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Shaping Engineers, Making Gender Politics

Swedish Universities of Technology and the Creation of a Policy Field, 1976–1998

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ABSTRACT

Despite a global reputation as a gender-equal nation, the labour market in Sweden is segregated. This particularly applies to engineering. Five decades of national gender equality policies and engineering recruitment campaigns have only partially transformed the situation. This thesis combines the study of two parallel and interlinked phenomena: the development of Swedish engineering education and profession and the evolution of a national gender equality policy field. It examines how the Swedish engineering profession – represented by the universities of technology – from the mid-1970s, responded to demands from both national policies and from within the engineering communities. The push to act went in two directions; national policies pressured universities of technology to take measures, and representatives from the engineering communities often shaped gender equality policies. How engineering educators steered definitions of gender equality and the corresponding solutions in directions that suited their professional needs are at the heart of the analysis here. Drawing on previously unexplored archival sources and interviews and deploying a theoretical framework of professional boundary work (Thomas F. Gieryn), the dissertation argues that the Swedish male-dominated engineering profession, represented by their technical universities, conducted *gender equality politics*. The study adds to an emerging international research field on the history of gendered engineering (e.g. Amy Sue Bix, Nathan Ensmenger, Laura Ettinger, Mar Hicks, Alice Clifton-Morekis, Londa Schiebinger, Karin Zachmann) and the Swedish historiography of national gender equality politics. It presents Swedish historiography on the gendered culture in engineering and national gender equality policy to an international audience.

Keywords: engineering profession, engineering education, gender equality, Sweden, recruitment logic, reform logic, STEM, boundary work.

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1
Introduction

> Problems associated with female engineering graduates' entry into the job market have often been reported to the Swedish Association of Graduate Engineers. Such problems should not, of course, exist in our modern age but we must, unfortunately, accept the fact that many issues have not yet been resolved. There also exists inequality in employment terms between men and women, e.g. relating to retirement. And several other problems exist as well.[1]

In September 1969 Alfred Nettelbrandt, a lawyer and Director of the Swedish Association of Graduate Engineers (*Sveriges Civilingenjörsförbund, CF*), proposed a new organisational body in the form of a women's council.[2] Nettelbrandt identified women as a steadily growing minority within his association and considered it necessary to address issues relating to the situation of female engineering graduates in the job market.[3] Despite this being the "modern age", many problems still required resolution. To safeguard the special interests of this minority group, the association was now in need of advice. Regardless of a few protests, in January 1970, CF launched a gender equality council (*CFs Likställighetsråd*) made up of ten hand-picked women with engineering degrees.[4]

At least three aspects in Alfred Nettelbrandt's proposal are worth noting. The first is the point in time. To twenty-first century readers it might come as a surprise that the long-term male-dominated engineering profession launched a formal initiative for gender

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[1] "Kallelse till Q-råd", 16 Jan. 1970, TAM-Archives, Swedish Association of Graduate Engineers' archive [from now on TAM, SAGE archive], F10Fa:2.

[2] "Punkt 13, Q-råd", Stencil 168/69, TAM, SAGE archive, F10Fa:2. Reference to the suggestion in § 82, CF board meeting (*förbundsstyrelsesammanträde)* minutes No. 7/69, 10 Sep. 1969, TAM, SAGE archive, A1a:12; M. Alfred Nettelbrandt, Projekt Runeberg, Vem är vem?, http://runeberg.org/vemarvem/sthlm62/0974.html, retrieved 12 April 2019.

[3] I will use male/female when there is a need to distinguish persons or groups who identify themselves or are identified by others, as men/women. See Ulrika Dahl, "Kön och genus, maskulinitet och femininitet", in *En introduktion till genusvetenskapliga begrepp*, ed. Anna Lundberg and Ann Werner (Gothenburg, 2016), 15–19. Engineering graduates refer in this thesis to engineers with an engineering university degree (in Swedish titled *civilingenjörer*).

[4] "Konstituerande sammanträde Q-råd", meeting minutes 21 Jan. 1970, TAM, SAGE archive, F10Fa:2; protest in § 23, CF executive council meeting (*fullmäktigesammanträde*) minutes No. 2/69, 27 Oct. 1969, TAM, SAGE archive, A1a:12.

equality at the end of the 1960s. It would be the first in a seemingly endless series of efforts to address inequality between men and women within the profession.[5] Although fields outside STEM (science, technology, engineering, mathematics), such as the care sector, medicine and the military, were also strongly gender-segregated, the STEM field gained disproportionately greater attention from the Government and funding agencies in the post-war twentieth century.[6] Efforts during late modernity have not managed to diversify the Swedish labour market. Formal barriers have been removed, but informal structures remain intact. Qualitative research has investigated the questions of how and why.[7] Historical processes interlinking national economics, industrialisation, labour market conditions and gender ideologies have created segregated areas of employment for men and women. Engineers and governmental bodies rarely consulted such sources of knowledge before launching new "gender equality" projects (*jämställdhetsprojekt*).

A second curious aspect of Nettelbrandt's proposal is that the trade union organisation, seemingly for the first time, recognised women as a group facing unique problems within the profession. Since the removal of formal barriers in the early twentieth century, women at technical universities and in the engineering workforce had been treated as rare individuals, even trespassers, who most likely would abandon their

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[5] On the long tradition of projects and their limited effect, historian Gunnar Qvist stated already in the 1970s: "[Why] has actual gender equality not been achieved in Western industrial societies despite a series of equality reforms and a multitude of equality slogans within political, union and non-profit organisations." UHÄ-rapport 1978:22, 9, quoted in Jakob Winther Forsbäck, *Med dubbla syften: forum för kvinnliga forskare, aktivism och statsfeminism 1975–1995* (Gothenburg, 2017), 75, footnote 150. Regarding engineering gender equality projects see e.g. Fredrik Palm, "Det är inte bara image – skäl till kvinnors bortval av ingenjörsutbildning", *NyIng report No. 15* (Linköping, 1999) and Cecilia Svantesson, *Tjejer till tekniska utbildningar eller tekniska utbildningar för tjejer?: projekt och initiativ med syfte att öka antalet tjejer inom tekniska utbildningar* (Linköping, 2006).

[6] Between 1985 and 1994, Swedish colleges and universities conducted 946 projects with the purpose to increase gender equality. About one third were located at technical colleges and universities. Most projects lasted one year or less. In Departementsserien 1994:130, *Kartläggning och utvärdering av jämställdhetsprojekt inom universitet och högskolor* (Stockholm, 1994), attachment "Inventering av jämställdhetsprojekt vid universitet och högskolor 1985–1994" (in Swedish National Archives, Archive of the Ministry of Education, E1A:4024, State Cabinet decision 16 Feb. 1995). See also Mia Heikkilä and Annelie Häyrén Weinestål, *Kartläggning och analys av jämställdhetsinsatser vid svenska universitet och högskolor 2000–2009* (Stockholm, 2009).

[7] Birgitta Jordansson, Line Holth and Lena Gonäs, "Genusarbetsdelning: Exploatering av kvinnors arbetskraft", in *Arbete: Passion och exploatering,* ed. Tuula Bergqvist et al. (Växjö, 2011); this thesis Chapter 2, sub-chapter "Gender Equality (Re-)Enters the Political Agenda".

professional careers when family and household duties increased.[8] In 1969 some of those in professional leadership no longer questioned the presence of women. Instead, the problems women were facing were acknowledged at the group level, i.e. as a structural issue.

Five decades later and compared to twenty-first century problems discussed among engineering leaders, Nettelbrandt's rhetoric appears progressive. Since the 1970s Swedish technical universities have launched countless projects to "attract more women", while failing to address the structural problems that exist. Such recruitment projects have been criticised for their one-dimensional focus on women's choices and for not recognising the masculine cultures and values inherent in the engineering and technology fields.[9] Meanwhile, national gender equality policies and legislation have developed, and the body of research on gender structures in engineering and society has grown. Despite this development, the quantitative framing of the issue from the side of the engineering profession has persisted. What's more, engineers have very limited knowledge of their own intense historical activity in gender equality efforts. The way the engineering profession frames gender inequality and its potential solution in the 2020s does not differ substantially from the way it was framed in the 1970s – the profession is still looking for what could be called a "gender fix" – a straightforward solution to a complex problem.[10] Why? A previously untested approach to answer this question is to examine how engineers have interpreted gender equality (*jämställdhet*) over time and how they historically have responded to national gender equality policies. That is the first part of what this study sets out to do.

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[8] Boel Berner, "Educating Men: Women and the Swedish Royal Institute of Technology, 1880–1930" in *Crossing Boundaries, Building Bridges*, ed. Annie Canel et al. (Amsterdam, 2000); Anna Karlqvist, *Från eftersatt till eftersökt: om kvinnliga studeranden på Kungl Tekniska högskolan* (Stockholm, 1997).

[9] Wendy Faulkner, "The Technology Question in Feminism: A View from Feminist Technology Studies", in *Women's studies international forum*, 24 (2001): 79-95; Palm, "Det är inte bara image"; Andreas Ottemo, "Rekryteringsarbete: Rådande utgångspunkter och alternativa strategier", *Proceedings från Den 2:a Utvecklingskonferensen för Sveriges ingenjörsutbildningar* (2009): 12-17; Andreas Ottemo, *Kön, kropp, begär och teknik: passion och instrumentalitet på två tekniska högskoleprogram* (Diss. Gothenburg, 2015), 32.

[10] Compare with the concept of "technological fixes", Lisa Rosner ed., *The Technological Fix: How People Use Technology to Create and Solve Problems* (Routledge, 2013); Sean F. Johnston, *Techno-Fixers: Origins and Implications of Technological Faith* (McGill Queen's University Press, 2020). For Londa Schiebinger's analysis of three gender policy fixes see this Chapter, sub-chapter "Three Fixes: Women, Institutions, Knowledge".

The study is, however, focused on a specific time and place in a unique context. The 1980s and 1990s are considered transformative decades in Swedish history – politically, economically and socially. Affected by the 1960s' intensified debate on gender roles and gender inequality, the governing Social Democratic Party established national gender equality policies starting from the 1970s.[11] Subsequent state cabinets developed and consolidated this new policy field. For decades Sweden has taken national pride in being an international forerunner in issues of gender equality, and has been celebrated as such. But what were the implications of this new policy field? The policies manifested themselves in labour market contexts. Parallel to reforms in economic and family policy enabling women to obtain "gainful employment", i.e. salaried positions outside the home, Swedish political leaders argued that the labour market needed to be transformed.[12] Not all sectors were given equal emphasis however; one stood out: the engineering and technology industry. Members of parliament, higher education bureaucrats and representatives from the field of engineering agreed that future employment – for men and women – would be found in the engineering and technology industry.

Increasingly, higher education was considered necessary for such positions. To Swedish gender equality advocates, universities of technology thus became the focal point in efforts to draw women into the labour market. National gender equality policies were built on a close yet not uncomplicated relationship between national political leadership and engineering representatives such as those at universities of technology. When the economic recession hit the Swedish economy in the early 1990s, the state cabinet saw higher technical education as the way out of the national crisis.[13] Gender equality policies, university expansion and reforming universities of technology became interlinked. Scholars in the field of women's and gender studies have highlighted the political processes leading up to the formation of the gender equality policy field in the 1970s (outlined below). Still, little effort has gone into empirical studies of those targeted by these policies. This thesis is the first serious effort to unpack the interplay between the Swedish gender equality policy field (*den svenska jämställdhetspolitiken*) and the engineering profession's development in the twentieth century's final decades. The study thus analyses two parallel, interlinked processes: the evolution of a Swedish gender equality policy field

[11] This thesis, Chapters 2 and 3.
[12] This thesis Chapter 3.
[13] This thesis, Chapters 4 and 5.

and the responses to this field by a high-status, male-dominated engineering profession. Phrased differently, it explores how the engineering profession did *gender equality politics*.

Market-oriented governance gradually replaced the formerly strong Social Democratic welfare state during the period in focus. Neo-liberal or corporate academia, New Public Management, marketisation and commodification are concepts commonly referred to in scholarly and public discourse.[14] The materiality of this transformation constitutes the immediate context of the events studied. The thesis thus transcends the object of the study – the engineering profession and university engineering programmes – and interlinks dreams of technological modernity, national economic growth and emancipation with university expansion and university reform. By exploring the co-construction of a core profession in Swedish late modernity and the policy field of gender equality, the thesis takes an empirical approach to deepen our understanding of a transformative period in post-war Sweden.

PREVIOUS RESEARCH

The study is positioned at the intersection of three research fields: the gendered history of the engineering profession, the Swedish history of gender equality politics, and gender in professions and professionalism. The first field, the professionalisation of engineers and its gendered history, was initially driven by US-based historians active within the Society for the History of Technology, SHOT, and its special interest group Women in Technological History, WITH, and has expanded since the 1970s.[15] It drew on feminist scholarship in the history of science and on feminist technology studies, further discussed below. In the twenty-first century, the field has become well-established in the European context and has begun spreading beyond the Global North in research focus and in authorship.[16] Swedish historians, sociologists and political theorists represent the second field, here summed up and categorised as the Swedish history of gender equality politics.[17]

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[14] E.g. Kjell Östberg and Jenny Andersson, *Sveriges historia. 1965–2012* (Stockholm, 2013), 358 ff.; Thomas Karlsohn ed., *Universitetets idé: sexton nyckeltexter* (Gothenburg, 2016), 30 ff.; Sven Widmalm, "Kun(d)skapssamhället", in *Det hotade universitetet*, ed. Shirin Ahlbäck Öberg et al. (Stockholm, 2016).

[15] See introduction and epilogue in Nina E. Lerman, Ruth Oldenziel and Arwen Mohun, eds., *Gender and Technology: A Reader* (Baltimore, 2003).

[16] See for example Francesca Bray's and co-workers' studies on the history of gendered technological work in China, e.g. Francesca Bray, *Technology, Gender and History in Imperial China: Great Transformations Reconsidered* (Routledge, 2013).

[17] Sub-chapter "The Proud National Label of Gender Equality" below.

In this broadly defined field, I include historical examination of the development of Swedish bureaucracy as well as research studies on how gender equality policies have played out in various gender-segregated organisations.[18] Finally, the field of gendered professions and professionalism stems from decades of sociological research on professional theory. It lends its theoretical perspectives to various disciplines.[19] The contributions to the first and second research fields are described in more detail below. The subsection entitled "Theoretical Framework and Main Concepts" details the third field.

Historiography of a Gendered Engineering Profession

Given the vast influence that engineering graduates have exercised in the building of the modern Swedish welfare state, the lack of studies on post-war engineering is notable. The research discipline of the history of technology is of course partly a history of engineering. Still, studies focusing specifically on the engineering profession are less frequent.[20] Moreover, according to historian of technology Svante Lindqvist, engineering *education* is a "blank patch" in the historian's mind.[21] Lindqvist has argued that this is not only the case for scholarship in Swedish contexts, but internationally as well.[22] A few Swedish

[18] Linda Ekström, *Jämställdhet - för männens, arbetarklassens och effektivitetens skull?: en diskursiv policystudie av jämställdhetsarbete i maskulina miljöer* (Diss. Stockholm, 2012); Ulrika Jansson, *Den paradoxalt nödvändiga kvinnan: könsdiskurser i Svenskt näringsliv - ett nyliberalt drama* (Diss. Karlstad, 2010); Anna Wahl, *Könsstrukturer i organisationer: kvinnliga civilekonomers och civilingenjörers karriärutveckling, 2. ed.* (Lund, 2003).

[19] For a review of the field, see Jeff Hearn, Ingrid Biese, Marta Choroszewicz and Liisa Husu, "Gender, diversity and intersectionality in professions and potential professions", in *The Routledge Companion to the Professions and Professionalism*, ed. Mike Dent et al. (London, 2016), 57–70.

[20] Studies by historians of technology analyse engineers to different extents but without professional analysis at the centre. See e.g. Mats Fridlund, *Den gemensamma utvecklingen: staten, storföretaget och samarbetet kring den svenska elkrafttekniken* (Diss. Eslöv, 1999); Per Lundin, *Bilsamhället: ideologi, expertis och regelskapande i efterkrigstidens Sverige* (Diss. Stockholm, 2008); Nina Wormbs, *Vem älskade Tele-X?: konflikter om satelliter i Norden 1974-1989* (Diss. Hedemora, 2003); Anna Åberg, *A Gap in the Grid: Attempts to Introduce Natural Gas in Sweden 1967-1991* (Diss. Stockholm, 2013).

[21] Svante Lindqvist, "Ideology and Institutional Structure: The Historical Origins of the Present Crisis in Swedish Engineering Schools", in *Universities and Sciences* (1993), 181.

[22] To some extent, the Tension of Europe series changed this, integrating the development of European engineering education. See Martin Kohlrausch and Helmut Trischler, *Building Europe on Expertise: Innovators, Organizers, Networkers* (New York, 2014). Historians of technology Amy Slayton and Amy Sue Bix have analysed the gendered and racial dimensions of US engineering education: e.g., Amy Sue Bix, *Girls Coming to Tech! A History of American Engineering Education for*

historians have engaged with the history of the engineering profession since the 1970s.[23] They have mainly focused on the formative years of the profession in the late nineteenth and early twentieth centuries.[24] Only a small number of them have addressed the gendered dimensions of the profession. The foremost example is sociologist Boel Berner's historical analysis of the masculine knowledge, pedagogy and homosocial culture that formed at the Royal Institute of Technology and Chalmers Technical Institute in the early twentieth century.[25] Berner has also studied the class aspects of engineering ranks and reflected on the conditions for women in engineering during the twentieth century. Her work is extensively outlined in Chapter 2 as it provides essential context and theoretical points of departure for this thesis. Anna Karlqvist's master's thesis on female engineers in the first half of the twentieth century and Katarina Ek-Nilsson's doctoral thesis focusing on engineers' autobiographies add to the otherwise limited gender analysis of Swedish early twentieth-century engineering.[26] Beyond the field of history,

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Women (Cambridge, MA, 2013); Amy Slayton, *Race, Rigor and Selectivity in US Engineering: The History of an Occupational Color Line* (Cambridge, MA, 2010). See also Rosalind H. Williams, *Retooling: A Historian Confronts Technological Change* (Cambridge, MA, 2003). On historical US engineering education reform see Atsushi Akera and Bruce E. Seely, "A Historical Survey of the Structural Changes in the American System of Engineering Education", in *International Perspectives on Engineering Education: Engineering Education and Practice in Context. Volume I*., ed. S. H. Christensen et al. (2015).

[23] Göran Ahlström, *Engineers and industrial growth: higher technical education and the engineering profession during the nineteenth and early twentieth centuries: France, Germany, Sweden and England* (London, 1982); Henrik Björck, *Staten, Chalmers och vetenskapen: forskningspolitisk formering och sociala ingenjörer under Sveriges politiska industrialisering 1890-1945* (Nora, 2004); Nils Runeby*, Teknikerna, vetenskapen och kulturen: ingenjörsundervisning och ingenjörsorganisationer i 1870-talets Sverige* (Uppsala, 1976); Bosse Sundin, *Ingenjörsvetenskapens tidevarv: Ingenjörsvetenskapsakademin, Pappersmassekontoret, Metallografiska institutet och den teknologiska forskningen i början av 1900-talet* (Diss. Umeå, 1981); Rolf Torstendahl, *Dispersion of Engineers in a Transitional Society: Swedish Technicians 1860-1940* (Uppsala, 1975).

[24] An exception is Carl Magnus Pålsson, *Ombyggnad pågår: Lunds tekniska högskola och ingenjörsrollens förändring* (Lund, 2003).

