
Number of women PhDs	21	16	19	28	38	11 (80.9%)
% of women PhDs	21.4	15.4	20.2	24.3	29.2	
Number of all Licentiatees awarded	111	133	149	140	172	
Number of women awarded Licentiatees	26	31	40	36	42	16 (61.5%)
% of women awarded Licentiatees	23.4	23.3	26.8	25.7	24.4	

Chalmers Annual Report 2002) ISSN 0281-6629

Table 10 - Women graduates in tertiary education (ISCED 5 & 6) in the EU, by all fields, Science and Engineering, (absolute numbers and %) 2000

	Total (all fields)		Science, mathematics and computing		Engineering, manufacturing and construction	
	Number	%	Number	%	Number	%
EU	1,184,530	55.3	105,798	41.4	60,936	20.4
Belgium	38,121	55.9	1,510	30.1	1,716	21.7
Denmark	21,667	56.7	966	32.5	1,337	26.3
Germany	152,064	50.3	8,755	31.4	8,542	16.4
Spain	149,182	57.3	11,267	42.5	9,327	23.9
France	277,082	55.4	31,813	41.8	14,072	18.7
Ireland	23,133	55.1	4,556	50.3	930	17.2
Italy	106,555	56.0	8,718	55.0	8,179	27.5
Netherlands	43,006	54.2	1,162	27.5	1,039	12.6
Austria	11,855	47.5	656	35.2	840	14.9
Portugal	38,017	65.0	1,450	45.7	2,476	34.6
Finland	22,298	61.7	1,265	46.4	1,494	20.3
Sweden	24,739	58.4	1,969	47.5	2,192	24.8
UK	276,801	54.9	31,711	41.5	8,882	18.1

Source: Eurostat, UoE, including ISCED 5 and 6

Missing data: Greece

Not applicable: Luxembourg

France, Italy: 1999 data

Denmark: In 2000 no data for ISCED 6; indicator on basis 1999.

From Rubasamen-Walpmann, H., Sohlberg, Ragnhild, and Others. Women in Industrial Research: A wake up call for European Industry (2003). European Commission. Brussels, Belgium.

Table 11 -- Distribution of ISCED 6 women PhD graduates by broad field of study, (ranked by sum of importance of science and engineering fields), EU, 2000

Field/ Country	Science, math and computing	Engineering, manufacturing & construction	Health and welfare	Education and training	Humanities, arts & services	Agriculture and veterinary	Social science, business and law	Unknown or other
Belgium (Flemish)	50.7	7.0	24.9	.4	7.0	1.7	7.9	.44
Ireland	49.6	5.9	11.4	.8	19.9	1.3	11.0	.00
Belgium	46.2	5.9	20.3	.5	10.3	5.1	11.5	.26
France	44.2	5.7	7.4	1.4	21.6	.3	18.9	.54
Belgium (French)	39.8	4.3	13.7	.6	14.9	9.9	16.8	.00
UK	35.9	8.1	19.3	4.7	14.3	2.9	14.2	.63
Sweden	21.2	16.5	36.1	3.9	7.1	3.8	11.2	.18
EUIS	28.1	6.5	26.9	3.0	14.3	4.0	16.4	.90
Spain	29.3	3.6	22.9	4.5	13.7	4.0	20.3	1.82
Italy	19.1	13.4	27.1	.0	17.1	6.3	17.0	.00
Portugal	21.2	10.6	7.4	6.9	12.3	2.4	31.4	7.69
Austria	20.1	10.0	3.1	10.2	15.4	6.3	33.8	1.08
Denmark	18.2	11.7	34.2	.0	14.8	11.1	9.7	.28
Germany	21.7	3.0	43.1	2.0	11.8	5.1	12.6	.69
Finland	15.7	8.3	25.8	11.7	14.0	2.4	20.5	1.70
Netherlands	15.8	7.3	33.3	.0	10.5	8.2	24.9	.00

Source: DG Research, Unit C5

Data: Eurostat, New Cronos

EU 15: estimated, excludes Greece, Luxembourg

Denmark, France and Italy: 1999 data

Luxembourg and Liechtenstein do not have a complete university system. Most students study abroad

From Rubasamen-Walgmann, H., Sohlberg, Ragnhild, and Others. Women in Industrial Research: A wake up call for European Industry (2003). European Commission. Brussels, Belgium.

