



3. Technology, the engineering profession and gender: a historical perspective

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This text is part of a series of publications on gender research and gender equality that has been produced by researchers at KTH as part of the efforts at KTH to integrate knowledge about gender equality, diversity and equal conditions in education. The purpose of the series is to disseminate, in an accessible way, knowledge from gender research in various subject areas that are relevant to students, doctoral students and teachers at KTH.

This text describes the way in which meanings of gender in organisations may be described, and how gender inequality is expressed in practice. This knowledge provides a basis for understanding the conditions for gender equality measures in working life and society. This section contains a presentation of theories and concepts that provide guidance in being able to perform an analysis of problems associated with gender inequality at organisation level. It also provides a background to change processes aimed at achieving increased gender equality and equality in organisations.

Certain things and certain occupations or work duties may be associated with either men or women. We sometimes refer to this as gender marking or gender coding. When it comes to different occupations, we can take the examples of preschool teacher and waste collector, the first of which is dominated by women, while the second is dominated by men. This dominance may make us think of a woman when we hear someone talking about the occupation of preschool teacher, and of a man if the occupation is that of waste collector. For certain occupations, a gender reference is even included in the title, e.g. fireman. There are also closely related occupations for men and women where it is unclear to most of us why we have two words for more or less the same occupation, e.g. tailor and seamstress.

Coding of occupations is a way of sorting and is a societal process that can take a long time. This may occur through the clarification of values and changes to the conditions for certain types of work. Advertising and popular culture are important arenas for such processes in a secular society, although religion and political ideology are also

important forums for discussions about what women and men can and should do. In order to be able to work towards gender equality, it is important to understand that it has to do with processes and that these roles may change.

History can do this particularly clearly. For example, Lena Sommestad has shown how the milking of cows and handling of milk in the old farming society was strongly coded as a work duty for women. Women took care of the cows and performed the milking, which was physically hard work involving a lot of heavy lifting. Dairymaids were muscular specialists in their field of work. When the dairy industry was mechanised and technology was introduced in the form of milking machines and other technological developments, the occupation was recoded and instead became a male occupation. Men were deemed to be better suited to the job of managing the machines, which meant, inter alia, that the heavy lifting disappeared from the work. The female dairymaid was thus replaced by the male dairyman.

Another example is that of numerical calculations. Jennifer Light has shown how dominant women were as mathematicians when it came to complex calculations prior to the arrival of computers. Her article is entitled *When computers were women*, and the title captures the author's point perfectly. In the infancy of the development of computers, there were still many women who coded computers, and their role was key during World War II. However, women were gradually replaced by men, and a strongly male-coded computer industry developed. In their studies of Great Britain, Mar Hicks has shown how the perception that women couldn't be managers meant that the computer industry got rid of the women and instead recruited men when it became obvious that the sector had potential to grow and there was a need for clear leadership and hierarchies.

Sometimes it appears to be difficult to recode occupations, or at least a very sluggish process. One example is the occupation of engineer, which has long been a male-coded occupation in Sweden. When it comes to certain types of positions and roles for engineers, this depends in part on the fact that they had a military background, and the military was an arena dominated by men. The word engineer is derived from the Latin words *ingeniare* (to design) and *ingenium* (cleverness) and was used, at an early stage, to denote a person in the artillery. The oldest engineering programmes in Swedish higher education were aimed at civil engineers, on the one hand, and mining engineers on the other. Both of these occupational groups had a history stretching far back in time, and they were strongly male-coded occupations. There were even laws that prohibited women from being in mines.

The education of engineers was structured and academised when KTH, the Royal Institute of Technology in Stockholm, received its current Swedish name of *Kungliga Tekniska högskolan* in 1877. At that time, the programme of education was intended for "young men who wish to pursue a technical profession", and the idea was that they

would be employed in the expanding Swedish industry that was in need of theoretically knowledgeable and practically skilled managers and leaders. In other words, it was perceived that these managers and leaders would be men, and a clear male culture was created at Sweden's technical universities, which manifested itself in different ways and in relation to the absent woman.