[25] Selected work by Boel Berner: *Teknikens värld: teknisk förändring och ingenjörsarbete i svensk industri* (Lund, 1981); "Kvinnor, kunskap och makt i teknikens värld", *Tidskrift för genusvetenskap* 3 (1982): 25-39; *Sakernas tillstånd: kön, klass, teknisk expertis* (Stockholm, 1996); Boel Berner, ed., *Vem tillhör tekniken?: kunskap och kön i teknikens värld* (Lund, 2003); "Educating Men". Chalmers gained its university status in 1937. The new English translation of the name became Chalmers Institute of Technology (*Chalmers tekniska högskola*), but Chalmers University of Technology was sometimes deployed. In the 1970s, the university management formally decided on Chalmers University of Technology (e-mail conversation with Folke Hjalmers). To avoid confusion, I will consistently use Chalmers University of Technology for events taking place after 1937.

[26] Katarina Ek-Nilsson, *Teknikens befäl: en etnologisk studie av teknikuppfattning och civilingenjörer* (Diss. Uppsala, 1999); Karlqvist, *Från eftersatt till eftersökt*; ongoing work by historian of architecture Isabelle Doucet, "Women in Architecture after 1968", Chalmers University of Technology.

anthropologists, ethnographers and organisational theorists have conducted occasional studies touching upon the gendered dimensions of Swedish engineering careers and workplaces since the 1980s.[27] Such studies to some extent result from the reforms at the technical universities analysed in this thesis.[28] With growing attention to gendered education and professions, universities of technology launched research programmes that would study the intersection between gender, technology, engineering and society. One outcome of such institutionalisation was an increase in scientific publications – journal papers as well as doctoral theses – on gendered science, technology and engineering. Chapter 5 returns to these transformations. It notes that the universities of technology did not build on this momentum to further develop the new field of study. The publications were primarily published in the late 1990s and the early 2000s. Gendered science, management, entrepreneurship and organisations gained some attention after 2000, but Swedish publications on gendered engineering – historical and contemporary – are few and far between.[29]

Besides filling a thematic and temporal void in historical Swedish research, this thesis presents Swedish historiography on the gendered culture in engineering and national gender equality politics to an international audience. It adds to a growing body of international, historical research that critically analyses the gendered dimensions of engineering professions and engineering education. The edited volume *Crossing Boundaries, Building Bridges: Comparing the Histories of Women Engineers 1870s–1990s* is a classic example of that field. In the book, European and US historians collected accounts of women's struggles to be able to participate in engineering education and the engineering profession starting in the mid-nineteenth century.[30] Since the late 1990s this research field has continued to expand. Monographs by historians of technology such as Ruth Oldenziel, Amy Sue Bix and Amy Slayton have examined the male, white and middle-class heritage

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[27] A selection: Ulf Mellström, *Engineering Lives: Technology, Time and Space in a Male-Centred World* (Diss. Linköping, 1995); Line Holth, *Den raka och den krokiga vägen: om genus, ingenjörer och teknikkarriärer* (Karlstad, 2015); Wahl, *Könsstrukturer i organisationer*; Olle Hagman, *Nollan blir nymble: passageriter på Chalmers tekniska högskola i Göteborg* (Gothenburg, 1984).

[28] This thesis Chapter 5, sub-chapter "Gender Analysis Enters the University of Technology".

[29] Selected studies after 2000: Helene Ahl, *The Scientific Reproduction of Gender Inequality: A Discourse Analysis of Research Texts on Women's Entrepreneurship* (Stockholm, 2004); Anna T. Danielsson, *Doing Physics - Doing Gender: An Exploration of Physics Students' Identity Constitution in the Context of Laboratory Work*. (Diss. Uppsala, 2009; Jansson, *Den paradoxalt nödvändiga kvinnan*; Ottemo, *Kön, kropp, begär och teknik*.

[30] Annie Canel, Ruth Oldenziel and Karin Zachmann, eds. *Crossing boundaries, building bridges: comparing the history of women engineers, 1870s-1990s* (Amsterdam, 2000).

of US engineers and the resistance women and African-Americans faced when applying to engineering universities.[31] Bix also examines the US and European movements parallel to the ones analysed in this thesis.[32] Historian Laura Ettinger and her team are working on an oral history project on the pioneering generation of US female engineers who graduated in the 1970s.[33] Alice Clifton-Morekis' dissertation examines engineering cultures and white masculinity at the Tennessee Valley Authority between 1930 and 1950.[34] Gendered histories of programming work, the branch of engineering which has so far been focused on the most by historians interested in the engineering communities' gendered dimensions, provide additional insights into engineering professionalisation processes.[35] In summary, the history of the gendered culture in engineering reveals women's and minorities' long-term participation in technical areas of work while simultaneously being excluded from the engineering profession in the Global North. In analysing the interplay between government and universities of technology, this study focuses on the people who have worked to reform the content of engineering education and to improve representation rather than focusing on the experiences of the marginalised female minority. As such, it approaches the engineering profession from a previously unexplored angle in Swedish research.[36]

Before moving onto the second research field, I will outline three themes intimately linked to the abovementioned field and that are of particular importance to this study. Firstly, feminist researchers in the field of science and technology studies have created the concept of *co-production* of gender and technology. Although the idea of co-production is

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[31] Bix, *Girls Coming to Tech!*; Ruth Oldenziel, *Making Technology Masculine: Men, Women, and Modern Machines in America, 1870–1945* (Amsterdam, 1999); Slayton, *Race, Rigor and Selectivity in US Engineering.*

[32] Selected work by Amy Sue Bix: "From 'Engineeresses' to 'Girl Engineers' to 'Good Engineers': A History of Women's U.S. Engineering Education*", NWSA Journal* 16, No. 1 (2004): 27–49; *Girls Coming to Tech!*; "Engineering Girls: The Evolution of Advocacy for Young Women's STEM Education", in *Growing Up America: Youth and Politics since 1945,* ed. Susan Eckelmann Berghel et al. (Athens, 2019); *Recruiting Engineer Jane and Astrophysicist Amy: American STEM Advocacy for Girls, 1965-2015,* fortcoming book.

[33] Laura Ettinger, Nicole Conroy, and William Barr II, "Then and Now: Women Engineers' Perspectives on Changes and Challenges in the Field Since the 1970s", *Society of Women Engineers Magazine* 64, No. 2 (2018): 68–73.

[34] Alice Clifton-Morekis, see personal profile at Georgia Tech webpage.

[35] Sub-chapter "Theoretical Framework and Main Concepts" below.

[36] Regarding the US, see two decades of scholarship by Amy Sue Bix (footnote 32 above). For a US account of a movement similar to the Swedish "MTS-movement" (this thesis Chapter 5) see Matthew H. Wisnioski, *Engineers for change: competing visions of technology in 1960s America* (Cambridge, MA, 2012).

not explicitly deployed in this thesis, their analysis is critical in making sense of discussions of gender and technology among engineering educators in the period studied.

Making Technology Masculine

A key aspect of historical discussions of gender inequalities in engineering education has, not surprisingly, been the issue of technology. What does technology mean to engineers, to the general public, to men and to women? Can it be interpreted in more than one way? Questions like these were at the centre for advocates of gender equality in engineering degree programmes during the period studied in this thesis. A sub-field within science and technology studies (STS), has combined feminist research, where gender is understood as the social construction of masculinities and femininities, with SCOT analysis from the STS field, and created the concept of *co-production* of gender and technology.[37] This sub-field is often referred to as feminist technology studies or FTS. A co-production approach facilitates the exploration of two parallel processes. Industrial machinery is made masculine in the first process, while technical equipment such as sewing machines, washing machines and vibrators are coded as feminine. The latter items have historically been excluded from technological discussions.[38] In the second or opposite process, masculinity is intrinsically bound to technology, while femininity by definition excludes technological skills or interest.[39] When something or someone is referred to as feminine, other skillsets than technological ones are associated with it/them, such as caring or aesthetic skills. Gender is thus constructed in line with technology; technology is constructed based on gendered ideas. In times of social change, people alter

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[37] SCOT = social construction of technology. Francesca Bray, "Gender and Technology", *Annual Review of Anthropology* 36, No. 1 (2007): 37–53; Faulkner, "The Technology Question in Feminism"; Lerman et al., introduction in *Gender and Technology*; preface to Rachel Maines, *The Technology of Orgasm: "Hysteria," the Vibrator, and Women's Sexual Satisfaction* (Baltimore, 2001). See also Catharina Landström, "Queering Feminist Technology Studies", *Feminist Theory* 8, No. 1 (2007): 7–26.

[38] Ibid. (Lerman et al.); Katrine Marçal, *Att uppfinna världen: hur historiens största feltänk satte käppar i hjulet* (Stockholm, 2021).

[39] E.g. Lena Sommestad, "Att skapa genus: Teknik och kvinnlighet i svenska mejerier", *Dædalus* 61 (1993): 30–52; Ulf Mellström, *Män och deras maskiner* (Nora, 1999); Nathan Ensmenger, "'Beards, Sandals, and Other Signs of Rugged Individualism": Masculine Culture within the Computing Professions', *Osiris* 30, No. 1 (2015): 38-65; Marie Hicks, *Programmed Inequality: How Britain Discarded Women Technologists and Lost its Edge in Computing* (Cambridge, MA, 2017).

the way they relate to the material world, and in times of technological transformation, we should expect to find new ways of constructing gender.[40]

A now classic example of a study exploring such shifts is historian of technology Ruth Oldenziel's monograph *Making Technology Masculine: Men, Women, and Modern Machines in America, 1870–1945*. Oldenziel points towards the relatively recent rise of the concept of technology. She explores how the concept of technology came into being, was made masculine and was produced as what she calls a "modern male myth" along with the second wave of industrialisation in the US.[41] Technology became the overarching label that signified the new world of large technological systems – railways, telegraph systems, canals and electrical power grids. In this sense it included some but excluded much of what had previously fallen under the label of crafts or the "useful arts", for example, technical work that included jobs done by others than white middle-class men, such as blue-collar workers, Native Americans and women.

This myth continues to shape the making of technology, the images it produces and its uses. It shapes people's perception of what technology is, can be and who it is for. It shapes the industry and the engineering profession, and, of particular importance for this study, it shapes engineering education. Technology was at the centre of gender equality discussions at Swedish universities of technology in the 1980s and 1990s. The content and definition of technology were taken for granted by some and debated and redefined by others. In contrast to discussions about technology, gender was discussed to a lesser extent. Due to professional ideals, standards and norms, qualitative gender analysis of the field of technology and engineering was neglected by the engineering majority.

Curricula, Student Culture, Inertia

The Swedish higher education is part of the Swedish university system. At the same time, it is a distinctly separate and unique educational system, intimately linked to Swedish industry. The history and structure of this system is elaborated in Chapter 2. The engineering curriculum has not been free from opposing views, but nevertheless stayed surprisingly intact. Following historian of technology Arne Kaijser, I will refer to the reform struggle as a curricular battlefield.[42] That battlefield is critical to explaining the

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[40] Ibid.; Lerman et al., introduction in *Gender and Technology*.

[41] Oldenziel, *Making Technology Masculine*, 10–11. See also Leo Marx, "Technology: The Emergence of a Hazardous Concept", *Technology and Culture* 51, No. 3 (2010): 561–577.

[42] Arne Kaijser, "Ingenjörer i takt med tiden?", in *Vad är en ingenjör?*, ed. Ingela Björck (Linköping, 1998), 43–44. Kaijser uses the concept *kampen om schemat*.

reform inertia identified in this study. Kaijser suggests that the curricular battlefield is the primary reason for the lack of significant change since engineering education was institutionalised as a university degree in the late nineteenth century. The substantial number of stakeholders – or professional sub-groups – in Swedish engineering education caused a stalemate in curricular reform. The stability of the curricula at universities of technology resulted from the interest shown by four different stakeholders who, based on their positions and sentiments, invested in the existing structure. The four groups – employers, university educators, students, and professional and industrial organisations – strongly influenced the structure and content of curricula.

There has been discord within and among these groups. According to Kaijser, the employers – a group that encompasses a wide variety of actors, including industry, government agencies, schools and universities of technology – have expressed diverging opinions on which knowledge and skills an engineer should possess. Although government agencies and municipalities were still the largest employers of engineers in the 1990s, industry lobbyists made much more noise. University educators, the second group, have a financial interest and sense of status connected to the specific subjects they teach. Chapters 4 and 5 in this thesis illustrate how reform projects clashed with professors' personal preferences. A conflict among teachers which traces back to the mid-nineteenth century and the establishment of formal Swedish engineering education relates to the distribution between "pure" and "applied" science subjects, or, the relationship between the "mechanical" – or the "useful" – arts and science subjects.[43] Svante Lindqvist notes that an internal logic determines which essential core subjects are to be part of an engineering degree.[44] Similar to Kaijser, Lindquist emphasises the stability over time and across Europe and that there are "striking similarities between the curricula at *École Polytechnique* during the first decade of the nineteenth century and the first-year courses at KTH [Royal Institute of Technology]".[45] Since the "breakthrough of industrialism", there seems to be a common core, a kind of a core curriculum, in all engineering education.[46] Students have historically pushed for change, but at the same time they have held some

[43] Rolf Torstendahl, *Teknologins nytta: Motiveringar för det svenska tekniska utbildningsväsendets framväxt framförda av riksdagsmän och utbildningsadministratörer 1810–1870* (Uppsala, 1975); Eric Schatzberg, "From Art to Applied Science", *Isis* 103, No. 3 (2012): 555–63.

[44] Svante Lindqvist, "En sliten och alldeles för trång bonjour. Den historiska bakgrunden till KTHs organisatoriska struktur", in *Kungl. Tekniska Högskolans organisationsutredning* (Stockholm, 1992), 20.

[45] Ibid.

[46] Ibid.

of the most conservative positions.[47] Individuals within professional and industrial organisations, such as the Swedish Association of Engineers and Architects (*Svenska Teknologföreningen*) and later the engineering trade union organisations could also hold different positions. Still, over the twentieth century, these organisations increasingly aligned their goals with those of industry.[48]

Engineering historian Bruce Seely has elaborated on the theme of curricular inertia in the US context.[49] Despite the enormous technological development in the twentieth century, Seely argues that also US engineering curricula have stayed remarkably consistent. This is not to say that reforms and debates about reform have been lacking – quite the opposite. Seely claims that no other professional education has been the subject of so many studies and reviews. However, despite energetic debate, the curriculum has remained intact, retaining its core of mathematics, natural sciences and engineering science, as well as a varying share of non-technical subjects, all fitting into a four-year curriculum. Seely therefore raises a red flag regarding the risk of "reinventing the wheel" when new, reformed engineering programme curricula are launched.[50] He stresses the importance of looking to the past to find valid solutions already suggested. The ideas developed by Kaijser, Lindqvist and Seely assist in explaining the limited response to the 1990s reform projects analysed in this study. The development of various gender equality *logics* among engineering educators in the 1980s and 1990s was a negotiation, and sometimes a struggle, played out on a century-old curricular battlefield.

Furthermore, Swedish ethnographers have discussed the centrality of the engineering student culture at universities of technology.[51] In line with such studies, the thesis interprets the protection of engineering student culture as an additional aspect contributing to the status quo at these institutions. New students and graduates in positions as influential industry leaders have historically joined forces to protect rituals that contribute to a close-knit professional community. These rituals included discrimination, sexism and humiliation. As the empirical analysis demonstrates, protecting

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[47] Berner, "Educating Men"; Berner, *Teknikens värld*; Karlqvist, *Från eftersatt till eftersökt*; Kaijser, "Ingenjörer i takt med tiden". See this thesis Chapter 3, sub-chapter "Targeting the Minority, Avoiding Confrontation".

[48] Ibid. (Kaijser); Björck, *Staten, Chalmers och Vetenskapen*.

[49] Bruce Seely, "Patterns in the History of Engineering Education Reform: A Brief Essay", in *Educating the Engineer of 2020: Adapting Engineering Education to the New Century* (Washington, 2005).

[50] Ibid., 125.

[51] Ek-Nilsson, *Teknikens befäl*; Hagman, *Nollan blir nymble*; Mellström, *Engineering Lives*; Ottemo, *Kön, kropp, begär och teknik*.

student culture went hand in hand with preserving an elite professional status. This has been a key aspect of engineering graduates' professional *boundary work* – of engineers drawing, protecting and negotiating professional boundaries – further elaborated in the theory section below. This boundary work was permeated by gendered norms. Advocates of gender equality in engineering rarely targeted the student culture other than indirectly. This culture is, however, part of a core professional ritual, solidifying professional comradery and reproducing professional values and ideals.[52]

Three Fixes: Women, Institutions, Knowledge

A final important theme in previous research on the gendered engineering profession that has informed and structured this analysis is historian Londa Schiebinger's research on STEM (science, technology, engineering mathematics) gender equality policies internationally. Schiebinger has identified three "policy fixes" in efforts to improve gender equality within STEM in the Global North since the 1970s: "fixing the number of women", "fixing the institutions" and "fixing the knowledge".[53] Her fixes have been useful in creating a structure for the empirical analysis in this thesis, and also provide an international comparison. For five decades international researchers focusing on women and gender have gradually dismantled the idea of a quick and easy "gender fix". In 1997, Schiebinger called for communication between, on the one hand, gender scholars who analyse STEM education and professions and, on the other, STEM educators and faculty members. If the goal was substantive progress towards gender equality in science and engineering, communication between these actors was vital. In her article she outlined a programme that included gender analysis of scientific and institutional structures, scrutiny of research funding priorities, scientific language, and professional identities.[54] There is

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[52] Berner, "Educating Men"; Ek-Nilsson, *Teknikens befäl.*

[53] Schiebinger has published extensively on these three approaches, e.g. *Gendered Innovations in Science and Engineering* (Stanford, 2008); "Gender Science and Technology", Background paper, Expert Group Meeting, United Nations Division for the Advancement of Women (DAW, part of UN Women/UNESCO, Oct. 2010; "Gendered innovations: harnessing the creative power of sex and gender analysis to discover new ideas and develop new technologies", *Triple Helix* 1, No. 9 (2014); TedX Gendered Innovations, 2013, https://tedxcern.web.cern.ch/video/2013/gendered-innovations, retrieved 12 Nov. 2021; Londa Schiebinger and Martina Schraudner, "Interdisciplinary approaches to achieving gendered innovations in science, medicine, and engineering", *Interdisciplinary science reviews* 36, No. 2 (2011), 154–167.

[54] Londa Schiebinger, "Creating sustainable science", *Osiris* 12 (1997): 201–216.

yet to be a response from the Swedish universities of technology to most of the bullet points on Schiebinger's list.

Schiebinger's first two policy fixes are descriptive in that they thematise policy work conducted in the past. The third fix is mainly normative; Schiebinger argued and continues to hold that this is the way forward if STEM actors are sincere about their inclusive rhetoric. Her three time-bound fixes apply to Swedish gender equality policies within engineering education from the 1970s onwards, albeit to different degrees. While the first, "fixing the number of women", had few opponents from the 1980s, the latter two have not yet convinced the entire engineering community. A majority in the Swedish engineering community has fully accepted that the number of women in engineering should increase. External recruitment activities to increase female representation in the engineering student body have historically been the "go to" measure. This policy fix, fixing the number of women – and also "fixing the women" as I refer to in Chapter 3 – gained momentum at Swedish universities of technology in the early 1980s. Engineering educators continuously reinforced this measure, or solution, to combat gender inequality, despite efforts during the 1990s to disrupt its influence. The strategy is closely connected to the "pipeline model", which states that increasing the participation of women in science and technology overall is done by increasing the share of women in undergraduate education.[55] The pipeline model has been shown to be flawed but is still heavily relied upon.[56] The idea of fixing the number of women/fixing the women, which I refer to as the *recruitment logic*, fits neatly with traditional engineering professional norms (Chapters 3 and 6). In my understanding, the inability to look beyond representation in gender equality policies, just as in most types of diversity work, is a consequence of professional structures established as engineering graduates strived for status in the late nineteenth century. That process is detailed in Chapter 2. The structures, professional values, norms and convictions continued to permeate the engineering profession into the late twentieth century. The second and third policy fix, and especially fixing the knowledge, challenged the very core of the engineering profession's culture and structures, and thus generated less enthusiasm. The recruitment logic left that core untouched. By embracing the recruitment logic, Swedish engineering representatives have been successful in incorporating language about diversity and gender equality, while at the same time

[55] Londa Schiebinger, *Has feminism changed science?* (Cambridge, MA, 1999), 14.
[56] Ibid., 14, footnote 25.

protecting core aspects, such as curricula and student culture, from undergoing radical change.

