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In 1997 the Natural Sciences and Engineering Research Council of Canada (NSERC), along with industrial and university support, created five regional Chairs for Women in Science and Engineering (WISE) to multiply efforts and increase visibility on issues pertaining to the attraction, retention and promotion of women in science and engineering fields. In addition to their professorial roles in science and engineering teaching and research, the five Chairs provide a strong voice on women in science and engineering issues from coast to coast. They are all involved in raising public awareness with respect to these issues as well as furthering society's knowledge by conducting collaborative and focused research. In addition, they are coordinating the development of targeted programs to address the low representation of women through the Chairs and in cooperation with other groups.

Dr. Elizabeth Cannon, a Professor in the Department of Geomatics Engineering at the University of Calgary, holds the NSERC/Petro-Canada Chair for Women in Science and Engineering (Prairie Region). Although



The five NSERC Chairs for Women in Science and Engineering who were appointed in the summer of 1997 met in Calgary recently for a joint planning session. They are: **Dr. Monique Frize, NSERC Chair for Ontario**, jointly appointed by University of Ottawa and University of Carleton, **Dr. Maria Klawe, NSERC Chair for BC/Yukon**, and Dean of Science at University of British Columbia, **Dr. Elizabeth Cannon, Prairie Region Chair**, and Professor at University of Calgary, **Dr. Claire Deschenes, NSERC Chair for Quebec**, and Associate Professor at Laval University, and **Dr. Mary Williams, NSERC Chair for the Atlantic Region**, and Professor, Memorial University of Newfoundland

her five year mandate is to encourage women to consider careers in all aspects of engineering and science, she places a special emphasis on the attraction to the geomatics field. The five broad objectives of her Chair are to:

- (1) Be visible and show leadership;
- (2) Provide a focal point for diverse groups working on women's issues in science and engineering;
- (3) Interest and encourage girls and women to consider careers in science and engineering;
- (4) Increase the enrollment of women in undergraduate and graduate programs in science and engineering in the Prairie Provinces, and;
- (5) Increase the retention rate of women in science and engineering careers.

An Advisory Council consisting of twenty-two members from academia, industry, and government was formed to develop the strategic direction of the Chair and to help disseminate information to the community at large. The activities of the Chair broadly fit into two categories, namely public awareness and program development. A third category on research was also added since there is not a full understanding of issues surrounding these goals. These three areas are intertwined and are used to direct work done in each area.

During the past 20 months, the Chair has given over seventy presentations to a number of groups including students (and teachers), community groups as well as industry and political leaders. In general, these presentations have consisted of specific presentations on the role of women in science and engineering, while others have been on engineering as a career or the Chair's research work in the area of the Global Positioning System (GPS). An important component of the presentation material is up-to-date statistical information on the participation and performance of females in science and math courses (in Junior and Senior High Schools), the enrollment of women in university-based programs (undergraduate and graduate levels), the participation, promotion and retention of women in industry, and results from research conducted by the Chair and others. It has been found that this type of information is critical to dispelling myths surrounding the participation of women in science and engineering, while gaining support for action. Over 5,000 people have attended presentations by the Chair to date. A web page has been developed (www.ensu.ucalgary.ca/cwse) containing information on the Chair goals and activities as well as statistical information discussed above, links to other relevant sites and a bibliographic database on women in science and engineering research.

Research will be carried out in the four areas identified as priorities, namely at the junior/senior high school level, university level, graduate student level, and pertaining to retention in industry. Two of these research projects have been initiated to date, while the other two will be started within the coming months. A research project entitled *Gender Differences in Student Participation and Achievement in the Sciences: Choice or Chance?* was started in January, 1999 with collaboration between the Chair and colleagues in Educational Psychology and Community Health Sciences. The three year project has the following objectives:

- I. To investigate the key personal and educational factors that contribute to junior and senior high school participation and high achievement in the sciences for males and females;
- II. To identify the factors that most directly contribute to decisions on the part of males and particularly females to pursue programs and careers in science and related disciplines;
- III. To explore roots of differences and similarities for males and females in early decisions about adult life-role and career choices, and;
- IV. To investigate parent/teacher/counselor influence on student participation in the sciences.

The study will consist of surveying an initial sample of 1500 grade 7 and 10 males and females in Calgary. This information, along with achievement data will be analyzed to examine the relationships between the factors of interest. A sub-sample of 100 average and high-average ability students in grades 7 and 10 will be identified to participate in in-depth interviews and further surveys at the beginning, mid-point and end of a two-year period. The significant support relationships of parents, teachers, and school counselors will also be investigated through a survey and interview.

A second research project entitled *Gender Differences in Academic Choices of Engineering Undergraduates* began in April, 1998 was recently completed with collaboration from colleagues in the Department of Sociology. The project objectives were to determine the key influencing factors for women and men to select engineering as a major in their university undergraduate program; and to further determine the factors for selection of an engineering specialization (i.e. geomatics versus civil engineering). A survey was developed and administered to 1066 men and women undergraduate engineering students at the University of Calgary in October, 1998. The questionnaire contained a number of questions relating to the students' interest, performance and perceived abilities in High School and University courses, the positive (and negative) factors that influenced them to select engineering, and factors which influenced their decision to select their engineering specialization.