But back then, as now, not all women had the same interests, and there were women that applied to KTH despite the aforementioned strong male culture. The first time a woman applied to KTH was in 1892. We don't know who she was, but her application was rejected with reference to the wording of the statutes i.e. "young men". Not everyone felt that this was a good thing, and as early as the following year a change to the statutes was proposed by one of the professors at KTH, although this was dismissed by the board, whose members did not wish to see any change. However, a few years later, in 1901, the statutes were amended, as the words "young men" were changed to "those". Boel Berner, who has written in many contexts about the development of the occupation of engineer in Sweden, argues that this change was primarily made to also enable the admission of older men. At the same time, a formulation was added which meant that women could also study at KTH *subject to demand and availability*, although only as special students, and they were not allowed to take the final examination.

One woman who applied for admission as a special student was Agnes Magnell, and Boel Berner has described her path into KTH. She was admitted after completing an entrance exam in 1897. Prior to that she had studied at what we now know as the University of Arts, Crafts and Design (Swedish name: Konstfack), although at the time it went by the Swedish name "Tekniska skolan" (literally "The Technical School"). And earlier she had also attended a private school in the district of Östermalm in Stockholm, where she passed the Swedish university entrance examination of the time ("studentexamen"). This was because Swedish universities were not open to women at that time, and women were therefore forced to study as private students or attend private schools. Magnell also had social capital and was a relative of the civil engineer Carl Jacob Magnell, who would later become a professor at KTH and eventually the President of KTH in 1909. Agnes Magnell applied to the Department of Architecture and thus chose a technical area which, at the time, was deemed to be particularly suitable for women.

At this time there were strong notions regarding the types of occupations that women should have in the modernised Sweden. The subjects which were deemed suitable and "natural" for women, and which would not give rise to "serious drawbacks", were architecture, chemistry, chemical engineering, chemical metallurgy, physics and electronics. The Department of Mining Engineering, on the other hand, was not deemed appropriate, and one argument to support this was that the programme included a study trip during which alcohol and "courtship with the local ladies" were

involved, and consequently the programme was not deemed suitable for women. This is an interesting argument – the alcohol and courtship are not the problem, but rather the fact that women cannot participate in these activities.

From 1921, women had the formal opportunity to apply as regular students and thus also the opportunity to take the final exam and graduate as university engineer, a title that was formally adopted in 1915. One such student was Greta Westberg, later Woxén, who began studying electrical engineering in 1924. She graduated in 1928 and then worked at the Swedish Electricians' Federation's statistical department for three years. She married a fellow student and they had six children together, whereupon Greta stopped working to focus on her duties as a mother. This was a common pattern for women at the time. Perhaps less common was the fact that she later divorced her husband and eventually began working again as a teacher in mathematics, among other subjects.

After 1921, one might imagine that women would begin seeking admission in droves, but this was not the case. Anna Karlqvist's study shows that the percentage of female students at KTH continued to be very low for many years, and certain programmes had no women enrolled at all. The final programmes to admit female students were surveying (1959) and civil engineering (1962). In the latter case, this occurred when the internship requirement was removed from the programme.

The internship requirement had namely been a problem. From 1927 it was obligatory to undertake six months of internship as part of all programmes with the exception of chemistry, where the internship requirement was four months. This internship requirement remained as part of many programmes for a long time, although not as a requirement for admission, but rather as part of the education programme itself. As an entry requirement this meant – in practice – that women were prevented from studying, as they had great difficulty in gaining access to internship positions in the industry due to their gender. Yet another example of a similar form of discrimination was that advantages were available to applicants who could demonstrate that they had undertaken military service. As late as the 1960s, there was still a recommendation that those who applied to the aerospace engineering programme should have previously undertaken military service in the Air Force, an effective signal as to the type of student that was desired for this programme.