Schiebinger's second fix, fixing the institutions, gained momentum internationally from the late 1980s. As outlined in Chapters 4 and 5, it also did so in Swedish policymaking and among a few "elites", well-positioned faculty and leaders, at universities of technology. This shift in focus, calling for internal reform of curricula and pedagogical methods, was supported by representatives in central management and among the engineering faculty at Linköping University and Chalmers University of Technology.[57] The Vice-Chancellor of Linköping University (who later became the Vice-Chancellor of KTH), and the Pro-Vice-Chancellor (*pro-rektor*) of Chalmers were strong supporters of curricular reform and lobbied the Ministry of Education for reform funding. Chapter 4 demonstrates how this *reform logic* gained ground within a circle of elite actors connected to the Ministry of Education. These individuals were representatives in university management, faculty, members of parliament and education bureaucrats. Regarding the third fix, fixing the knowledge, Schiebinger refers to gender analysis of the science and technology field. She argues that the STEM majority, including engineering faculty members, must still be trained in this approach.[58] Chapter 5 examines how gender analysis was taken into consideration in a national reform project spearheaded by Linköping University in the late 1990s.[59] This analysis did not, however, gain momentum at Swedish universities of technology in general.

As Schiebinger discusses, the three fixes are connected to theoretical approaches that have informed policymakers.[60] Policies involving fixing the number of women were driven by a gender-neutral approach, not taking into account the gendered aspects of technology (see sub-chapter "Making Technology Masculine" above). The second fix was driven by a difference approach; one that acknowledged gender differences and therefore problematised science and engineering institutions as masculine. Missing in this perspective was sensitivity to factors such as race, ethnicity, class and age. It ignored the

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[57] Possibly also at other Swedish universities of technology not studied in this thesis.

[58] Schiebinger, "Gender Science and Technology", 8–9, 25 ff.

[59] Lena Trojer emphasises the need to distinguish between "efforts to improve gender equality" (*jämställdhetsarbete*) and gender analysis within science and technology as two distinctly separate activities. In the Swedish context, Luleå University installed a research division for gender and technology already in 1982. This was the first Swedish academic division for gender research overall. Lena Trojer, *Genusforskning inom teknikvetenskapen: en drivbänk för forskningsförändring* (Stockholm, 2002); personal communication with Lena Trojer, 21 Oct. 2022.

[60] Schiebinger, "Gender Science and Technology", 4–5.

fact that differences within the groups of men and women were greater than between these two groups. An intersectional framework could have shown that students from working-class or immigrant backgrounds, for example, had a different starting point to students from white middle-class families.[61] Also missing were insights regarding the world view of students. If students' world views and outlook on society were incompatible with science and engineering ideology, they would have had little interest in pursuing a STEM education, regardless of their gender.[62] Instead, STEM educators considered men and women as two respectively homogenous but different groups. The third policy approach, fixing the knowledge, was driven by further theoretical development. Schiebinger calls this perspective an "equality approach through gender analysis".[63] The concluding Chapter 6 discusses how this knowledge has, up to now, had limited influence on gender equality policies in Swedish higher technical education.

The Proud National Label of Gender Equality

Research on the development of a Swedish policy field for gender equality is the second major research field of importance to this study. The field encompasses several disciplines: history, political science and organisational studies. Previous research points to a recurring stumbling block in gender equality policy and efforts focused on gender equality, namely determining which problems the policies would be expected to solve, and the cause and extent of the problems. This does not only apply in the area of engineering, but also in many other male-dominated arenas. The debate around gender equality and activities relating to it within the governmental bureaucracy, the military, non-governmental organisations and industry organisations have all demonstrated similar tendencies. Common to these various arenas is that no definition of gender equality is stated at the outset. It is instead, as political scientist Katarina Tollin points out, an "empty sign"; a term that is often assigned contradictory meaning and content depending on the actors' norms and values.[64] Likewise, this thesis examines gender equality as a concept up for negotiation.

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[61] On intersectional analysis see Kimberlé W. Crenshaw, *On Intersectionality: Essential Writings* (New York, 2017).

[62] Lena Hansson and Britt Lindahl, "Apropå Fuglesang: världsbilder och rekryteringen till naturvetenskapliga/tekniska utbildningar", *NorDiNa: Nordic Studies in Science Education* 3, No. 2 (2007): 99–106.

[63] Schiebinger, "Gender Science and Technology", 4.

[64] Katharina Tollin, *Sida vid sida: en studie av jämställdhetspolitikens genealogi 1971–2006* (Diss. Stockholm, 2011), 53.

Historians Christina Florin and Bengt Nilsson have outlined the processes leading up to the institutionalisation of the new Swedish gender equality policy field in the 1970s.[65] Yvonne Hirdman's work on the Swedish gender system is important in understanding this process.[66] Jessica Lindvert has made a comparison of national gender equality policy development from the 1960s in Sweden and Australia.[67] Fia Sundevall and Alma Persson have examined how issues around men, women and gender equality within the military were addressed between the 1960s and 1990s.[68] Kerstin Alnebratt and Malin Rönnblom have analysed the gender equality policies of the Swedish Government over time, starting from the 1970s, and found an ambiguity whereby efforts to address gender equality within the Swedish public sector go around in circles.[69] Linda Ekström has studied gender equality policies in three male-dominated Swedish organisations/workplaces and points to the power of definition.[70] Ulrika Jansson explores the views within the Confederation of Swedish Enterprise (*Svenskt Näringsliv*) on gender equality, and Tollin analyses parliamentary debates on gender equality between 1970 and 2000.[71] In covering the 1980s and 1990s – decades that have only been briefly touched upon so far by gender historians – this thesis provides new perspectives on continuities and change. It expands on the findings of the above-mentioned scholars by analysing the response to and feedback on governmental gender equality policies from a key actor in Swedish modernity, the engineering graduate (*civilingenjören*).

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[65] Christina Florin and Bengt Nilsson, "'Something in the nature of a bloodless revolution…': How New Gender Relations Became Gender Equality Policy in Sweden in the Nineteen-Sixties and Seventies", in *State Policy and Gender System in the Two German States and Sweden 1945-1989* (1999), 11–77; this thesis Chapter 2, sub-chapter "Gender (Re-)Enters the Political Agenda".

[66] Yvonne Hirdman, "Genussystemet: reflexioner kring kvinnors sociala underordning", *Kvinnovetenskaplig tidskrift* 3 (1988), 49–63; Yvonne Hirdman, *Genussystemet: teoretiska funderingar kring kvinnors sociala underordning* (Uppsala, 1988); Yvonne Hirdman, *Genus: om det stabilas föränderliga former* (Malmö, 2001).

[67] Jessica Lindvert, *Feminism som politik: Sverige och Australien 1960–1990* (Diss. Umeå, 2002). See also Anita Nyberg, "Gender Equality Policy in Sweden: 1970s-2010s", *Nordic journal of working life studies* 2, No. 4 (2012): 67-84.

[68] Alma Persson and Fia Sundevall, "Conscripting Women: Gender, Soldiering, and Military Service in Sweden 1965–2018", *Women's history review* 28, No. 7 (2019): 1039–1056. See also Fia Sundevall, *Det sista manliga yrkesmonopolet: genus och militärt arbete i Sverige 1865–1989* (Stockholm, 2011).

[69] Kerstin Alnebratt and Malin Rönnblom, *Feminism som byråkrati: jämställdhetsintegrering som strategi* (Stockholm, 2016).

[70] Ekström, *Jämställdhet - för männens, arbetarklassens och effektivitetens skull?*.

[71] Jansson, *Den paradoxalt nödvändiga kvinnan*; Tollin, *Sida vid sida.*

STUDY OBJECTIVE AND RESEARCH QUESTIONS

From the mid-1970s, national regulations, funding opportunities, external social pressure and internal gender equality advocates urged universities of technology to address gender inequalities. The way in which the goal of gender equality should be interpreted was, however, negotiable. Engineering educators had room to manoeuvre. This thesis aims to analyse the interplay between two parallel processes: the evolution of the Swedish field of gender equality policy and the development of the Swedish engineering profession, represented by the universities of technology. An overarching research question can be formulated as follows: How did Swedish universities of technology respond to, and impact, national gender equality policies between 1976 and 1998?

To answer the question, the study analyses how the actors involved – university leadership, the engineering faculty, state cabinet ministers and education bureaucrats – formulated the problem of gender inequality and its solutions, and how such definitions intersected with contemporary political transformation, highlighting continuities and change over time. Past research on gender and engineering has argued that a combination of military tradition, professional norms formed in the late nineteenth century, and an intimate link to emerging technology industries has created and reproduced a homosocial masculine community in the twentieth century.[72] At universities of technology, these values became locked into curricula, pedagogical methods and ritual-like student social activities – all based on practices that were 100 years old or more.[73] Building on these studies (further outlined in the theory section and Chapter 2), I argue that engineering representatives at universities of technology drove gender equality policy by practising *professional boundary work*. They activated the concept of gender equality to fulfil the needs and ambitions that were of concern to the profession.

In fulfilling its objective, this thesis makes several novel contributions. It adds to the growing body of international research on the history of gendered engineering and engineering education reform by presenting a national case that has gained attention for decades but has been less frequently analysed in depth. To the body of Swedish research on the topic it contributes insights into a significant period in Swedish late modernity. It shows how visions of welfare and national economic growth, a labour market of full

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[72] Feminist theorists use the concept of homosociality to describe non-erotic, mainly men-to-men relationships that are important for the (re-)production of social hierarchies. See e.g. Charlotte Holgersson, "Homosociality as a Gendered Process", *Norma* 1, No. 1 (2006): 24–41.

[73] E.g. Berner, "Educating Men"; Oldenziel, *Making Technology Masculine*; Seely, "Patterns in the History of Engineering Education Reform".

employment, modern technology and a knowledge society all materialised through university expansion. These visions shaped gender equality politics and were driven by the boundary work of a male-dominated profession. The thesis therefore sheds new light on how Sweden became what has often been perceived as an international forerunner in gender equality.[74] It combines the study of gender equality politics and engineers' practise of professional boundary work, deepening our understanding of both. The analysis essentially explores how engineering educators defined and negotiated problems and corresponding solutions when responding to gender equality policies imposed in national regulation or encouraged by public funding between 1976 and 1998.

AREA AND PERIOD OF STUDY

The focus of this study, the four-year engineering degree, *civilingenjörsutbildningen,* was established in the 1870s and became the jewel in the Swedish technical higher education system. This professional degree guaranteed social standing and professional authority throughout the twentieth century.[75] Previous engineering history research has established a strong connection between specialised and monopolised education and professional legitimacy.[76] The university of technology is a microcosm of engineering norms, values and ideals competing against each other.[77] Whereas a higher degree, the PhD in Engineering, existed from the late 1920s and was pursued in order to conduct research, the four-year professional degree provided professional status. During their years studying, individual students were assimilated into the profession: in the lecture halls, in the laboratory, through internships in industry and at engineering workplaces, and not least, in ritual-like student activities.[78] University education moulds and shapes the engineer as a social being. The practise of *professional boundary work* between 1976 and 1998 analysed in this thesis provides a window, an example or a case showing the struggles in the engineering communities to define what this social being should represent.

Between 1976 and 1998, the time span which this analysis covers, the identity of the Swedish engineer was challenged and transformed. The formerly self-identified male-

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[74] For feminist criticism on this position see Lena Martinsson, Gabriele Griffin and Katarina Giritli Nygren, eds., *Challenging the myth of gender equality in Sweden* (Bristol, 2016).

[75] Berner, "Educating Men"; Ek-Nilsson, *Teknikens befäl.* Further elaborated in this thesis Chapter 2.

[76] E.g. Berner, *Teknikens värld*, 204 ff.

[77] Berner, "Educating Men"; Kaijser, "Vad är en ingenjör?"; Lindqvist, "Ideology and Institutional Structure".

[78] Ek-Nilsson, *Teknikens befäl.*

exclusive profession was navigating new realities, a focus on gender diversity being one of them. In 1976, systematic efforts to promote gender equality became mandatory for all public agencies, including universities (Chapter 3). The subsequent decades saw an intense interplay between Government requirements and funding for activities to increase gender equality, calls from within the engineering communities for renewal and reform, and engineering educators negotiating and responding to the new situation. In 1998, two projects, Project D++ at Chalmers (Chapter 4) and Project NyIng at Linköping University (Chapter 5), published their final reports.

THEORETICAL FRAMEWORK AND MAIN CONCEPTS

Overall, my analysis is governed by two underlying hypotheses, or assertions, which highlight the overarching feminist perspective. Departing from decades of work by theorists of women's and gender issues, this thesis understands perceptions of gender – the relationship between masculinities and femininities, but also the relationship between different masculinities and femininities – as perceptions of power. This means that where gender structures are challenged, so too are power structures.[79] Accordingly, challenging gender structures also means challenging professional boundaries. Secondly, the material and ideological consequences of these gender perceptions are always contextual. Time and place matter.

Practises of Gendered Boundary Work in the Engineering Profession

Professionals are commonly described as experts in a specific field, who base their expertise on a specialised education, scientific research and knowledge.[80] The traditional professionals are medical doctors, lawyers and teachers, but engineers are often placed in this category too. In Sweden, scholars such as Nils Runeby, Boel Berner and Henrik Björck have deployed and developed the framework of professional theory in their

[79] The classic international reference for gender historians is Joan W. Scott's two papers, "Gender: A Useful Category of Historical Analysis", *The American Historical Review* 91, No. 5 (1986): 1053–1075 and "Gender: Still a Useful Category of Analysis?", *Diogenes* 57 (2010): 7–14. For historical analysis in the Swedish context see Hirdman, *Genussystemet*. Both Scott and Hirdman view the dualist gender hierarchies as socially constructed; gender roles and gender ideologies are situated in time and place and are constantly challenged.

[80] Thomas Brante, *Den professionella logiken: hur vetenskap och praktik förenas i det moderna kunskapssamhället* (Stockholm, 2014), 15, 19.

historical analysis of the engineering profession.[81] This study is conducted through a lens of professional *boundary work*, a theoretical framework that takes its cue firstly from the broad field of gendered professions and professionalism and secondly from research on boundary work first suggested by science historian Thomas F. Gieryn as a tool to understand professionals' – in his case scientists' – rhetorical approach to legitimise their methods and findings.[82] Gieryn argues that scientific actors construct boundaries in a cultural landscape by articulating interests, thereby creating legitimacy, social influence and financing opportunities. Their rhetorical negotiation and protection of professional boundaries never ceases altogether, as other actors in the cultural landscape constantly question the boundaries. However, it is most active when there is something at stake.[83]

Feminist research has combined the theory of boundary work with theories on professions and professionalism to analyse the gendered boundaries that professions demarcate, negotiate and uphold.[84] In light of the early decades of the professional theory developed from the 1950s, the gendered perspectives represent a theoretical shift, a "turn".[85] I will not go into detail on the historiography of professions and professional theory, a 70-year-old academic development.[86] Suffice it to say that this thesis transcends

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[81] See this thesis, Chapter 2. Berner, *Teknikens värld*; Björck, *Staten, Chalmers, och vetenskapen*; Thomas Kaiserfeld, *Vetenskap och karriär: svenska fysiker som lektorer, akademiker och industriforskare under 1900-talets första hälft* (Lund, 1997); Runeby, *Teknikerna, vetenskapen och kulturen.*

[82] Thomas F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Chicago, 1999). Recent reviews of the field of gendered professions and professionalism in Hearn et al., "Gender, diversity and intersectionality in professions and potential professions; Beate Sløk-Andersen and Alma Persson, "Letting the Right Ones In: Gendered Boundary Work in the Military Profession," in *Transformations of the Military Profession and Professionalism in Scandinavia*, ed. Anne Roelsgaard Obling and Lotta Victor Tillberg (Copenhagen, 2021), 49–70.

[83] Ibid. (Gieryn).

[84] Jeff Hearn, "Notes on Patriarchy, Professionalisation, and the Semi-Professions", *Sociology* 16, No. 2 (1982): 184–202; Anne Witz, *Professions and Patriarchy* (London, 1992); Elianne Riska, "Gender and the Professions", in *The Wiley Blackwell Encyclopedia of Health, Illness, Behaviour, and Society*, ed. William C. Cockerham et al. (London, 2014), 633–637; Hearn et al., "Gender, diversity and intersectionality in professions and potential professions"; Sløk-Andersen and Persson, "Letting the Right Ones In".

[85] Sofia K. Ledberg, *Officeren, staten och samhället: ett professionsperspektiv* (Lund, 2019), 20; Hearn et al., "Gender, diversity and intersectionality in professions and potential professions".

[86] Relevant summaries of this development in: Pål Nygaard, *Ingeniørenes gullalder: de norske ingeniørenes historie* (Oslo, 2013), 38–43; Ledberg, *Officeren, staten och samhället,* 17–21; Sløk-Andersen and Persson, "Letting the Right Ones In". A recent and more extensive assessment of professions and professional theory in Brante, *Den professionella logiken*. Brante discusses professions from four defining perspectives – legitimacy, trust, authority, and autonomy (p. 15, 19). For state-of-the-art international research and contemporary developments, see Mike Dent,

the early practices of defining what a profession *is*, which occupations should be viewed as professions, "semi-professions", "proto-professions" and so on, often labelled as the functionalist approach.[87] Instead, and in line with the described theoretical turn, my analysis is inspired by concepts taken *from* the academic field of professions and professionalism. What professions *do*, rather than what they *are,* thus becomes the focus. Among the international community of historians of science and technology it is generally agreed and empirically well-established that professionalisation has often implied masculinisation.[88] Nathan Ensmenger, Mar (previously Marie) Hicks and Janet Abbate have studied the transformation of programming work, generally presumed to have involved a shift from unskilled routine clerical work to skilled software engineering.[89] These scholars explain women's gradual exclusion through professionalisation processes. While coding and programming always involved skills and problem solving, such skills were only recognised once the tasks became professionalised – when they became supported by professional or industry organisations, specialised education and status. The professionalisation processes went hand in hand with the masculinisation of the profession.

In their review of the gendered theoretical shift, Jeff Hearn and his co-authors make a list of "neutralised professional traits" that professions and early analysts of professions have called upon:

> universalistic standards; specificity of professional expertise; affective neutrality; status achieved through individual performance; decision-making based in client's interest not the practitioner's self-interest (the service ethic); and control by voluntary association (extended expert training, internalized codes of practice, and control by peers (Blau and Scott, 1964: 60-63).[90]

Ive Bourgealt, Jean-Louis Denis, and Ellen Kuhlman eds., *The Routledge Companion to the Professions and Professionalism* (London, 2016).

[87] Ledberg, *Officeren, staten och samhället*, 17.

[88] Ensmenger, "'Beards, Sandals, and Other Signs of Rugged Individualism"; Hicks, *Programmed Inequality*; Margaret W. Rossiter, *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore, 1982); Sommestad, "Att skapa genus"; Oldenziel, *Making Technology Masculine.*

[89] Ibid.; Janet Abbate, *Recoding Gender: Women's Changing Participation in Computing* (Cambridge, MA, 2012).

[90] Hearn et. al., "Gender, diversity and intersectionality in professions and potential professions", 57.