A major finding of the study was that male and female engineering students are generally similar in terms of their academic performance, interests and perceived abilities in engineering and related subjects, and in their perceptions regarding the characteristics that make engineers successful. One area of concern is the role of high school physics for female students, because they reported significantly less interest and perceived ability, but similar performance levels, compared to male students. This pattern appears to carry over to the university level where female students also report significantly less interest and perceived ability in physics than their male counterparts.

Family members were found to play an important role in influencing students' decisions to major in engineering. This suggests that it is imperative to have outreach programs that are aimed at, or include, parents since they form an important positive component in students' overall decision-making process. Results show that half of the engineering students have a parent or other family member who is or was an engineer. Male and female students who had mothers or fathers who were in engineering were more likely to receive encouragement from their parents to select engineering compared to those who did not have a parent in engineering.

Participation rates of engineering students in extra-curricular science and/or engineering programs prior to entering university show that the majority of students did not partake in these initiatives. Since only a low percentage of students felt that these activities had a positive influence on their decision to enter engineering, this may indicate that these programs are not as important compared to other factors (e.g., parents, high school performance), or that they are not properly targeted. These findings do not suggest that these programs are not worthwhile, since they may have influenced students to take particular science and math courses in order to keep their career options open; however, they do support the need to evaluate the impact of any intervention programs that are implemented.

A number of programs are being piloted through the Chair to assist in the promotion and retention of women students in science and engineering undergraduate and graduate programs. These include a *Graduate Student Networking Group* for women graduate students to provide the opportunity to meet each other as well as women who are leading successful careers after obtaining a graduate degree. The *Graduate Education Opportunities Program* was developed to expose undergraduate women students to graduate studies opportunities. Women engineering students with average or above grades were identified and invited to a three hour session that consisted of (1) an introduction to the requirements and program content of graduate programs, (2) presentations by women who hold graduate degrees and are working successfully in industry, and (3) presentations by current women graduate students from each Department on their own research areas. A survey that was conducted at the end of the session indicated that the women students were significantly more interested in graduate studies as a result of the session.

Other programs that have been developed with colleagues in the Faculty include the Women in Engineering Day where approximately 140 Grade 10 and 11 female students are invited to the University to learn about engineering, to participate in hands-on activities and to meet practicing women engineers and faculty members, (2) the Women in Engineering Breakfast which brings together about 75 men and women from the engineering community for an update on the Chair activities as well as a presentation by a prominent woman engineer, and (3) 'Meet the Dean' night where women students entering the Faculty are invited to meet each other, Faculty members and the Dean of Engineering.'

The impact of the Chair at the University of Calgary will not be measurable for another few years, but to date there has been an increase in the representation of women in the first year engineering program to 24% which is one of the highest in Canada. In addition, the enrolment of women in geomatics (which is entered in second year engineering) has reached 34% from previous levels of about 20%.

For more information on the Chair for Women in Science and Engineering, please contact **Dr. M. Elizabeth Cannon** at cannon@ensu.ucalgary.ca.

Personalities



Agneta Ericsson is a Chief County Surveyor at the National Land Survey of Sweden. She got her Master of Science in Surveying and Mapping at the Royal Institute of Technology in Stockholm in 1973.

Through out the years she has been engaged mainly in cadastral issues e.g. in the development of the Swedish Land Data Bank System and the digital cadastral index map. During 4 years (from 1994-1998) Agneta was employed by Swedesurvey, a state owned company responsible for marketing the services and co-ordinating the activities of the National Land Survey of Sweden. At Swedesurvey she was responsible for Swedesurveys activities in Asia and Latin America.

As a member of the Swedish group of UN's HABITAT commission to prepare for the congress in Istanbul 1996, she initiated and participated in an international workshop on women's access to land that was organized in Gävle, Sweden in October 1995. Women from all over the world participated. The purpose of the workshop was to gather together a number of experts from different parts of the world in order to discuss and identify two fundamental questions "What are women's legal rights to land and settlement today?" and "What are the obstacles or mechanisms behind the fact that women have less control and management over land use than men?" The workshop resulted in a list of recommendations to ensure that women have the same rights to land as men. At the UN Habitat II Congress World Congress in Istanbul 1996, the need of security of tenure for women was highlighted.

Since 1994 she has been involved in FIG commission VII, first as the Secretary of "Working group cadastral systems in developing countries" (1994-1998) and now as the chairperson of the task force group regarding Women's Access to Land. The objectives of the Task Force Group are to advise land surveyors and make recommendations on how they can contribute in improving women's situation regarding access to land and security of tenure. Another objective is to elaborate a FIG guideline on Women's Access to Land and Security of Tenure.