Between 1970 and 2010, the number of women studying at KTH increased from only a few hundred to tens of thousands. A look at KTH's statistics for 1997 shows that 30.6 percent of the admitted students were women. In 2020 this figure had risen to 32.1 percent. But there is an unequal distribution of women between the various programmes. Certain engineering programmes – biotechnology and media technology, for example – have a high numerical balance, whereas programmes such as computer science, IT, physics and electrical engineering are still male-dominated.

With regard to electrical engineering and aerospace engineering, the percentage of female students has actually halved between 1997 and 2020. Chemistry and architecture have long been programmes with an even gender distribution.

Even if we already understand and realise it, these figures tell us that women as a group are not uninterested in technology, which is something that has often been asserted in the repeated recruitment campaigns that have been undertaken since the 1980s. These are often designed to make girls and women interested in technology through various projects. In her research, Malin Nordvall argues that this approach is still used today, although with slightly different emphasis; these days, attempts are made to interest women in applying for a technology-related programme through the use of role models, ideally entrepreneurial role models. The idea is that women will be able to identify with someone (a role model) who has already completed a certain programme and will thus become interested in applying for the same programme. Nordvall argues that these campaigns reproduce the notion that women must be encouraged to become interested in technology-related programmes, and that this contributes to an idea of women and technology that is false and simply reinforces an existing misconception.

It is also important to think about what we actually mean when we use the term technology (teknik in Swedish), which has a very broad meaning and, like so many other words, changes in meaning over time as it is associated with new content, and as new names are given to different things. This discussion is different across languages as words seldom translate exactly. In US English for example, technology has almost totally replaced other words, like technique. In British English, and other European languages, technique is still used. In Swedish we use both “teknik” and “teknologi”, often interchangeably. This might have consequences. In the latest Swedish curricula for secondary and upper secondary school, technology – “teknik” - has been emphasised as an activity and skill, which has changed the meaning of the term in the Swedish educational context. And from the technique used by Charlotte Kalla and other top-class skiers to the development of the internet since the mid-1990s and modern-day references to information technology, there are many examples of contexts in which our use of the term has changed. The word technology – actually and originally knowledge about technique – is now often used in branches and sectors that we view as advanced. For example, we talk about high technology but never about low technology. By renaming a certain area or field, our associations regarding that area or field may also change. We associate the word technology with science, higher education and research, which has long been a male-dominated arena.

These days we also often talk about innovation when we actually mean technique, and in doing so we run a great risk of forgetting techniques that are old, as we associate innovation with something new. Needlework and sewing, for example, are extremely old techniques that women have often excelled at and been responsible for, even since

parts of the textile work have been mechanised by the development of the sewing machine. Yet we don't think of needle and thread as a form of technique. A similar example is that of baking and cooking, while beer brewing was also an occupation for women in certain cultures.

When we try to understand the relationship of women and men to technology over time, we must therefore be aware that the words and activities they describe have changed in meaning. During the 19th century, as well as earlier and later, women have undertaken activities that we now view as technical in nature. These activities were often referred to as arts and craft, although the word technology was also used in certain contexts. The Swedish word for art ("konst") appears in KTH's emblem, where it has long featured alongside the Swedish word for science ("vetenskap"). But the words art and science had other meanings in the 19th century compared with what we now mean when we use these terms today. Back then, the terms art, craft and technique were used almost synonymously in relation to various activities. We can think, for example, of words such as artificial, and of the fact that Chalmers University of Technology was long referred to in Swedish as "slöjdskola" (literally "handicraft school"). Back then the word science was also used differently than it is today, and primarily meant systematised knowledge.

In other words, it is important that we don't draw overly anachronistic conclusions and that we don't fall into the trap of thinking that change can only occur in one direction. As the statistics referred to above have shown, there have been both fewer and more women admitted to the various engineering programmes at KTH in recent times, so the trend has gone in both directions at the same time. And at one of the schools that was eventually restructured to form the present-day KTH, namely "Teknologiska institutet" (literally "Institute of Technology"), things looked very different in 1827. In that year, out of a total of 75 enrolled students, 34 were men and 41 were "unmarried or married women". In other words, the situation has been different before, and it can be different again.

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