In the early days of professional theory, professionals and theorists defined professional groups by these values and principles. It was a measure to contrast professional ethics with bureaucratic hierarchies and organisation, where the professionals were considered "colleague groups of equals".[91] These groups were thought to follow specific standards apolitically beyond self-interest. Those groups were gendered throughout.[92] Their assumed neutrality – generally white, male, high-status – was identified by another high-status, white male profession, that of academic sociologists. Applying an intersectional perspective, professions appear not only as gender-segregated but also as class-based, racialised and heteronormative. The gendered shift has provided tools to analyse the development of professions and professionalism in a post-industrial world, where professionals are no longer exclusively all male, white, non-disabled, and leaning on a female workforce doing unpaid household work. Concepts like expertise, ethics, professional community or "esprit de corps" (*kåranda*), knowledge monopoly, autonomy and (political) neutrality – referred to as professional norms – are used as tools in fulfilling the purpose of this thesis: to examine how the engineering profession responded to and negotiated external and internal demands on gender equality from the mid-1970s. Engineering educators have loudly called upon or silently leaned on these professional norms when steering political agendas for gender equality in specific directions. I call this practise *professional boundary work*.

Negotiating Gender Equality

Londa Schiebinger's three fixes pointed to what has already been discussed above, the recurring difficulty in gender equality policy and efforts to promote gender equality regarding which problems the policies are expected to solve, and the cause and extent of the problems. As stated, this thesis interprets gender equality as a concept open for professional negotiation. Engineering communities filled the concept of gender equality and what the result of gender equality efforts should look like with various content over time. What is gender equality? What are efforts to promote gender equality meant to achieve? These questions were seldom explicitly asked or answered by the actors studied

[91] Ibid., 58.
[92] Ibid.

in this thesis. But through analysis of directives, decisions, non-decisions, debates and internal discussions, it is still possible to seek answers to such questions.[93]

Before moving on, a final note on the concept of gender equality – in Swedish *jämställdhet*. The reader might ask why the concept of *gender equity* is not deployed in this thesis. Scholars and organisational reformers introduced the concept of equity to distinguish between efforts to promote equality aimed at giving everyone equal resources, no matter the hierarchies this might create or reproduce, and efforts to promote equity that recognise that additional support is needed for some groups to reach the final goal of equality.[94] This thesis translates *jämställdhet* as gender equality, not gender equity, for two reasons. By using the term gender equality, I want to emphasise the multiple meanings that the Swedish concept of *jämställdhet* has had and continues to have. Some actors – engineers and others – stresses that gender equality has already been achieved since anyone with sufficiently high grades can formally apply to and enrol in Swedish university engineering programmes. Other actors have highlighted the fact that structural, informal gender inequalities do exist. To counteract such inequalities, additional support is necessary for groups who historically have been neglected or taken advantage of. While native English speakers in these instances speak of gender equity, Swedish advocates have been stuck with the broader and less defined concept of *jämställdhet* (gender equality). This has likely been one reason for the wide acceptance of ideas of gender equality in Sweden. For example, statements such as "we are all for gender equality, but do not believe in quotas for women", are abundant.[95] It has also paved the way for many ineffective measures. It is, therefore, an active choice not to use the concept of gender equity, which I understand to have a more fixed meaning. The second reason for consistently using the term gender equality is that previous translations of Swedish historical studies on

[93] I am inspired by political theorist Carol Bacchi's WPR approach ('What's the problem represented to be?) and the questions that the approach poses. Carol Bacchi, "Introducing the 'What's the Problem Represented to be?' approach", in *Engaging with Carol Bacchi: Strategic Interventions & Exchanges,* ed. Angelique Bletsas and Chris Beasley (Adelaide, 2012). My material is more dynamic than that of Bacchi, who analyses text-based policies, but the questions are still relevant.

[94] SIDA (The Swedish International Development Agency) argues that gender equality is a broader term that can include, e.g., intersectional analysis, whereas the concept of gender equity has played in favour of conservative forces. SIDA Gender Tool Box [Brief], "Hot Issue: Gender Equality and Gender Equity", Nov. 2016.

[95] E.g. Maria Törnqvist, *Könspolitik på gränsen: debatterna om varannan damernas och Thamprofessurerna* (Diss. Lund, 2006).

jämställdhet have used the concept of gender equality. I have chosen to stay with that tradition.

METHOD AND SOURCE MATERIAL

My method can be described as focusing on the actors or, to be precise, focusing on their decisions. Rather than interpreting events as inevitable outcomes in a historical process, I investigate the decisions, large and small, as well as the paths not taken, by the actors involved, leading up to the event of interest.[96] Each chapter aims to identify the complex entanglement of factors preceding the decision to launch the project, campaign, or working group studied. It has been equally important to identify the interpretations of gender equality among the actors involved. By analysing their rhetoric, I have tried to discover what has been left unsaid.

In focusing on the decisions leading up to a project, less emphasis has been placed on how gender equality processes were implemented. This is particularly evident in Chapter 4, which deals with a 1990s curricular reform programme called the Five Gender-Inclusive Projects (FGIP) and its implementation at Linköping University and Chalmers University of Technology. While the bureaucratic processes and debates among national and local actors are discussed at length, less time is spent on the actual implementation phases of The IT Programme at Linköping and Project D++ at Chalmers.

To fulfil the objective of my thesis, various sources have been used, most of them written ones: archival documents such as board meeting minutes, official parliamentary documentation, project and campaign reports and evaluations, marketing materials, professional journals, student magazines and media materials. But I also use oral sources, which I discuss in more detail below. When conducting contemporary historical research, the issue of locating materials is not as pressing as the question of how to limit your material collection for analysis. I have examined a period of 22 years during which many gender equality projects were initiated. Being selective and setting limits are essential. My main selection criterion has been recruitment and reform projects that have resulted in published reports or projects that historical actors and sources have consistently referred to. Can these projects be considered representative of gender equality initiatives at universities of technology during the period studied? And what about validity? Are the

[96] This approach has been described as writing history "forward" in contrast to writing history "backwards", that is, to start in a contemporary phenomenon and look for its roots or origins. See Göran B. Nilsson, "Historia som humaniora", *Historisk tidskrift* 1 (1989): 1–15.

sources I am analysing relevant to answer my research question?[97] I suggest that, in their very existence, the published reports and evaluations communicate the importance assigned to these projects by the actors involved. The three main initiatives studied reflected widespread assumptions among contemporary engineering representatives engaged in gender equality promotion. The arguments of local engineering actors were repeated by engineering gender equality advocates at other universities and within political leadership. At the same time, by exploring the actions of the gender equality advocates, the response from the engineering majority is revealed. Thus in Chapter 4, while a "gender-inclusive" reform project is the focus of the chapter, the parallel efforts of some of those who opposed the strategy are also analysed in depth.

Other than internal project evaluations and governmental reports, studies committed to a more critical analysis of gender equality in engineering education are few and far between.[98] Two exceptions are worth mentioning and they concentrate on one specific initiative: the Five Gender-Inclusive Projects programme in the 1990s. These two publications offer a critical analysis of this initiative. In her doctoral thesis, gender scholar Minna Salminen-Karlsson interviewed participating engineering actors and examined the gendered understandings of engineering in this programme.[99] Pedagogical scholar Ingrid Wistedt evaluated the entire national initiative.[100] These studies helped me to identify essential actors and their decisions. I have built and expanded on Salminen-Karlsson's and Wistedt's findings, but I have also treated their studies as primary sources. They belong to a stream of Swedish gender analysis of STEM education which I discuss further in Chapter 5.

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[97] Representation and validity in historical work is discussed in Maria Ågren, "Synlighet, vikt, trovärdighet–och självkritik. Några synpunkter på källkritikens roll i dagens historieforskning", *Historisk tidskrift* 125, No. 2 (2005): 2–15.

[98] A selection: Christina Chaib, *Modeller för rekrytering av flickor till tekniska utbildningar. Delrapport 1, Erfarenheter av kampanjen för vidgad rekrytering av flickor till teknikerutbildningen* (Jönköping, 1988); Departementsserien 1994:130; Palm, "Det är inte bara image"; Minna Salminen-Karlsson, *Bringing Women into Computer Engineering: Curriculum Reform Processes at Two Institutes of Technology* (Linköping, 1999). Salminen-Karlsson points out that practically all Swedish studies on gender and engineering focus on women (p. 20). In that sense, gender researchers in the 1980s and 1990s were as narrow focused as the engineering gender equality advocates.

[99] Salminen-Karlsson, *Bringing Women into Computer Engineering*. For an international comparison see Jane Margolis and Allan Fisher, *Unlocking the Clubhouse: Women in Computing* (Cambridge, MA, 2002).

[100] Inger Wistedt, *Five Gender-Inclusive Projects Revisited: A Follow-Up Study of the Swedish Government's Initiative to Recruit More Women to Higher Education in Mathematics, Science, and Technology* (Stockholm, 2001).

Archival Sources

The thesis is informed by material from the Swedish National Archives, the Chalmers Central Archive, the Swedish Labour Movement's Archives and Library, the TAM Archives (*Tjänstemäns och Akademikers arkiv*), and interviewees' private archives. The Swedish National Archives house all archived material from Sweden's national ministries before 1997. Material from the Ministry of Employment and the Government's labour market committee (*Statens arbetsmarknadsnämnd, SAMN*) has been an essential source. In Chapter 3, the personal archive of Anita Gradin, 1980s Minister for Immigration and Gender Equality has a prominent place. Her archived documentation from her state cabinet years helped me to understand current labour market policies and debates and the emphasis that the Social Democrats in the early 1980s placed on technical industries and higher education in science and technology in efforts to keep women in the workforce. To explore decisions and rhetoric at universities of technology, I use material from Chalmers' central archive, and the archives of the Government's labour market committee and the Ministry of Employment. Gender equality advocates at universities of technology submitted their reports, plans and documentation of systematic gender equality efforts during the 1980s to the Government's labour market committee and the Ministry of Employment. Private archives from sources Bertil Svensson and Kent Hartman were invaluable when writing Chapters 4 and 5. Likewise, the oral testimonies of several actors pointed me to the national archives of interest and helped me to fill in some of the gaps.

Oral Sources

I have conducted interviews with 14 individuals, mainly in the format of life story interviews.[101] This is a semi-structured format that begins with questions about childhood and early adulthood and, moving step-by-step towards the period of interest. I used the interviews primarily to understand relevant project processes, to locate contemporary sources, and to fill in gaps where written sources fell short. In several cases, the actors interviewed provided me with valuable materials they possessed, such as meeting minutes, printed marketing brochures, conference proceedings and the literature they had built their arguments on. The interviewees often pointed me towards other relevant actors. Interviews with Inga Alander and Christina Ullenius provided helpful information for the

[101] Four of the interviewees were contacted because of their engagement in the Swedish Association for Graduate Engineers' Gender equality council in the early 1970s, not analysed in this thesis.

analysis in Chapter 3. Likewise, Ullenius, Bertil Svensson, Peter Jansson and Ingemar Ingemarsson helped me to understand the events studied in Chapter 4. Chapter 5 is based on material and testimonies from Kent Hartman, Ingemar Ingemarsson and Anders Flodström.

My first contact was by email or letter where I briefly introduced myself, my doctoral project and the reason for my interest in the person I was contacting.[102] This was followed by a phone call about a week later, often leading to half an hour of informal conversation over the phone, where I explained a little more, asked some preliminary questions, and requested a formalised interview.[103] All of the actors I contacted agreed to an interview.[104] After the phone call, I took notes on what had been decided upon and the essential findings. I conducted in-person interviews at the interviewee's homes, their workplace (present and former) and occasionally at a café.[105] They lasted between 1.5 and 3 hours. Apart from Kerstin Hanzon and Bertil Svensson whom I interviewed twice, I met with each interviewee once. I audio recorded the interviews on my mobile phone for subsequent transcription.[106] The recordings and transcripts allowed me to conduct most interviews early on (during the first two years of the project) and return to them when conducting my analysis in the later stages of the project.

In addition to interviews, I have had informal conversions with a few actors. These were unstructured meetings, i.e. lunch meetings and online meetings. When occasionally referred to in this thesis, I refer to the meetings as "personal communication".

Printed Sources

Since the events studied take place as much among national actors as engineering actors, the official documents, e.g., bills and official reports from the Swedish Government and public inquiry reports produced within the Swedish governing system, are central to my analysis. In addition, printed project evaluations and summaries are examined in all three empirical chapters. They have helped me to identify critical turns of events and significant

[102] Towards the end of my project, I made 'cold' calls, phone calls without first sending an introductory mail.
[103] These introductory phone calls gave important information but were not transcribed.
[104] However, one interviewee wished that I did not publish the content of our conversation.
[105] The first three interviews, however, I conducted over the phone. Those interviews concerned the CF Gender equality council, not analysed in this thesis.
[106] Conducted by myself. I did either full transcripts or detailed summaries. Except from one, all of the interviews conducted were recorded.

decisions, but in particular to analyse the gender equality discourse within the initiatives studied.

DISPOSITION

The thesis evolves over six chapters. After this first introductory chapter, a background chapter follows that contextualises the object of my study in time and place. It outlines the gendered history of Swedish engineering university education and the late nineteenth-century professionalisation of Swedish engineering graduates. It also describes the creation of a Swedish gender equality policy field in the 1970s. After that context is provided, three empirical chapters follow, analysing three major gender equality initiatives at technical universities, one in each chapter.

Chapter 3 explores early expressions of what I call the engineering *recruitment logic*. It does so by analysing the national campaign "More Women into Industry" in the early 1980s and how the campaign was manifested at universities of technology. From 1976 all public authorities were obliged to have a systematic gender equality focus and the chapter interprets the campaign as a response to findings from these systematic efforts. But the campaign was also a response to actors lobbying for more public resources for engineering and industry. Chalmers University of Technology is treated as a case in terms of its first modest attempts to respond to the new national demand to focus on gender equality and its later involvement in the campaign. I define the engagement of gender equality advocates at universities of technology as a form of feminist activism that has previously been overlooked. The chapter interprets their rhetorical construction of "the female engineering student" (*den kvinnliga teknologen*) in recruitment outreach projects, and their failure to address internal structures and cultures, as an outcome of the engineering majority's practise of professional boundary work.

Chapters 4 and 5 demonstrate a new mindset around gender inequalities among a minor yet influential group of "elite" engineering educators. Instead of outreach campaigns, they turned their gaze towards engineering institutions. This elite group primarily focused on engineering curricula. They were convinced that engineering education at universities desperately needed reforming – not only to broaden the student pool but to make engineering relevant in a world where "the technological" and "the social" could not be separated. Traditional engineering curricula, the elite educators argued, were built on the assumption that technology was independent of context, such as the social, political, economic, environmental and gendered contexts. The 1990s

reformers opposed such distinctions. Chapter 4 focuses on the tension between what I identify as an emerging *reform logic* and the previously all-encompassing recruitment logic. Whereas engineering actors focusing on gender equality since the 1970s and 1980s turned to new ideas of curricular and pedagogical reform, in the early 1990s the engineering majority held on to the recruitment logic, to the conviction that girls needed to be convinced that "technology is fun". Universities of technology thus kept launching outreach and information campaigns to this end.

In contrast, the minor "reform elite" of higher education bureaucrats, natural science professors and engineering educators turned to new measures. A national programme facilitated by the state cabinet and the Minister for Education provided funding for curricular reform. The launch and context of this programme and how it played out at Chalmers and Linköping University are at the centre of Chapter 4. The tension between engineering educators embodying the recruitment logic – launching information campaigns and turning their back on curricular reform – and faculty engaging in reform projects constitutes the core of the chapter. It outlines early examples of the reform logic at a stage when gender equality was interpreted and motivated as part of a push for another prioritised goal: to raise educational quality. Compared to the reform project outlined in Chapter 5, the reforms lobbied for and implemented in the early 1990s were modest. They built on a "home-brewed" gender in engineering discourse which claimed that women would contribute feminine perspectives, something that was needed in engineering education. The thesis suggests that the reform logic developed but split into different fractions in the 1990s. One path would develop into CDIO (conceive, design, implement, operate), an international concept for engineering curricular reform first initiated at MIT.[107] Swedish engineering educators soon followed suit.[108] A different path was taken by a group at Linköping University, with funding from the Ministry of Education. This project, Project New Engineering Education or Project NyIng (*Projekt NyIngenjörsutbildning*), is the focus of Chapter 5.

The final analytical chapter, Chapter 5 highlights an engineering initiative, Project NyIng which looks utopic compared to engineering rhetoric in the 2020s. In today's "crisis of engineering", as literature and technology historian Rosalind H. Williams has

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[107] Williams, *Retooling,* 51, 210.

[108] Interview with Anders Flodström, 20 Jan. 2021; Göran Gustafsson, "Experiences from the transformation of an engineering education introductory project design course into a project design-build-test course", in *Shifting Perspectives on Engineering Education,* ed. Michael Christie (Gothenburg, 2006), 33–43, 34.

put it, such initiatives are worth revisiting.[109] Chapter 5 closely connects to Chapter 4. It does so in the motivations and activities the actors involved proposed and developed, but their scope had now become wider and their ideas more radical. Chapter 4 already introduces one of the main individuals featured in Chapter 5, Professor Ingemar Ingemarsson. While managing the setting up of the new IT programme at Linköping University starting in 1993, Ingemarsson was assigned to spearhead Project NyIng. It was a launch with the intention of rethinking *all* Swedish engineering programmes, not just a few local ones. The project identified three areas of focus to provide the route towards a renewed and more relevant engineering education at universities: problem- and project-based learning, integrating humanities and social sciences with engineering, and a return to practical knowledge. Such renewal was not only necessary to align engineering education with industrial contemporary challenges, but to diversify the student body.

Further, the project management actors argued that many engineering programmes made it difficult for students to choose, often leading to programme-switching and a prolonged period before graduation. Project NyIng strongly recommended restructuring. While aware of the curricular battlefield and its inertia, project management actors severely underestimated the difficulties of implementing such reform. In Project NyIng the reform ideology was radicalised. Project management focused on integrating social sciences and the humanities. Pedagogical scholars, journalists, cultural commentators and even theologists were invited to participate in the reform processes. Together the findings of chapters 4 and 5 suggest that, while dominant strains in 1990s' Swedish national politics emphasised minimal state intervention, Project NyIng as well as the earlier Five Gender-Inclusive Projects programme, represented an older conviction; a belief in the possibility – and necessity – of politics and education for citizenship. This position was dependent on the background of influential engineering educators who came of age during the radical politics of the 1970s' and found themselves in influential decision-making positions nationally in the 1990s. The chapter explores how the management consulted scholars studying the gendered aspects of science and technology. Such research, which Schiebinger identifies as "fixing the knowledge" gained ground at minor divisions at universities of technology by the end of the 1990s. As the chapter discusses, most universities did not build further on this momentum.

[109] Williams, *Retooling*; personal communication with Rosalind H. Williams, March 2019 and Oct. 2019.

Chapter 6 sums up the thesis analysis and presents significant findings. The ideological and material implications of the recruitment logic, the dominant gender equality logic among engineering educators from the 1970s and onwards, are unpacked. The chapter discusses the "the female engineering student" as an ideological trope, an outcome of engineering educators' demarcation of professional boundaries. Building on the novel reform initiatives, which were started by visionary engineering faculty members in the 1990s but never became mainstream (Chapter 5), the final chapter considers alternative paths for future policy and reform efforts.

2

Background: The Making of a Gendered Profession

This chapter has two main objectives. The first is to outline the broad social, economic and political context that forms a backdrop for this thesis. The "making" of a Swedish gendered engineering profession, starting from the mid-1800s, was interlinked with broader societal transformations. Secondly, the chapter aims to demonstrate how the 1970s was a time of turbulence and change, not only in Swedish society in general, with the spread of social movements such as the women's movement, the environmental movement and the peace movement, but also for professionals like the engineering graduates. Work by historian and sociologist Boel Berner, mentioned in Chapter 1, is vital here. But before outlining her gender analysis of the Swedish engineering profession and education, the chapter discusses some formative events of the nineteenth century: the emerging technical education system in the early nineteenth century; the creation of a professional association of engineering graduates towards the end of that century; and the professional challenges that entry of women posed from the early twentieth century. In its conclusion the chapter outlines the emergence and establishment of a national gender equality policy field.