Note: 10 Years German Working Group „Women in Surveying“ (AG FiV)

The next national Congress INTERGEO organised by the German association DVW will take place from 1st to 3rd September 1999 in Hannover, During this congress the DVW Working Group "Women in Surveying" (AG FiV) will celebrate it's 10 years anniversary. With a panel discussion concerning the different situations in Austria, Switzerland and Germany the AG FiV will pay attention on possibilities of women support. On the panel: Ms Gerda Schennach, Austria, Ms Käty Hofer Buser, Switzerland, Ms Gabriele Dasse, Germany; moderation: Ms Regina Kistermann-Stötzel, Germany.

For more details please contact the editor.

The Everyday Occupational Life in Natural Sciences and Engineering

A gender-related study on inner conflicts and how men and women try to solve them

by Dr. Renate Kosuch, FH Oldenburg, Germany

22 men and women, who work in high positions in traditional "male" occupational fields such as natural sciences and engineering, were intensively interviewed on their internal reactions to work-related incidents, that subjectively are seen as a problem.

**This is a short outline of the results, that were published in 1994.
The study is my Ph D. thesis.**

Female practioners in science and engineering show significantly more inner conflicts than men, while talking about problems that occur in the workplace. Asked for the most depressing difficulties, they name role conflicts (e.g. being an engineer versus being a women), powerlessness and personal insufficiencies. Men on the other hand mention their suffering from job-related constrictions, and suffering from competition and rivalry.



The inner conflicts of the male probands are more often related to situations where key qualifications are demanded (e.g. The inner conflicts of the male probands are communication, teamwork, management skills, social competence...). Women show significantly more inner conflicts in dealing with problems concerning their gender-role, feelings of being

excluded and solitariness. Men however significantly more often show inner conflicts when dealing with communication and competition in the workplace and when they talk about the tasks they have to fulfil (here inner conflicts show when work has to be organized, the person is being interrupted in the working process, or when dealing with a lot of routine work.)

All in all male practioners in science and engineering show inner conflicts exactly in those situations, where new skills are needed that no longer match the traditional job descriptions ("modern" skills, such as the key-qualifications mentioned above). Women, though, are more able to meet the needs of today's worksites.

The complexity of female role conflicts is one reason why women show significantly more conflicts than men. Even the sense of achievement is ambivalent for the women and is a source of inner conflicts. But these conflicts cannot be explained as being internal alone. The study can show that they have an external basis: when listening to the accounts of their male workmates, one realizes that women cannot meet their demands of a "female engineer who masters her job successful" because characteristics are conflicting (e.g. women have to improve the climate in the workplace, they should talk about other than job-related topics and "be different from us". They should not be competitive. At the same time they have to be a more male type of person ("be like us"), they should adapt and behave like everybody else. They should also be assertive.)

Male employees develop inner conflicts when dealing with female work-mates, who are of the same status or above. They have difficulties accepting a female boss as well as to accept female work-mates on the same level, even when their position is of the same status. The impacts of this are strong: Male colleagues with these inner conflicts are a real barrier to the integration of women into the traditional male dominated workplace. The different forms of attribution when trying to deal with or solve a problem are also a reason why inequity persists.

Patterns of problem solving weakens the self-confidence of women and lead to a lack of self-criticism of men. Altogether women significantly more often blame themselves, while men blame others or the circumstances. Men lack the ability to question their own behavior and there-

fore don't change as much as it is needed – not only to integrate women in male dominated professions, but also to meet the needs of employers. One example: Most of the interviewed men suffer from the competitive atmosphere in their surroundings. But the stories they tell show, how their own behaviour is a part of creating this atmosphere.

To question one's own behavior is an important and positive skill, because in the end it is only your own behavior you can change. This pattern of problem-solving weakens one's own self-confidence only if one fails to notice important external sources of problems such as discriminative behavior, as it happens to women in this study.

Gender-differences in central inner conflicts

What are the fears behind the fears? Women more often are afraid of loosing touch ("I could be lonely and abandoned, and that is the worst that can happen."). Men tend to fear the loss of status ("I have to hold my position in any case").

Women are still the one's in charge of family-work

How do work and other fields in life go together? Women always associated family work as opposite to their work, when asked this question. Men often talked about their hobbies when answering. Also other features show: men tend not to take their responsibility for reproductive work in the families. This is a strong barrier to the full equal rights of female practioners in science and engineering.

Theoretical background of the study

The theoretical background of this study is the Theory of Imperatives, a cognitive-emotive conflict theory, that was developed by Angelika C. Wagner, Ph.D., Professor at the university of Hamburg, Germany. It shows how a person gets into mental knots in thinking and feeling, when inner conflicts evolve from difficult situations. The theory offers a concept of how "knots in thinking and acting" arise and offers a well-tested set of steps how to resolve them.

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If you are interested to report about activities concerning under-represented groups in surveying, please contact the editor.

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