Table 12 - Number of Women and Men Professors and Percent of Women Professors by Research Areas (1999)

Research Area	Women	Men	Total	% Women
Humanities/Theology	84	273	357	23.5
Law	13	49	62	21.0
Social Sciences	66	369	435	15.2
Mathematics	2	72	74	2.7
Natural Science	34	325	359	9.5
Technology	35	510	545	6.4
Agriculture	25	124	149	16.8
Medicine	66	549	615	10.7
Odontology	5	47	52	9.6
Pharmacy/Pharmacology	1	11	12	8.3
Veterinary Medicine	3	22	25	12
Other	21	19	40	52.5
Total	355	2,370	2,725	13

Swedish Universities & Colleges, 1999. Short Version of the Annual Report, National Agency for Higher Education (ISBN-91-88874-61-3)

Table 13 -- Number (proportion of women) on staff in higher education institutions

	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Staff (FTE) at state, regional authority and private universities and university college	44,400 (53%)	44,750 (47%)	46,690 (47%)	47,610 (47%)	48,900 (48%)	49,300 (49%)
Teaching personnel	21,000	21,060 (34%)	21,800 (35%)	22,270 (35%)	22,800 (36%)	22,700 (37%)
Proportions of professors, senior lecturers, junior lectures and post doctoral fellows with doctoral degrees	51%	53%	53%	55%	55%	55%
Proportions of women professors, senior lecturers, junior lectures and post doctoral fellows with doctoral degrees	21%	31%	32%	24%	25%	25%
Proportion of women professors		10%	11%	13%	13%	14%

Compiled from annual reports by the National Agency for Higher Educations

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Appendix A

IGEPT 2002 Meeting Agenda Sheraton Boston Hotel 39 Dalton Street Boston, MA 02199 (617) 236-2000

WEDNESDAY, FEBRUARY 13, 2002

SHERATON BOSTON HOTEL/KENT ROOM

6:00pm – 8:30pm

Dinner

Welcoming Remarks

Yolanda S. George, Deputy Director, Education & Human Resources Programs, AAAS
Suzanne G. Brainard, Executive Director, Center for Workforce Development, University of Washington

Speakers

William Wulf, President, National Academy of Engineering
Anders Flodström, President, Kungl Tekniska Högskolan

THURSDAY, FEBRUARY 14, 2002
D

SHERATON BOSTON HOTEL/BACK BAY BALLROOM

8:00am – 9:30am

Breakfast/Overview

Shirley Malcom, Head, Directorate for Education & Human Resources Programs, AAAS

Opening Speakers

Sheila Widnall, Abby Rockefeller Mauze Professor of Aeronautics and Astronautics, MIT and Former Secretary of the U.S. Air Force
Kerstin Eliasson, Science Policy Advisor, Embassy of Sweden, Washington, DC

9:30am – 11:00am

Leadership Panel

Denice Denton, Dean of Engineering, Univ. of Washington

Britt Strandberg, Section Leader, Vattenfall

US Respondent: Alice Agogino, Roscoe and Elizabeth Hughes Professor of Mechanical Engineering, University of California at Berkeley

Sw Respondent: Gunilla Sterner, Head of Gender Equality Division, County Administrative Board of Stockholm

US Respondent: Jan Brown, Principal, JB Consulting

US Respondent: Cathy Lasser, VP, Business to Business Initiatives, IBM

11:00am – 12:00pm Breakout Session for Leadership

12:00pm – 1:30pm

Lunch

Eleanor Baum, Dean of Engineering, Cooper Union
Jan-Eric Sundgren, President, Chalmers University of Technology

1:30pm – 3:00pm

Engineering Design Panel

Cathy Lasser, VP, Business to Business Initiatives, IBM
Maria Kihl, Dept. of Communication Systems, Lund Institute of Technology

US Respondent: Judy Ramey, Chair of Technical Communication, Univ. of Washington

Sw Respondent: Maria Uden, LULEÅ University of Technology

US Respondent: Linda Ryan-Doolittle, Director, ibm.com Services

Sw Respondent: Erik B. Svedberg, Seagate Technology

3:00pm – 4:00pm

Breakout Session for Engineering Design

4:00pm – 4:45pm

Concluding Remarks

Tommy Block, Vice President & Operations Leader, Dow Chemical Company

Wanda E. Ward, Deputy Assistant Director (On-Detail to Council on Competitiveness),
Directorate for Social, Behavioral & Economic Sciences, National Science Foundation

4:45 – 5:00pm

Next Steps

Yolanda S. George
Suzanne G. Brainard

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February 13-14, 2002
Boston, MA**

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