SWEDISH UNIVERSITIES OF TECHNOLOGY: DUAL HERITAGE OF MILITARY AND CRAFTS

While there were attempts at developing education back in the seventeenth century – most notably by Christopher Polhem, the roots of formal Swedish engineering education are usually associated with educational institutions established in the early nineteenth century. Sweden was an agricultural society; much of the population lived their lives in the countryside. It would take another century for the city to become the home of the majority of the population, but in larger cities, small-scale industries such as textile mills, chemical factories and mechanical shops were slowly emerging. In connection with such sectors, state and private actors established crafts schools (*slöjdskolor*) to provide factory and shop workers with the skills needed.[110] Chalmers School of Arts and Crafts

[110] Berner, *Teknikens värld*, 118–123. See also Björck, "A Distinguished Scientific Field? Pursuing Resources and Building Institutions for Engineering Research in Sweden, 1890–1945", *History*

(*Chalmersska Slöjdskolan*) in Gothenburg, the predecessor of Chalmers University of Technology, is one example. The Technological Institute (*Teknologiska institutet*) in Stockholm, which became the Royal Institute of Technology (KTH), is another. These institutions gave courses in a variety of subjects. Students at the Technological Institute, for example, could learn how to make artificial flowers from "a foreign lady" (*utländskt fruntimmer*). In contrast to the later universities of technology, the courses were open to both women and men.[111] The sharp distinction between technology and crafts is a twentieth-century invention; nineteenth-century commentators commonly used the term "useful arts" to describe what later evolved into two separate categories.[112]

Around the same time, during the first decades of the nineteenth century, the Swedish Government established the first formal engineering schools. In 1818, the Military Academy at Marieberg (*Högre Artilleriläroverket*), close to Stockholm, opened to provide technical education for military purposes, e.g. road and waterway construction for fortification. A year later, in 1819, a mining college (*Falu bergsskola*) was founded, and in 1830 the Swedish School of Mining and Metallurgy (*Bergsskolan i Filipstad*) opened. Both schools were later integrated into KTH.[113] The existence of these institutions reveals two things about contemporary Sweden at the time. First, the nation was a military power. In the 1600s the men who provided the military with fortification expertise had engineering titles. The engineer thus made his way into the Swedish vocabulary through the military system. Through the establishment of the Academy at Marieberg, the Swedish state educated engineers with civil functions who built canals, bridges and later railroads and telecommunications. The Swedish degree called *civilingenjör* which, starting in the twentieth century, refers to all engineers with a university degree, regardless of their specialisation

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and Technology 32, No. 4 (2016): 315–348; Lindqvist, "Ideology and Institutional Structure"; Torstendahl, *Teknologins nytta*, Chapter 1.

[111] Maja Fjæstad, "Teknikens kvinnor: Perspektiv på en mångfacetterad historia", https://www.sverigesingenjorer.se/globalassets/fortroendevald/stod-och-verktyg/teknikens_kvinnorperspektiv_pa_en_mangfacetterad_historia_webb.pdf, retrieved 2 Nov. 2017.

[112] In Sweden, the concepts of art (*konst*), crafts (*slöjd*) and technology (*teknologi*) were used interchangeably without specific distinctions. See Torstendahl's empirical analysis in *Teknologins nytta* and Svante Lindqvist, "En sliten och alldeles för trång bonjour. Den historiska bakgrunden till KTHs organisatoriska struktur" (Stockholm, 1992). More on crafts schools in Torsten Althin, *KTH 1912–62: Kungl. Tekniska högskolan i Stockholm under 50 år* (Stockholm: 1970); Berner, *Teknikens värld*.

[113] Boel Berner, "Professional or Wage Worker? Engineers and Economic Transformation in Sweden", in *Engineering Labour: Technical Workers in Comparative Perspective,* ed. Peter Meiksins and Chris Smith (London, 1996), 171; Berner, *Teknikens värld*, 119–121.

(not only civil engineering, which a direct translation would suggest), was established in 1844 to distinguish between the engineers with civil functions trained at Marieberg and their military counterparts with the title *ingenjör*.[114] Second, mining was the dominant industrial sector in the early nineteenth century. Before the establishment of engineering education institutions, the first engineering exam was, according to Boel Berner, a "university degree in law and sciences (1750)".[115] This was a route to a position within the Swedish Board of Mines (*Bergskollegium*). From the early nineteenth century, the new mining colleges provided specialised training for such positions. Sweden's dominant position as an exporter of copper in the seventeenth century and iron in the eighteenth made the country "the OPEC of its day" with a near monopoly of high-quality iron, tar and copper.[116] In addition to the civil engineers trained at the military academy at Marieberg and the mining engineers trained at the newly established mining colleges, the early nineteenth-century Swedish state employed a third type of engineer. These were experts connected to the rise of the Swedish empire, often of Dutch or German origin. Hence, being an engineer was, in Berner's words, "from the seventeenth until the mid-nineteenth century, to be part of a hierarchically organised, civil or military state corps of military or technical men", a theme Berner has further elaborated on in her exploration of the early twentieth-century educational cultures at the Royal Institute of Technology and Chalmers.[117] Concerning this military tradition, drawing on analysis carried out by Berner and also by sociologist Sally Hacker, Minna Salminen–Karlsson has argued that recruiting women to engineering education "means taking women into a system which both historically and currently has a function of strengthening a masculine identity and male bonding".[118] This point should not be underestimated; the military and hierarchical tradition are critical to understanding the microcosm at technical universities in the late twentieth century – whether discussing curriculum, teaching and learning methods, or student culture.

While formerly dedicated to the nobility, state bureaucracy positions were, from the 1800s to an increasing extent, given to men with technical or scientific training. Parallel

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[114] For the development of the Swedish term *ingenjör* see Berner, *Teknikens värld*, 116. For the corresponding European development, see, e.g. John Rae and Rudi Volti, *The Engineer in History* (New York, 1993).

[115] Berner, "Professional or Wage Worker?", 168–195, 170–171.

[116] Ibid., 170-171.

[117] Ibid.

[118] Salminen-Karlsson, *Bringing Women into Computer Engineering*, 25.

to the professionalisation process of the engineers in the late nineteenth century (see sub-chapter "Creating a Homosocial Elite"), this group gained an increasing hold on management positions within public agencies. When the Swedish industrialisation process took off in the 1890s, an extensive technical education system was already in place, which meant, first, that a minority group of around 2,000 highly educated engineers could influence the course of large-scale industrial change, and second, that this group of engineers had already created a "professional identity for itself, based upon its educational credentials and its importance for the nation's infrastructural and technical modernisation".[119] These circumstances, Berner argues, would make the Swedish engineers trained at KTH and Chalmers view themselves as "a central force" behind industrial transformation and society's modernisation.[120]

Despite those early engineers being a product of the needs of the Swedish state, the establishment of higher technical education took place in close association with the emergent private industry. Historian of technology Svante Lindqvist has shown the connection between early industrial sectors, the first engineering programmes and the geographical location of both. He demonstrates that not only was this typical for nineteenth-century development but it has been the pattern until at least the 1980s.[121] This relationship is a cornerstone in the engineer's self-image. Building on the work of Sven Eric Liedman and Lennart Olausson, both scholars in the history of ideas, Svante Lindqvist aimed to explain the tensions built into the Swedish higher technical education system.[122] In 1988, Liedman and Olausson introduced and developed the concept of "frozen ideology", a tool to explain academic organisational inertia.[123] Shortly thereafter, Svante Lindqvist suggested that this was a valuable concept in the analysis of technical universities.[124]

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[119] Berner, "Professional or Wage Worker?", 173, 176. This number likely includes graduates from KTH as well as Chalmers. In 2010, 34 percent of all engineers between 20 and 74 years old held a MSc degree in engineering, representing 105,000 individuals. Women made up 22 percent (23,000). Statistics Sweden (SCB), *Ingenjörerna: En djupanalys av ingenjörsutbildade och personer med ett ingenjörsyrke*, Temarapport 2013:1, 9.

[120] Ibid.

[121] Lindqvist, "En sliten och alltför trång bonjour"; Lindqvist, "Ideology and Institutional Structure".

[122] Ibid. ("Ideology").

[123] Sven-Eric Liedman and Lennart Olausson, ed., *Ideologi och institution: om forskning och högre utbildning 1880–2000* (Stockholm, 1988). See Williams, *Retooling*, 38, for a discussion of historian of technology Edward Layton's analysis of "ideology of engineering".

[124] Lindqvist, "Ideology and Institutional Structure".

Liedman and Olausson understood ideology as an implicit, or explicit, but often *contradictory* system of ideas, rituals and possible actions responses (*handlingsberedskaper*). The system gains content and meaning in a particular society, as ideologies depend on the specific classes, groups, institutions, traditions, and conflicts that define each society.[125] An ideology is, according to Liedman and Olausson, built up of three parts: convictions, values, and norms. How the ideology materialises depends on its bearers and how they connect these different parts. The connections are often made in conflicting ways.[126] Furthermore, Liedman and Olausson interpret a frozen ideology as a system based on older convictions, values and norms. It might not have any explicit proponents today, but traces of it are found in, for example, organisational structures. The power structures and hierarchies embedded in the frozen ideologies are activated occasionally, although the ideology itself is dead.

Svante Lindqvist, in turn, argued that universities of technology, despite their university status, were inherently different to the traditional university system. They were perceived as part of the Swedish industrial infrastructure rather than as institutions of higher education. The same was true for similar institutions all over Europe. Their location provided one piece of evidence for this. Instead of being established in traditional university cities, the first Swedish engineering colleges were located in industrial towns.

Moreover, the growth and addition of new engineering programmes were intimately linked to Swedish industrial expansion. Early programmes – in mining, metallurgy, and civil engineering – demonstrated the close ties to early Swedish industrialisation and the military. Programmes were subsequently added with each new industrial field, as presented in Figure 1.1.

In contrast to traditional universities, which had been research institutions for a long time, engineering colleges were supposed to provide the industry with an adequately trained workforce. In this regard they differed significantly from the much older universities. The strong post-war research focus at Swedish universities of technology was only established in the inter-war period. However, the "frozen ideology", the organisational structure still remaining from the nineteenth-century, to some extent hindered institutional change. Lindqvist argues that this has caused a kind of tension at universities of technology; an incompatible structure that positions research as a core (high status) activity. At the same time they are aiming to provide industry with engineers

[125] Liedman and Olausson, ed., *Ideologi och institution*, 9.
[126] Ibid.

with sufficient skills.[127] This is the frozen ideology that Lindqvist recognises. To his conceptual framework, he adds *semi-frozen* ideology among the senior faculty and professors at the universities. Their "basic values" were formed during the early years of their education.

> If the basic ideology of an individual is cast in his or her, say, late twenties, it means that they too will constitute a "frozen ideology" in some sense during the next forty years within an institution. This component of the total ideology is "semi-frozen" in the sense that this part of the total number of scholars is constantly "melting away" as they retire to make way for younger generations.[128]

Lindqvist acknowledges that this situation is not specific to technical universities. Thanks to their rise in power over the years, a group of older individuals could exercise substantial influence in any institution. It is, however, possible to argue that universities of technology, at least in Sweden, are peculiar in nature. Engineering graduates and engineering faculty are very often loyal to their educational institutions.[129] Active graduates associations, past graduates visiting as industry professionals during labour market days, and frequent exchanges between engineering graduates, industry and student organisations are just a few examples. At Chalmers, for example, this strong loyalty is referred to as "the Chalmers spirit" (*Chalmersandan*).[130] The comparison and competition between the different universities of technology, especially the two oldest, Chalmers and KTH, is another example of this peculiarity. The university corridors are inhabited by faculty members who have spent decades inside the same organisational walls. Feminist scholarship on engineering has shown how engineering faculty and graduates are proficient in reproducing what this thesis would identify as professional norms for new generations of engineering professionals and faculty.[131] This is independent of the gender

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[127] Lindqvist, "Ideology and Institutional Structure", 192.
[128] Ibid., 183.
[129] E.g. Ek-Nilsson, *Teknikens befäl*.
[130] *Chalmersandan* is integrated in the 2021 Chalmers Code of Conduct, https://www.chalmers.se/sv/säker/Sidor/chalmers-code-of-conduct.aspx, retrieved 12 Nov. 2021.
[131] E.g. Ek-Nilsson, *Teknikens Befäl*; Kai Lo Andersson and Catharina Landström, "The Sole Engineering Genius: A Professional Identity Not Fit for the Purpose of Gender Equality", forthcoming article.

identity of the newcomer; the majority of students assimilate engineering professional culture.

The tension between academic and industrial values is a built-in dilemma at these institutions that has never ceased. Lindqvist argues that only through reform and development to find ways to navigate this situation can it be eased.

1853/54	**59/60**	**69/70**	**77/78**	**97/98**	**99/100**	**01/02**	**14/15**	**16/17**	**32/33**	**84/85**	**85/86**
M	M	M	M	M	M	M	M	M	F	F	A
K	V	V	V	M'(E)	M'(T)	T	T	T	M	D	B
	K	K	A	V	E	E	E	E	T	M	D
		B	B	A	V	V	V	V	E	T	E
			K	B	A	A	A	K	V	E	F
				K	B	B	B	B	K	V	K
					K	K	K	A	B	K	L
									A	B	M
									L	A	T
										L	V

M = Mechanical engineering
K = Chemical engineering
V = Civil engineering
B = Mining and metallurgy
A = Architecture
E = Electrical engineering
T = Transportation engineering (incl. naval architecture)
F = Engineering physics
L = Surveying
D = Computer science

Figure 1.1. The growth of various engineering programmes (or "schools") at the Technological Institute/Royal Institute of Technology, 1827-1990. The order of presentation before 1985/86 corresponded to a "hierarchy of prestige" that was "incomprehensible to the initiated", reflecting a "mixture of values based partly on seniority and partly on the relative theoretical level of the subject matter of each school". Lindqvist, "Ideology and Institutional Structure", 186. Reprinted with permission of the author.

CREATING A HOMOSOCIAL ELITE

The higher technical education system began to take on a more distinct identity in the mid-1800s. After decades of debate, the Technical Institute in Stockholm received

university status in the 1870s.[132] The civil engineering degree at Marieberg and the mining engineering degrees at the previously independent engineering education institutions became integrated into the new Royal Institute of Technology (KTH).[133] Now, the group of highly educated engineers graduated at KTH and Chalmers Technical Institute (previously Chalmers School of Arts and Crafts, later Chalmers Institute/University of Technology) formed a small, well-defined elite.[134] As sons in the upper middle class families, they had gone through the education system supported by the "mobility machine for men", the secondary school system which provided privileged boys with knowledge and social connections.[135] Thus, the young men who entered the KTH in Stockholm and Chalmers in Gothenburg, belonged to a privileged minority of the male population who had received a publicly financed secondary education. Berner stresses that "the student entering higher education had already been socialised in seeing himself as a member of a select social group".[136]

This process, integrating the different engineering degrees within the university system, has often been discussed in terms of professionalisation.[137] As outlined in Chapter 1, professionals are commonly described as experts in a particular field who base their expertise on a specialised education as well as scientific research and knowledge.[138] Through their university education, engineers in the late nineteenth century aspired to gain management positions at state agencies and in industry.[139] Meanwhile they strived to distance themselves from engineers without a degree. Central to these efforts was forming professional organisations, and one that stands out is *Svenska Teknologföreningen* (*STF*), a Swedish association of engineers and architects. First established as an organisation for

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[132] Chalmers did not gain a university title until 1937. However, it basically functioned as a university much earlier than that, see e.g. Björck, *Staten, Chalmers och vetenskapen*. See also this thesis chapter 1, footnote 25.

[133] Runeby, *Teknikerna, vetenskapen och kulturen*; Berner, *Teknikens värld*, 118–123.

[134] Berner, *Sakernas tillstånd*; Björck, *Staten, Chalmers och vetenskapen;* Runeby, *Teknikerna, vetenskapen och kulturen;* Torstendahl, *Teknologins nytta*.

[135] Berner, "Educating Men", 92. Also Christina Florin and Ulla Johansson, *"Där de härliga lagrarna gro –" kultur och kön i det svenska läroverket 1850–1914* (Stockholm, 1993); Staffan Wennerholm, *Framtidsskaparna: vetenskapens ungdomskultur vid svenska läroverk 1930–1970* (Lund, 2005).

[136] Berner, "Educating Men", 92.

[137] This thesis Chapter 1, sub-chapter "Historiography of a Gendered Engineering Profession".

[138] Brante, *Den professionella logiken,* 15, 19.

[139] Berner, *Teknikens värld,* 204 ff.; Björck, *Staten, Chalmers och vetenskapen*; Runeby, *Teknikerna, vetenskapen och kulturen*; Bosse Sundin, *Den kupade handen: historien om människan och tekniken* (Stockholm, 2006), Chapters 10 and 11.

students at the Technical Institute (later the Royal Institute of Technology, KTH) in 1861, it was transformed to become the leading organisational body for Swedish engineering graduates in 1887 and, in time, became the most significant professional organisation for engineers.[140] At lectures, debates and in STF's organisational journal, *Teknisk Tidskrift*, engineers discussed issues of importance to professionalisation. Through the Association's function as a governmental consultation body (*remissinstans*), these engineers created strong connections to political and industrial leadership, even inhabiting such positions. Thus through STF, the homosocial community of elite engineers formed a platform from which they could push their agenda.[141]

The argument for a "scientific curriculum" was critical to engineering professionalisation. This science-based curriculum was central in the engineering graduates' attempts to distance themselves from engineers with less formal education. A few decades later, starting in the 1910s, a curriculum for the "modern engineer" also had to include courses in management and economics, according to parts of the community. They argued that this would be critical for future leadership in the field. As outlined in the previous chapter, the twentieth century inherited a curricular battlefield stemming from these early professional negotiations. The battlefield would impact later reform attempts.

While distinguishing between professional engineers and those without a degree needed to be motivated, excluding women from engineering university education (*civilingenjörsutbildning*) required less effort. Although Swedish women at the turn of the twentieth century participated in public society, they did so in an atmosphere of strong gender dualism. Gendered notions of women's and men's different skills and functions in society barred women from university education in engineering for decades.

WOMEN'S STRUGGLE TO ENTER SWEDISH ENGINEERING EDUCATION

Legislation has historically worked as a safeguard to keep occupations and professions male-exclusive. There have been numerous formal obstacles preventing women from entering education and obtaining salaried positions. Swedish universities, open to men with diplomas from upper secondary school (*gymnasium*), only started accepting women in

[140] Ibid.

[141] On the community of engineering graduates as a homosocial collective, see Berner, "Educating Men", 93–94; this thesis Chapter 1, sub-chapter "Study Objective and Research Questions".

1870. But such restrictions did not only apply to the higher education system; many professions excluded women until the second half of the twentieth century.[142] For example, up until 1958 the Swedish state church did not allow women to be ordained, and prior to 1989 only men were permitted to take up command positions within the military.[143]

This is not to say that only the Swedish elite excluded women from its professions and higher education system. The Swedish workers' movement did not shy away from regulations prohibiting women from having salaried work. In 1909 the Swedish Trade Union Confederation (*Landsorganisationen i Sverige, LO*), which organised Swedish workers, reached an agreement that banned women from working at night, excluding half of the population from employment in many areas of industry. The financial system also contributed to women having fewer opportunities in the labour market. The Swedish state indirectly discriminated against married women through the taxation system until the 1970s. Prior to 1971 the State taxed married couples jointly so that most of the second salary was consumed by taxes. This meant that married women with salaried employment were only able to make a small financial contribution to the household.[144] Also, for most of the twentieth century, women's salaries ranged between half and two-thirds that of what Swedish men earned.[145] Sweden as a gender-equal nation is thus a more recent phenomenon than how it is sometimes described. More importantly, the removal of formal barriers did not happen overnight. Each of the examples above was preceded by specific struggles, debates and lobbying efforts.

The official account of women's entry into Swedish engineering education often starts in 1914, seven years before Swedish women's long fight for suffrage finally paid off. That year, Chalmers Technical Institute enrolled chemical engineering student Vera Sandberg. The same year women gained the right to vote, in 1921, the Royal Institute of

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[142] Jordansson el. Al., "Genusarbetsdelning," 38, 40. In English, see Holth et al., "Gender and the division of labour in a Swedish context", in *Gender and change: Power, Politics and Everyday Practices,* ed. Maria Jansdotter Samuelsson, Clary Krekula and Magnus Åberg (Karlstad, 2012).
[143] Ibid.; Sundevall, *Det sista manliga yrkesmonopolet*.
[144] Jordansson et. al., "Genusarbetsdelning", 38.
[145] Ibid; Statistics Sweden (SCB), "Genomsnittlig månadslön, 1973–2021", https://www.scb.se/hitta-statistik/statistik-efter-amne/arbetsmarknad/loner-och-arbetskostnader/lonestrukturstatistik-privat-sektor-slp/pong/tabell-och-diagram/genomsnittlig-manadslon-1973-/, retrieved 20 Jan. 2023. In 2019, women's average salaries were 90.1 percent of men's average salaries. In Swedish National Mediation Office, *Löneskillnaden mellan kvinnor och män 2019*: *Vad säger den officiella lönestatistiken?*, https://www.mi.se/publikationer/loneskillnaden-ar-2019/, retrieved 19 May 2021.

Technology removed its formal barriers towards women. These two institutes had the national exclusive right to educate and award engineering degrees, the highest degree within the technical education system.[146] From then on, so the story goes, the number of women entering engineering programmes at universities would continue to grow, albeit at a slow pace initially, leading up to the current average of 35 percent. Progress was slow but steady. However, the enrolment of women in higher technical education has a more complex history. Women studied at the Technological Institute (later KTH) from its establishment in the early nineteenth century. As the institute was focused on craftsmanship, it was open to students without an upper secondary school diploma – a qualification reserved for young men from the social elite.[147] Historian Rolf Torstendahl has examined the process that transformed the Technological Institute from a craftsmanship school into a technical university. The gendered dimension of this process is, however, a story yet to be told.[148] The quiet entry of women into university engineering programmes from 1914 has been contested, scrutinised and refuted by historians. Boel Berner has made corrections to the official narrative of constant progress. In her study of engineering students at the Royal Institute of Technology (KTH) in the first decades of the twentieth century, Berner describes 30 years of women's requests to enrol being rejected.

Back in 1892 a young woman (name unknown) applied to the Royal Institute of Technology, forcing the university board to address the matter. After being rejected based on the statutes – it was an institution for "young men" – KTH installed an advisory committee the following year to evaluate the issue of allowing women to enrol. Several professors found the statutes outmoded, not least since universities as well as law and medical schools were already open to women. Still, the committee responded negatively stating that women's enrolment would lead to significant "inconveniences".[149] The inconveniences explicitly stated related to the institute's pedagogy. Reflecting the contemporary, gender-dualistic world view, the committee considered field trips and other types of mandatory practical work inappropriate for women. Although the committee deemed some engineering sub-fields suitable, particularly the more scientific

[146] In Swedish *civilingenjörsexamen*. See Björck, "A Distinguished Scientific Field?" for an overview of the Swedish higher technical education system at the turn of the twentieth century, including the process of creating technical doctorate degrees (KTH 1927, Chalmers 1940).
[147] Fjæstad, "Teknikens kvinnor".
[148] Torstendahl, *Teknologins nytta*.
[149] Berner, "Educating Men", 79–80.

ones, it believed that women, with their more "delicate constitution", might suffer from the demanding studies.[150] The committee thus framed the continued restrictions as concern for women's health and wellbeing. Such motivations are well-documented by gender historians in various fields and periods.[151] But Berner also makes a different argument, one that is fundamental to this study. Degrees from the higher technical education system were supposed to lead to managerial positions; positions that were seen as unsuitable for women. At the Royal Institute of Technology and Chalmers Technical Institute, the four-year scientific curriculum aimed to form *men of theory and practice*. This engineering graduate (*civilingenjören*), would gain status and reputation from a scientific curriculum, combined with the practical skills necessary to manage workers on the shop floor, in the mines or in railway and bridge construction in an era of national industrialisation and modernisation. While women had already been awarded scientific degrees from non-technical public universities from 1870, the curricula for the "modern engineer", the industry leader, were deemed inappropriate for women by most contemporaries – men and women alike. From this perspective it is certainly intriguing that some women challenged such perceptions and strived to enrol anyway. While Boel Berner and Anna Karlqvist have studied a few of these women, more empirical research is needed to unpack this aspect of Swedish engineering history.[152] Such research would also shed new light on a critical period of modernisation and industrialisation in Sweden.

In conclusion, 1892 can be seen as a new type of beginning: one of the struggle of isolated women for acceptance by a male-dominated professional institution. It would take three decades before legal obstacles like enrolment requirements were removed at the Royal Institute of Technology and Chalmers Technical Institute, yet formal as well as informal boundaries would remain in place. While female students were no longer excluded from higher technical education, the State still banned women from positions within public authorities, including public universities, until 1923.[153] In this, public universities differed from private higher education. The same year as Vera Sandberg enrolled at Chalmers, physicist Eva von Bahr applied for a professorial chair at the same institution. Her application was not even discussed. The gender-dualistic world view in

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[150] Ibid., 90.

[151] See e.g. Londa Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science*, (Cambridge, MA, 1989).

[152] Berner, *Sakernas tillstånd*; Karlqvist, *Från eftersatt till eftersökt*.

[153] The Royal Institute of Technology and Chalmers Technical Institute were both public institutions.

the higher technical education system was still robust.[154] It would take another 50 years, until the 1970s, before the number of women in university engineering programmes reached critical mass. But while the number of women increased, the gendered professional ideals, values and norms remained intact.

THE PINNACLE OF A HIERARCHAL EDUCATION SYSTEM

As outlined above, technical institutes were established in Sweden in the early nineteenth century to provide industry with skilled labour. They had direct links to mining and the military. In this sense they differed from the traditional universities in Uppsala and Lund.[155] Rather than taking their structure and curricula from the universities, they copied the emerging engineering education systems in Europe, especially Germany.[156] Until 1961, only two Swedish technical institutes had university status, the Royal Institute of Technology in Stockholm and Chalmers University of Technology in Gothenburg. While the number of engineering graduates remained relatively low until the 1960s, the number of engineers with lower qualifications increased exponentially.[157] They received their diplomas at an upper secondary school (*gymnasium*) or, increasingly, from correspondence courses and evening classes. An engineering correspondence course from, for example, Hermods – one of the private institutes providing tailormade correspondence courses for labour market needs – was a route to social advancement for Swedish men in the mid-twentieth century. The Government was instrumental in making this happen, encouraging industrial workers to enrol in engineering courses using, for example marketing campaigns.[158]

[154] Reference to "EK nr. 35, skrivelse från Hugo Grauers till Chalmers styrelse juli/okt 1914" in Kaiserfeld, *Vetenskap och karriär,* 89.
[155] Lindqvist, "Ideology and Institutional Structure".
[156] Torstendahl, *Teknologins nytta.*
[157] Berner, *Sakernas tillstånd,* 175–221.
[158] Ibid.

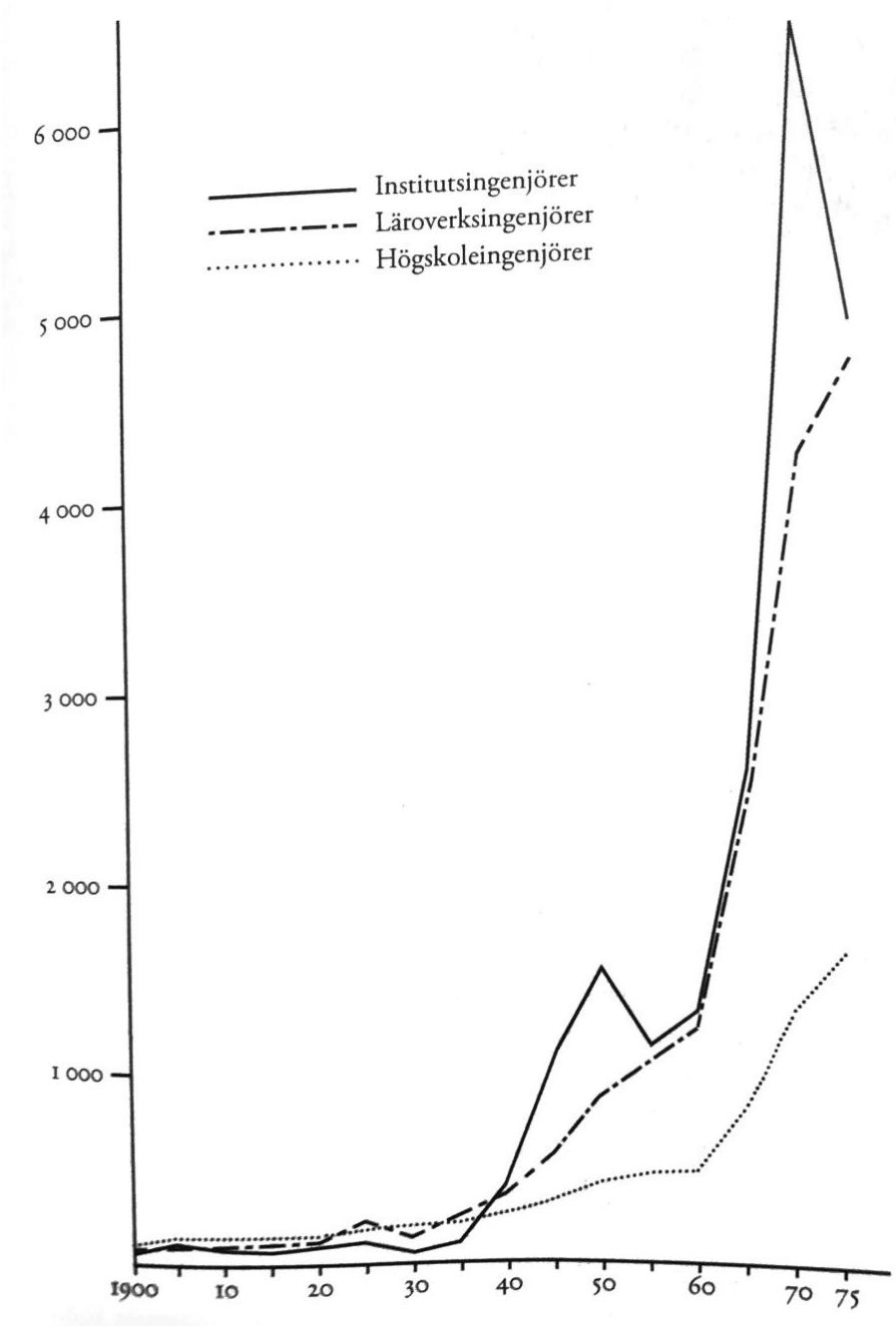

Figure 2.1. The expansion (and decline) of twentieth-century engineering qualifications: correspondence, upper secondary school, and university degrees. In Berner, Teknikens värld*, 126. The straight line represents diplomas from evening and correspondence courses, the dotted line the university degrees, and the line/dots represents upper secondary diplomas in engineering. Reprinted with permission of the author.*

The Swedish school and university system was substantially transformed in the second half of the twentieth century. Twelve years of schooling became the norm for all Swedish pupils from the mid-1960s. Expansion of the university system became a national priority. The Government established new colleges and universities, including new technical

universities. The third Swedish university of technology opened in Lund in 1961 and was followed by technical faculties in the cities of Uppsala, Linköping, Luleå and Umeå over the next two decades. The "lower" technical qualifications were, however, still more common.[159] The engineering qualification from an upper secondary school technical programme, referred to as the T4 diploma, was appreciated in industry. It was, however removed from the educational system in 1992.[160] Instead a three-year university degree was established and administered at universities of technology alongside their traditional degrees, which by this time took four and a half years to complete. This transformation was not free from controversy. The academisation of the technical higher education system was far from celebrated by all. Many educators, industry representatives and professional engineers stressed the need for a more practical-oriented T4 engineer.[161] This context is essential to understanding the discussion regarding Project NyIng which is analysed in Chapter 5. The university engineering degree (*civilingenjörsutbildningen*) has historically been the pinnacle of a hierarchical technical education system. However, the less scientific, shorter qualification became a close second with the institutionalisation of the three-year engineering degree programme called *högskoleingenjörsutbildning*, equivalent to a Bachelor's degree. Status and traditional hierarchies were at stake when the management of Project NyIng suggested in the late 1990s that the two degrees – one lasting three years and one four and a half – should merge into one degree.

While always integrated into the national university system, universities of technology have retained their unique position. On the one hand they have had to adjust to the national university structure, with the political implementation of programme boards, quality assessments, gender equality plans, the changing directions concerning centralised or decentralised decision-making and so forth. On the other hand they are at the top of an entirely different educational system – the higher technical education system – primarily answering to a specific societal and economic need, international industrial competitiveness rather than citizenship and *Bildung*.[162]

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[159] Carl Gustaf Andrén, *Visioner, vägval och verkligheter: svenska universitet och högskolor i utveckling efter 1940* (Lund; 2013); Pålsson, *Ombyggnad pågår*.

[160] Ingemar Lindskoug, "Från T4 till Högskoleingenjörsutbildning: och Hur få flera ungdomar att välja det naturvetenskapliga programmet?" *NyIng report No. 16* (Linköping, 1999), 1–8.

[161] Ibid.

[162] Lindqvist, "Ideology and Institutional Structure". For an intellectual history of the university "idea", see Karlsohn ed., *Universitetets idé*. On *bildning*, see Henrik Björck, "Teknik och bildning i begreppshistorisk belysning", in *På spaning efter teknisk bildning*, ed. Åke Ingerman et al., 1. ed.,

By the final year of the 1960s, Alfred Nettelbrandt, Director of the Swedish Association of Graduate Engineers (*Civilingenjörsförbundet, CF*) observed that a change had occurred regarding the number of women entering universities of technology. Previously the need for a women's council within CF had been considered "insignificant" according to Nettelbrandt, since the number of women in the university-educated profession had been very limited. However, the Association now faced a different situation, one he even considered "radically new", in that the number of female students at the these universities had "'increased rapidly".[163] Nettelbrandt's observation was correct. Between 1936 and 1970, 644 women and 21,559 men graduated from Swedish universities of technology (engineers and architects). The 1960s saw a massive expansion of higher education, with about half of the 22,000 or so engineering students completing their degrees during this decade. As already noted, the higher technical education system added five new universities in the 1960s and 1970s. The percentage of women graduating from these institutions in the 1960s was particular notable: 491 out of the total 644 women gained their degrees during this decade. Of these, nearly half took a degree in architecture and most of the remaining female students completed a chemical engineering degree. Before 1970 only a few women had graduated from one of the older engineering programmes, such as mechanical or civil engineering.[164] Still, by the final years of the 1960s representatives from the engineering profession, such as the CF director Alfred Nettelbrandt, noted a shift – the yearly increase of women in engineering and architecture did not seem to be slowing down. The male majority was still overwhelmingly large, but

(Stockholm, 2009); Anders Burman, *Pedagogikens idéhistoria: uppfostringsidéer och bildningsideal under 2500 år*. 2. ed., (Lund, 2019).

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[163] The suggestion and reference to attachment "stencil 168/69" in § 82 CF board meeting minutes (*förbundsstyrelsesammanträde*) No. 7/69, 10 Sep. 1969, TAM, SAGE archive, A1a:12. The attachment is saved in volume F 10Fa:2, "Punkt 13, Q-råd", CF 168/69.

[164] The statistics were collected and combined from Statistics Sweden publications: *Utbildningsstatistisk årsbok: 1978* (Stockholm, 1979); *Högre studier* (Stockholm, 1959–1964). See Appendix A. The numbers include diplomas in architecture. Statistics for the early decades of the twentieth century in Karlqvist, *Från eftersatt till eftersökt*. See also table in Berner, *Vem tillhör tekniken?*, 176. The distribution of Swedish engineering university newcomers between 1962 and 1969: 48 women/1,083 men in engineering physics, 29 (w)/3,013 (m) mechanical engineering, 37 (w)/2,502 (m) civil engineering, 75 (w)/3,359 (m) electrical engineering, 249 (w)/1,421 (m) chemical engineering, 383 (w)/1,277 (m) architecture. *Utbildningsstatistisk årsbok. 1978*, Table 15.4.

a new category of students – considered only isolated cases in the previous decades – had become visible.

YEAR	60/61	61/62	62/63	63/64	64/65	65/66	66/67	67/68	68/69	69/70
W	16	22	29	33	44	45	61	64	68	109
M	708	723	916	841	913	1,009	1,031	1,212	1,425	1,584

Table 2.1. The total number of graduates between 1961 and 1970 from Swedish universities of technology by study year, divided into women and men. Source: Utbildningsstatistisk årsbok 1978. *The numbers include degrees in architecture.*

Boel Berner has argued that until the 1970s, male dominance of the engineering profession went relatively unnoticed. At the national level the low number of women was only framed as a problem when a shortage of engineers and natural scientists in society was identified. Up until then it was taken for granted that girls and boys had different abilities and would be expected to contribute in different ways to future society.[165] The environment for the female minority entering universities of technology from the early 1920s has only been explored to a limited extent. Some of these women have stated that they felt welcomed by their male classmates, but that their professors did not expect them to stay in the profession.[166] Historian Lina Carls has, with empirical abundance, demonstrated the resistance towards female university students in general between 1930 and 1970.[167] Were the gender dynamics at universities of technology different? There is still work to be done by the scholarly community of Swedish gender historians in this area. As discussed briefly above, Boel Berner's studies show how resistance towards women within higher technical education was explicit in the early twentieth century. She has also demonstrated how this resistance was still being blatantly expressed by industry representatives into the 1960s.[168] A defensive yet confident approach of leaders in industry appeared in a debate in *Industria*, the journal of the Swedish Employers' Confederation (*Svenska Arbetsgivareföreningen, SAF*).[169] Mary Olson, certified as a graduate of an upper secondary school engineering programme, had been allowed to express her frustration in the journal over repeatedly seeking employment and repeatedly being rejected. Three

[165] Boel Berner, "Kön, teknik och naturvetenskap i skolan", in *Vem tillhör tekniken? kunskap och kön i teknikens värld,* ed. Boel Berner (Lund, 2003), 120 f.
[166] Karlqvist, *Från eftersatt till eftersökt.*
[167] Lina Carls, *Våp eller nucka?: kvinnors högre studier och genusdiskursen 1930-1970* (Lund, 2004).
[168] Berner, *Sakernas tillstånd,* 211. See also Karlqvist, *Från eftersatt till eftersökt.*
[169] Reference to *Industria* (1961), 48 f., in Berner, *Sakernas tillstånd*, 211, 343.

industry leaders were given space to separately vent their reflections on Mary Olson's letter published in the journal. Berner summarises: "Three employer representatives responded in the journal. All three strongly refuted Mary Olson's grievance. Disqualification based on gender had certainly not occurred to them".[170] One of these men, David Isaksson of Kabi AB, maintained that the women who worked at Kabi had never expressed any complaints. Their silence was, by Isaksson, interpreted as a sign that everything was in order. According to Isaksson, those who claimed there was gender discrimination at work were thus "a very small minority – the exceptions, the special cases".[171] Furthermore, the three industry leaders communicated their view that women were significantly different to men – an idea with deep historical roots.[172]

Another example is an illustration saved by the Association of Graduate Engineers' women's council in the 1970s. The illustrator drew on the widespread sexist idea that women only attend university to find a husband (and that women's foremost physical attributes are large, barely covered breasts) (Figure 2.2).[173]

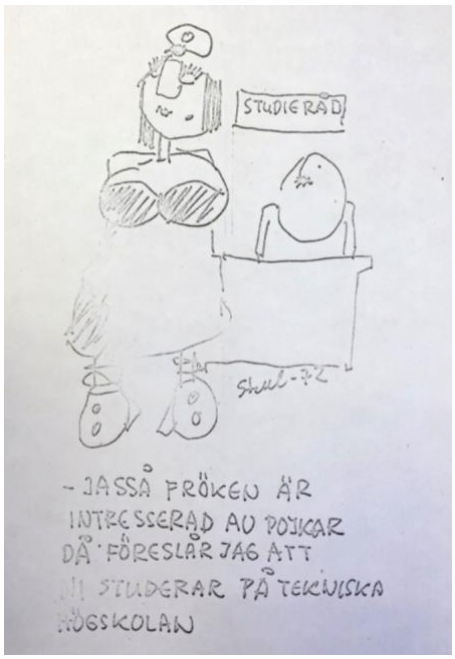

Figure 2.2. Career councillor to student: "So, miss is interested in boys. I then suggest that miss enrols at a university of technology". Courtesy of TAM, SAGE archive, F10Fa:2.

[170] Ibid.

[171] Ibid.

[172] Schiebinger, *The Mind Has No Sex?*.

[173] TAM, SAGE archive, F10Fa:2. For more on the same theme, see: Carls, *Våp eller nucka?*; Bix, *Girls Coming to Tech!*

The illustration was most likely published in the Association's journal, the *CF Journal*. Graphic images with the signature STRUL frequently appeared in the journal in the 1960s and 1970s, often with sexist undertones.[174] Surveys conducted by the Association's women's council in the early 1970s revealed that many female engineers felt discriminated against in the workplace.[175] The new situation in the 1970s, with an increasing number of women entering the profession meant that the formerly self-identified, politically neutral engineering profession was confronted with new labels: gendered, privileged and exclusive. A minority that until then had functioned as an opposite, an anomaly, a sanction of the male norm, suddenly uncovered the veil of neutrality. This new labelling would not go unchallenged.

GENDER EQUALITY (RE-)ENTERS THE POLITICAL AGENDA

The transformative period of the 1970s for Swedish engineering graduates corresponded to changes taking place in Swedish society. Gender equality politics (*jämställdhetspolitik*) emerged as an independent policy field for the Swedish Government. A council on equality between men and women (*Delegationen för jämställdhet mellan män och kvinnor*) instituted by Olof Palme and his Social Democratic cabinet in 1972, is often noted as a starting point.[176] In 1979, the Cabinet, now centre-conservative, enacted the first Gender Equality Act. During the interim years, in a process outlined further in Chapter 3, the cabinet introduced regulations for a systematic focus on gender equality within the Swedish public sector. At the same time, the Swedish Employers' Confederation (*SAF*) and the Swedish Trade Union Confederation (*LO/PTK*) agreed on similar rules for the private sector. The same regulations were imposed on county administrative boards (*länsstyrelse*) and municipalities in 1980. In 1988 the Government decided on a national action plan for gender equality, and in 1992 the Gender Equality Act was reformed and renewed. The gender equality policy field had consolidated and it now involved a gender equality minister, independent national bodies and gender equality experts on each county administrative board.[177]

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[174] I have skimmed through selected volumes of the *CF Journal* between 1965 and 1975. The signature occurs in many volumes and often more than once.

[175] Survey and survey reply in TAM, SAGE archive, F10Fa:5.

[176] See e.g. Florin and Nilsson, "'Something in the Nature of a Bloodless Revolution…'", 68; Elisabeth Sundin and Ulla Göranson, *Vad hände sen?: långsiktiga effekter av jämställdhetssatsningar under 1980- och 90-talen* (Stockholm, 2006), 12 f.

[177] Ibid. The process is summarised by Sundin and Göranson. Empirical analysis of the 1970s' institutionalisation of gender equality politics in Florin and Nilsson.

Where did the push for a gender equality policy field come from? The cultural history of Swedish "second-wave feminism" – the 1960s and 1970s radicalisation of gender equality and women's rights issues – often begins with the writings of young liberals, in particular an article by journalist Eva Moberg under the heading "*Kvinnans villkorliga frigivning*" (Women's Conditional Release) published in 1961.[178] In her essay Moberg confronted the earlier message communicated by Alva Myrdal – one of the leading Social Democratic voices since the 1930s – about the "two roles" of women: mother and wage-earner.[179] Moberg argued that since women were still expected to find purpose in life through marriage and family, "equality between the sexes" was not possible. Only when men and women took equal responsibility for home and family would women be free. Gender historian Yvonne Hirdman has portrayed such events, which took place in the 1960s and 1970s, as a drastic shift; as an expression for a new *gender contract* in Swedish society.[180]

The Liberal Party and liberal writers sparked this shift, but the Social Democratic political leadership soon embraced the rhetoric after making a 180-degree turn in their social politics. The new contract, which Hirdman labels the "gender equality contract" (*jämställdhetskontraktet*), followed a radically different logic than the "housewife contract" (*husmoderskontraktet*).[181] In the old "contract", women had their self-subscribed role as reproducers and caregivers. It was intimately linked to *folkhemmet,* "the people's home". The Social Democratic Party launched this vision of an ideal type of welfare state in the 1930s. In *folkhemmet* women would be financially taken care of by their husbands' employment, by the male "breadwinner".[182]

Yet many women participated in the labour market before the 1970s. They did not, however, benefit from the national welfare system. Swedish society viewed women in salaried employment as temporal workers, as "factory girls", or as "gainfully employed housewives" (*förvärvsarbetande husmödrar*), which was the official title for married women in the labour market in the national statistics.[183] It was assumed that these girls and

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[178] Eva Moberg, "Kvinnans villkorliga frigivning", in *Unga Liberaler: nio inlägg i idédebatten* (Stockholm, 1961).

[179] Alva Myrdal, https://www.skbl.se/sv/artikel/AlvaMyrdal, svensk kvinnobiografiskt lexikon (article by Maria Sjöberg), retrieved 29 March 2019.

[180] Hirdman, *Genus*, e.g. 158–162.

[181] Ibid. For a shorter period, during the 1960s, Hirdman identifies an "equality contract" (*jämlikhetskontrakt*).

[182] Ibid., 140–141, 147–152.

[183] Jordansson et al., "Genusarbetsdelning", 38.

housewives would soon get married and exit the labour market or if they were already married, their finances would be secured by their husbands. In each case, politicians, trade union organisations and industry representatives deemed their lower salaries to be fair. In constructing the woman as the caretaker of the home and family, and the man as the husband and sole breadwinner, the housewife contract followed a traditional heteronormative path.

Over the course of the 1960s and 1970s – two turbulent decades in terms gender norms – this contract shifted to a two-breadwinner norm, according to Hirdman.[184] The new gender equality contract, while still based on the heterosexual nuclear family, required both husband and wife to have salaried employment outside the home. This gender equality contract was in no sense a low-hanging fruit in the politically reformed Social Democratic Sweden. The one-breadwinner norm had been the goal of the male-dominated labour movement, and political reforms to guarantee its stability had been vital in the young Social Democratic Swedish State.[185]

How did this shift come about? Hirdman argues that empirical work is lacking, but as for any historical change, a complex network of interwoven factors resulted in this radical transformation of a gender-conservative society to one of the world's most gender-equal countries. Structural elements like education politics, changing demographics, a growing industry with a seemingly infinite need for more labour, and a relatively large number of highly educated women were all critical.[186] The Swedish overheated post-war economy, untouched by the material destruction of WWII, is often described as an economic golden age, "a time of harvest" (*skördetiden*), which would last for almost 30 years until the early 1970s.[187] The ideal of the one-breadwinner nuclear family had never been completely fulfilled. From the early twentieth century, Swedish industry employed a growing number of women, and women – albeit at a slow pace initially – were increasingly educated at specific girls' schools (*flickläroverk*) and at university. But in addition to structural factors, individual actors were also important. Historians Christina Florin and Bengt Nilsson have studied the actors that lobbied for economic and social reforms during the 1960s and whose lobbying work in media and within governmental agencies

[184] Hirdman, *Genus*, 162–171.
[185] Ibid., 147–152.
[186] Ibid., e.g. 172 f.
[187] Per Lundin, Niklas Stenlås, and Johan Gribbe, eds., *Science for welfare and warfare: technology and state initiative in cold war Sweden* (Sagamore Beach, MA, 2010).

eventually yielded results (Figure 2.3).[188] The outcome of these actors had been preceded by a radical vision back in the 1930s, when the well-known couple Alva and Gunnar Myrdal wrote their widely read *Kris i befolkningsfrågan*. Their vision did not align with the ideal of the Social Democrats' one-breadwinner norm. In the Myrdals' society, men and women would be freed from domestic work through public childcare, a community laundry service and dining halls.[189] Lobby groups in the 1960s, such as the progressive Group 222, put such issues on the agenda again.[190] In the 1970s the more radical women's movement, represented by, for example, Group 8, moved their agenda forward.[191]

This thesis explores voices in camps that have not been studied by historians before and who took part in this process. In the early 1970s, actors within the Swedish Association of Graduate Engineers worked to place gender inequalities in the engineering profession on the agenda, in the same way as Group 222 had done.[192] And at universities of technology, staff that were not research faculty members, for example administrators and non-faculty educators, seized the moment when a systematic focus on gender equality was required by the State later in the same decade. The upcoming chapter explores that process.

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[188] Florin and Nilsson, "'Something in the Nature of a Bloodless Revolution…'".

[189] Hirdman, *Genus*, 154 f.

[190] Florin and Nilsson, "'Something in the Nature of a Bloodless Revolution…'", 44 ff.

[191] For details on the 1970s socialist women's movement see Emma Isaksson, *Kvinnokamp: synen på underordning och motstånd i den nya kvinnorörelsen* (Stockholm, 2007); Elisabeth Elgán, *Att ge sig själv makt: Grupp 8 och 1970-talets feminism* (Gothenburg, 2015).

[192] Malin Nordvall, "The Resistant Profession: Gender Equality Work in the 1970s' Swedish Engineering Union", unpublished conference paper, SHOT Annual Meeting, Philadelphia, Oct. 2017.

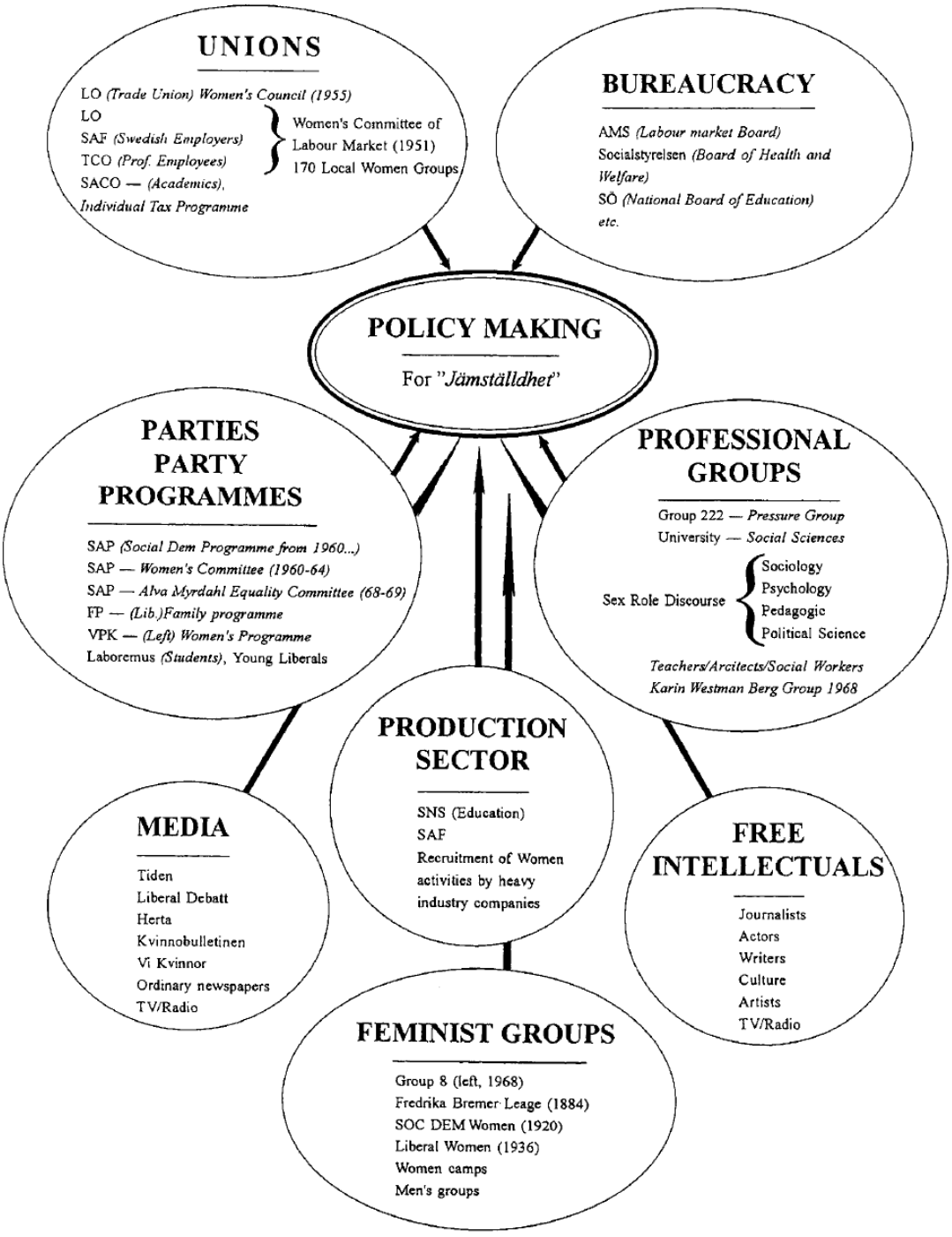

Figure 2.3. Illustration of "The policy-making progress for gender equality". It highlights group such as unions, professional groups and the production sector, actors that are further explored in this thesis. In Florin and Nilsson, "'Something in the Nature of a Bloodless Revolution…'", 67. Reprinted with permission of the authors.

3

Fixing the Girls: Recruiting the Female Engineering Student

In 1981 two engineering educators at Chalmers University of Technology proposed a course on steps to take if harassed in the workplace. The course was aimed at female students who were approaching graduation and intended to prepare them for entering the job market. One of its purposes was to provide guidance on how to deal with insults from male colleagues and superiors. The course objective stated that "female engineering students often encounter what they experience as unexpected resistance and an intimidating prejudice when they enter their professional career".[193] The resistance they faced was based on "ingrained values" of women in the workforce and "unfamiliarity with women's mastery of traditional male skills".[194]

The example illustrates how the prevalence of gender-based discrimination in male-dominated workplaces and universities of technology was a cause for concern for some engineering educators in the early 1980s. Contemporary reports supported their perspective: students voiced experiences of sexism and harassment in the media, an ethnographic study conducted at Chalmers identified highly sexist practices in student social activities, and surveys pointed towards gender-based discrimination in hiring.[195] However, efforts during the 1980s to improve gender equality at universities of technology seldom targeted the hostile and sexist work environment, neither at the educational institutions nor in industry. Instead, engineering educators focused on boosting the individual women's skills, confidence and interest in technology. How come?

This chapter explores the solutions proposed by 1980s Swedish engineering educators who, with increasing intensity, engaged in solving the problem of there being "few women in science and technology". The chapter outlines three government

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[193] Project application "Arbetsmarknaden och de kvinnliga arkitekterna och civilingenjörerna", Dnr. 28, 81/82, Chalmers central archive, Chalmers Central Administration [from now on CTH C-archive, C-Adm.], F2DA:3.

[194] Ibid.

[195] Anders Wallerius, "Vi fick en chock", in *Gnistor: från kvinnor och teknik-veckan våren 1982*, ed. Monica Westman (Stockholm, 1982); Elsa Haage-Wennerholm, "Visst vill kvinnor avancera", in *Gnistor*; Hagman, *Nollan blir nymble*, 42–43; "Samma rätt till arbete", copy of article in *Svenska Dagbladet*, 29 Oct. 1982, Swedish Labour Movement's Archives and Library, Personal archive Anita Gradin.

initiatives to achieve this, and how universities of technology responded to them. Firstly, the chapter describes new regulations in 1976 which required public authorities, including universities, to develop gender equality plans and subsequent measures to be taken at universities of technology. Secondly, it explores how the universities of technology used public funding provided in 1978 under a programme called *Jämställdhetsmiljonen* (Gender Equality Million). Thirdly and finally, the chapter investigates a national campaign called *Fler kvinnor till industrin* (More Women into Industry) aimed at getting more women into industry set up in 1983 to develop recruitment models.[196] The campaign involved many local actors – trade unions, industry associations and local schools – but made universities of technology and county administrative boards (*länsstyrelser*) its special partners. These government initiatives pushed universities of technology to undertake actions targeting gender inequalities. The campaign conclusions show that members of university leadership were not exactly willing participants. For advocates of gender equality in engineering it provided support and temporary momentum.

At the same time, female engineering students had their own perspective on what it entailed being a student in a male-dominated institution. As detailed in sub-chapter "Targeting the Minority, Avoiding Confrontation", these students did not speak with one voice. While student rituals as well as professors' behaviour could be sexist and discriminatory, only a few students addressed this matter in public. More often, they focused on their similarities with their male classmates, highlighting technological interest, competence and stamina rather their minority position. So did the small cohort of female professors and faculty members.

In the early 1980s women made up a small minority, just under 20 percent, of first-year students at Swedish universities of technology. Although still a small group, their numbers had increased significantly over the previous decade.[197] From the early 1980s continued female enrolment became a prioritised goal, not only among government bureaucrats and members of parliament, but also among engineering educators. Recruitment campaigns were backed by government funding, and new legislation pushed for systematic work against gender inequalities. Gender equality advocates and enthusiasts at universities of technology who were not part of the engineering faculty, and thus had a

196 Initially called the "10 million" campaign (*10-miljonerskampanjen*).

197 Maria Stanfors, *Säkert och sakta. En historisk översikt över kvinnor i naturvetenskaplig och teknisk utbildning* (Högskoleverket, 2000), 61. In total, 3,090 new students enrolled in Swedish engineering graduate programmes (*civilingenjörsutbildningar*) during the fall of 1981 (82 percent men, 18 percent women).

low status in the academic hierarchies, found themselves turning to external support to assist with recruitment activities aimed at girls.

While this chapter focuses on efforts at Chalmers University of Technology, it also illustrates a general trend. Most of the Swedish universities of technology launched similar activities. The advocates' idea was straightforward: women's enrolment would increase if they understood that science and technology were interesting, fun and promised prosperous future careers. The days were gone when that promise only included young men. The task of engineering educators was thus to identify communication and learning strategies to counteract the faulty image that women and girls had of the field. To rephrase historian of science Londa Schiebinger, contemporary gender equality advocates in government, industry and at universities of technology approached the problem of gender inequality through the idea of "fixing the girls".

As discussed in the introductory chapter, Schiebinger identifies three timebound phases. Three "fixes" have guided policymaking for gender equality in science and technology in the US and internationally. According to Schiebinger, the first phase, which emerged in the 1970s, corresponds to "fixing the number of women". It was driven by a gender-neutral approach as it did not consider gendered aspects of science and technology. The strategy may be necessary, but Schiebinger stresses its limitations as an isolated measure since it fails to look beyond women's careers. The approach overlooks the need for reform of science and technology institutions – of education and research methods, and of the research focus.[198] Government commissions in Sweden had emphasised the need for gender-sensitive approaches in natural science education in the 1960s and 1970s.[199] These commissions highlighted the fact that while science education at the primary and secondary school levels motivated boys and was tuned into their experiences, it alienated the girls. They found that the girls were assumed to lack the natural sense of "feeling at home" (*hemkänsla*) in the science lab and classroom, which the boys were assumed to have.[200] Engineering educators would embrace such conclusions in the 1990s. A minority, among them Inga Alander and Eva Ljungqvist whose work is explored in this chapter, embraced this perspective already in the early 1980s. The gender-neutral approach would, however, gain momentum at the universities of technology during that decade.

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198 Schiebinger, "Gender, Science and Technology", 7.

199 Daniel Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle: rekrytering till teknik och naturvetenskap under svensk efterkrigstid* (Lund, 2016), 85 f.

200 Ibid., 86.

This chapter is based on written materials from four different archives: the archive of the Government's labour market committee (*Statens arbetsmarknadsnämnd, SAMN*); the archive of the Ministry of Employment; the archive of Anita Gradin, the Minister responsible for gender equality issues; and the central archive of Chalmers University of Technology. I have also explored printed campaign and project publications. In addition to these written materials, three of the interviews I conducted have informed the chapter narrative. The story unfolds in two arenas simultaneously – at the national government level with increasing regulations requiring a systematic focus on gender equality, and the implementation of those requirements at local universities of technology. In addition to previous research by Swedish historians and political scientiest, public inquiries and cabinet bills provided me with an overall picture of this process. The efforts in the 1980s of Minister Gradin and the Ministry of Employment where Gradin worked are central to a full understanding of the process at the national level. In combination with press releases from the Ministry of Employment, I have therefore explored Gradin's archive to analyse events at the national level.[201]

GENDER EQUALITY ENTERS THE LABOUR MARKET

In the early 1980s Chalmers University of Technology (hereafter Chalmers) and other universities of technology implemented their first gender equality plans. This was done against the backdrop of two political impulses: the first one a regulatory offensive in the labour market from the mid-1970s and the second the institutionalisation of gender equality as a policy field.

The number of Swedish women in the labour market had steadily grown following World War II, and in the 1960s the number of women in salaried employment grew rapidly. Between 1960 and 1980 a substantial shift took place. In 1960, 38 percent of Swedish women between the ages of 15 and 64 worked outside the home.[202] Two decades later that number had increased to 83 percent. Married women with small children represented a majority of the newcomers. The changes were spurred by economic incentives but also by governmental reforms. From the 1960s the Swedish government ran several campaigns, mainly through its labour board (*Arbetsmarknadsstyrelsen, AMS*), to convince Swedish housewives – and not least husbands – that they should enter the labour

[201] For further details on my method and sources, see this thesis Chapter 1.

[202] Åsa Lundqvist, *Livet är för dyrbart för att dammas bort: aktiveringspolitik, kvinnors förvärvsarbete och omvandlingen av familjen 1960–1980* (Lund, 2019), 13 f.

market. This change of direction coincided with a significant labour shortage, expansion of the public sector and a political goal of full employment and low inflation.[203]

During the 1970s, although economic recession loomed large, the Swedish welfare state expanded its reach. The establishment of an independent gender equality policy field is part of that story. Historical accounts of the process often present Prime Minister Olof Palme's speech in 1972 as a cornerstone.[204] The cabinet had now declared gender equality a prioritised goal.[205] It implemented political reforms that strengthened women's position in the family and in the labour market. Among the most significant was separate taxation for husband and wife (1971), parental insurance including individual rights for fathers (1974), legal abortion (1975), expansion of the public childcare system (1976) and the right to public childcare (1977).[206] The reforms were part of what has often been called a "State feminist field of gender equality" which gradually developed during the 1970s.[207] It involved ministers, commissions, administrators, inquiries, committees and gender equality programmes.

From the start the new field was intimately linked to labour market reforms.[208] For instance, the ministerial post with responsibility for gender equality was placed early on under the Ministry of Employment. Still, gender equality reform was only one area of political intervention. Alongside it came a substantial increase in social, financial and labour market regulations. Housing benefits, a reduced work week to 40 hours for all workers, an increase in VAT (*moms*) and the implementation of a progressive income tax system are examples of the reforms enacted.[209] In the labour market, a push from the primary workers' union, the Swedish Trade Union Confederation (*Landsorganisationen i Sverige, LO*), resulted in a large "labour legal package" in 1976 which included four new laws.[210] Together the laws significantly expanded employee influence in the workplace and

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[203] Ibid. The goal of full employment and low inflation is most often referred to as "the politics of full employment" (*den fulla sysselsättningens politik*).

[204] See also this thesis Chapter 2, sub-chapter "Gender (Re-)Enters the Political Agenda".

[205] Florin and Nilsson, "'Something in the Nature of a Bloodless Revolution…'"; Alnebratt and Rönnblom, *Feminsm som byråkrati,* 25 f.

[206] Tollin, *Sida vid sida*, 83.

[207] Florin and Nilsson, "Something in the Nature of a Bloodless Revolution…", 14; Winther Forsbäck, *Med dubbla syften*, 48 ff.

[208] Ibid. (Florin and Nilsson), 68 ff; Alnebratt and Rönnblom, *Feminsm som byråkrati,* 26 f.; Tollin, *Sida vid sida,* 49–79.

[209] Östberg and Andersson, *Sveriges historia*, 218.

[210] Anders L. Johansson and Lars Magnusson, *LO andra halvseklet: fackföreningsrörelsen och samhället* (Stockholm, 1998), 185. The laws included: The Codetermination Act (*Medbestämmandelagen, MBL*), The Employment Protection Act, (*Lagen om anställningsskydd, LAS*), Board

limited the power of the employer organisations. The requirement that came the same year for public employers to set up gender equality plans must therefore be seen in the light of overall intensified labour market regulation. The Government's requirement to actively work towards gender equality targeted all public authorities, including the universities, which until recently had been autonomous. This was a move that signalled new confidence in centralised measures. Labour market regulation in general and emerging gender equality policies thus converged.

In contrast to the laws mentioned, the regulation of gender equality efforts in the workplace was not the result of a union push. In fact the LO workers' union was a strong opponent of State involvement in issues related to women's position in the workplace. To the labour movement, gender equality had to be understood as a dimension of the class struggle. It deemed the newly enacted laws, like the Codetermination Act (*Medbestämmandelagen, MBL*) and the Employment Protection Act (*Lagen om anställningsskydd, LAS*), as appropriate instruments to incorporate the gender equality issue. Backed by the Social Democratic party, LO argued that gender inequalities would be solved through the "Swedish model", the negotiation process between employer and employee organisations established in the 1930s.[211] But other political actors, spearheaded by the liberal People's Party (*Folkpartiet*), kept pushing for legal reforms. Finally, in 1979 the centre-right Government put its mark on labour market gender equality reform when the anti-discrimination law, the Gender Equality Act, was enacted after years of parliamentary debate.[212]

In 1976, however, a bill was passed requiring public employers to take active steps to improve gender equality. The bill was the result of the first public inquiry on gender equality and women in public service (*Kvinnor i statlig tjänst*). The new regulation required government agencies to submit action plans, impact assessments and documented measures every year.[213] In 1979 the Gender Equality Act further formalised these

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Representation Act (*Lagen om styrelserepresentation*) and The Trade Union Representatives Act (*Förtroendemannalagen*).

211 "Saltsjöbadsavtalet" from 1938 is considered the basis for the Swedish model. Tollin, *Sida vid sida,* 66–67; Östberg and Andersson, *Sveriges historia*, 118–119.

212 The Gender Equality Act, *Lag (1979:1118) om jämställdhet mellan kvinnor och män i arbetslivet*, 17 Dec. 1979, https://rkrattsbaser.gov.se/sfst?bet=1979:1118, retrieved 6 Dec. 2021. See Svante Nycander, *Makten över arbetsmarknaden: ett perspektiv på Sveriges 1900-tal*, 2. ed. (Stockholm, 2008), 374–377; Tollin, *Sida vid sida*, 69–73.

213 *Regeringens proposition 1975/76:173 om kvinnor i statlig tjänst* (Stockholm, 1976); Tollin, *Sida vid sida*, 69. Timeline of the regulatory publications following the bill in Hanna Antonsson,

requirements. From now on, public as well as private sector employers were required to take action. The law sharpened previous requirements for gender equality action, but what is more, it criminalised gender-based discrimination in hiring processes. From then on, financial penalties could be imposed on employers that did not follow the law.[214] The new legislation was, however, a compromise between the Social Democrats, the People's Party, the Centre Party (*Centerpartiet*) and the Moderate Coalition Party (*Moderata samlingspartiet*). Political scientist Katarina Tollin argues that while gender equality policies in the late 1970s had definitely made an entrance into the labour market, the new policy field had taken a direction which focused on protecting the individual rather than a more structural approach. Although the Gender Equality Act prohibited gender-based discrimination, its sanctions were rather toothless.[215]

CHALMERS ENTHUSIASTS CHALLENGE HALF-HEARTED LEADERSHIP

At Chalmers University of Technology, one of the country's oldest, largest and most respected institutions of higher education, the 1976 regulation was commented on briefly by the Rector's office, but not until May 1978.[216] It also resulted in a modest working group. The group's report does not leave much doubt about what it was motivated by: "By law, public authorities are required to take steps to improve gender equality within their organisations".[217] A requirement had been issued by the political sphere and the university administration had to respond. It was decided that three Chalmers administration representatives would "until further notice" make up the gender equality working group. Still, it took another six years until the group (*Chalmers Jämställdhetsgrupp*) finalised its first, long-term gender equality plan.[218] The slow pace with which Chalmers

"Kartläggning av ett halvt sekels jämställdhetsinsatser i Sverige", Vinnova Rapport VR 2008:07, 20.

[214] The Gender Equality Act, 17 Dec. 1979.

[215] Nycander, *Makten över arbetsmarknaden*, 374–377; Tollin, *Sida vid sida*, 69–73.

[216] § 10, Vice-Chancellor's office meeting minutes No. 36 1977/78, 24 May 1978, CTH C-archive, C-Adm, A1DA:1.

[217] Ibid.

[218] For the work leading up to a finalised plan, see the following Vice-Chancellor's office meeting minutes in CTH C-archive, C-Adm, A1DA:1–3: 24 May 1978; 7 Oct. 1981; 17 Aug. 1982; 15 Aug. 1983; 10 Oct. 1983; 24 Oct. 1983; 6 Feb. 1984; 15 June 1984; 20 June 1984. See also Chalmers University board meeting minutes 9 April 1984, CTH C-archive, C-Adm., A1AA:5. Chalmers long-term plan in the archive of the National Swedish Archives, Government's labour market committee (SAMN) [from now on NSA, SAMN archive], F3A:39.

proceeded with this task suggests the low priority placed on gender equality within the institution.

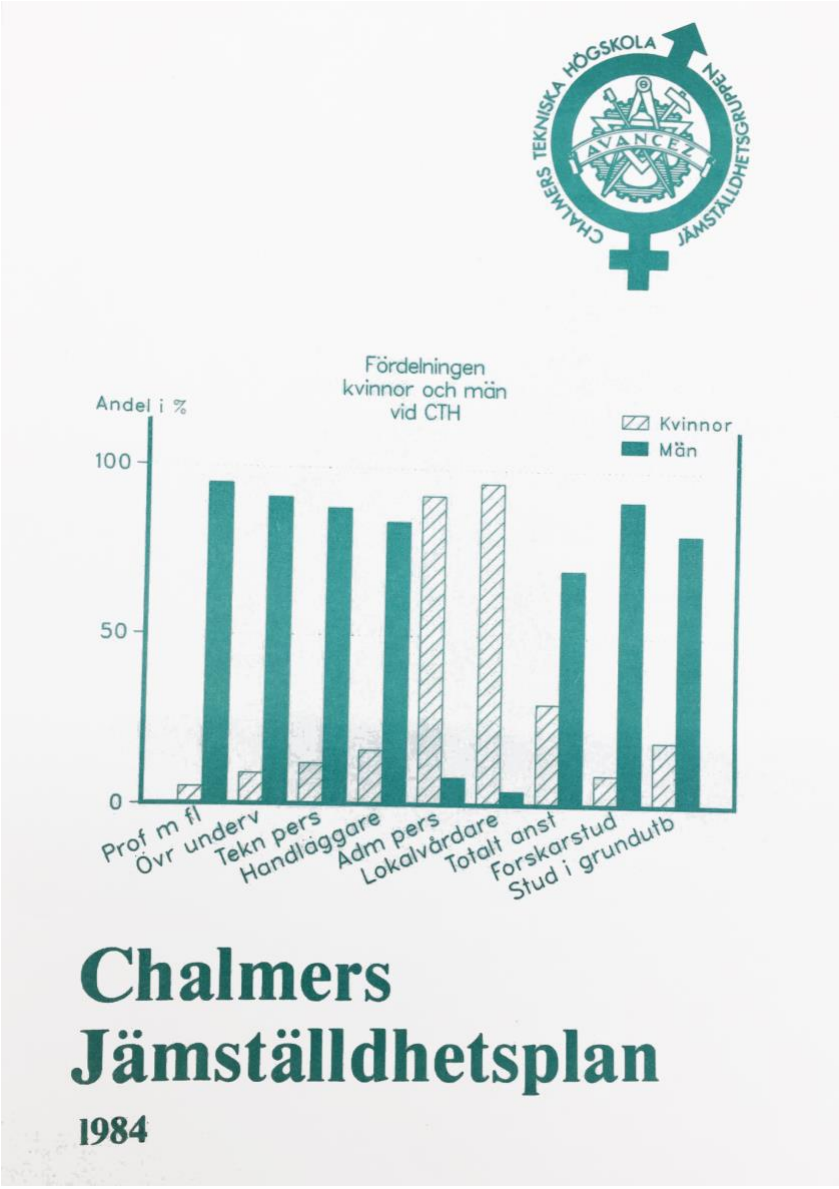

Figure 3.1. Front cover of "Chalmers gender equality plan, 1984" pamphlet. The bars represent the share women and men in different staff and student categories. While most categories, including teaching staff and technicians, were heavily dominated by men, the opposite was true for administrative and cleaning staff. Courtesy of the National Swedish Archives, the archive of the Government's labour market committee, F3A:39.

There is another factor that supports this conclusion. It concerns the hierarchical structure of academia and the question of who is doing what. Initially, the Rector's office appointed Chalmers directors Gunnar Brockman (*byrådirektör*) and Stig Ekman (*avdelningsdirektör*), representatives of the Chalmers central administration, to the working

group.[219] There is no archival evidence of them doing any substantial work. At the meeting in 1978 the working group was formalised, but the group did not produce anything resembling a plan of action until 1982.[220] At this point the initial members had all been replaced. Promoting gender equality was not considered a core activity by the directors. What, then, did gender equality improvement efforts look like in practice at universities of technology in the early 1980s? Who wrote the plans, suggested activities and made them happen?

At Chalmers, two individuals were instrumental. Based on the efforts of Eva Ljungqvist at the human resources department and Inga Alander, a teacher in the architecture programme, Chalmers launched a number of activities in the first half of the 1980s.[221] As a first step, in October 1981, the Vice-Chancellor's Office decided to form a reference group for gender equality.[222]

> At Chalmers University of Technology (CTH) there is to be a reference group for gender equality issues called the gender equality group. The group's task is to propose measures to promote equality between men and women at CTH according to the Swedish Gender Equality Act. The group is in particular tasked with providing input on which to base a gender equality plan and to issue a statement on the annual gender equality audit. / The Vice-Chancellor's office appoints five group members. The group may, at its own discretion, add additional individuals and decide on its own work procedures. / The Group have 3,000 kronor at its disposal for its work for the 1981/82 budget year. These funds are administered through the HR department.[223]

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[219] Vice-Chancellor's office meeting minutes No. 36 1977/78, 24 May 1978, CTH C-archive, C-Adm, A1DA:1. Stig Ekman's title in e.g. Vice-Chancellor's office meeting minutes, A1DA:2.
[220] § 1, Vice-Chancellor's office meeting minutes No. 2 1982/83, CTH C-archive, C-Adm, A1DA:3.
[221] To follow the work of Alander and Ljunqvist at Chalmers, see footnote 218; Chalmers' campaign application in National Swedish Archives, Ministry of Employment, Central Archive [from now on NSA, M. of Emp., C-Archive] E2DA:150, 1983 Nov. part 1, Act J 3235/83; documentation submitted to NSA, SAMN archive, F3A:39, F3A:69.
[222] § 8, Vice-Chancellor's office meeing minutes No. 9 1981/82, CTH C-archive, C-Adm., A1DA:1.
[223] Ibid. The 3,000 kronor allocated is equivalent to 9,270 kronor (approx. 930 euros) in October 2021. The conversion made for year 1981 at https://www.scb.se/hitta-statistik/sverige-i-siffror/prisomraknaren/, 6 Dec. 2021.

The decision further stated that Brockman and Ekman were dismissed from the group and five new members were appointed.[224] Among the five elected members, only Alander's and Ljungqvist's names are found in materials relating to subsequent activities. In our interview, Alander states that she cannot remember any other member other than herself and Ljungqvist furthering the process through any substantial work.[225] The 3,000 kronor allocated (equivalent to 9,000 kronor, or 900 euros, 40 years later) and was too small a sum to be anything other than symbolic. Soon, however, some external grants would materialise.

During the years that followed, Alander and Ljungqvist developed classroom materials for distribution at secondary schools.[226] They installed a technological workshop (*teknikverkstad*) – an early version of a science centre – directed towards preschool and school children. They created weekend camps for upper secondary school girls that included encounters with Chalmers faculty and industry representatives. In 1986 Ljungqvist was instrumental in organising a national conference at Chalmers to get more women into technical programmes, with speakers such as the Minister for Education. Alander and Ljungqvist also suggested a series of seminars and courses aimed at female engineering students and female engineers, intended to create social connections and raise awareness on handling workplace discrimination.[227]

These two enthusiasts held very different positions from those of the two aforementioned directors. Alander and Ljungqvist were not part of the line organisation, and although Alander was involved in a core activity at the university – education – she did not have a faculty position. Alander had terminated her doctoral studies before finishing any degree. She was acutely aware of the academic hierarchies and would become more so in the years to come. In my interview with her, she dwells on the frequent conversations that took place within Chalmers' central administration.[228] As "pedagogical consultant", she would later work closely with the Chalmers university management.[229] At least two members of this group had a licentiate degree but not a doctorate. These men

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[224] Ibid. "Members appointed until 30 June 1983 are Eva Ljungqvist (convening), Inga Alander, Aina Estelius, Anne-Marie Nilsson and Jan Fihn. / Gunnar Brockman and Stig Ekman are relieved of their duties to serve as a member of the work group for gender equality."
[225] Interview with Inga Alander, 15 Oct. 2018.
[226] Detailed in subchapters "Making Technology Fun" and "Targeting the Minority, Avoiding Confrontation".
[227] Ibid.
[228] Interview with Alander.
[229] Ibid; sub-chapter "Making Technology Fun".

frequently reminded their colleagues of the higher status of the traditional licentiate degree. It was referred to as "equal to a contemporary doctorate".[230] Titles mattered.

The strict academic hierarchy with faculty at the top and operational support at the bottom, has long framed certain tasks as central and others as marginal. At universities of technology in the 1980s the support functions were usually occupied by a female workforce. This was not only true in administration, HR and finance but also for participation in formalised efforts to promote gender equality. Researchers and commentators have noted that gender equality improvement in Swedish academia is the result of the efforts of enthusiasts – enthusiasts who were rarely faculty members.[231] This can be ascribed to a particular institutional innovation. Starting in 1979 public authorities, including universities, had a dedicated administrative position; a person appointed to oversee and develop internal, systematic gender equality efforts (*jämställdhetshandläggare)*.[232] The position institutionalised gender equality efforts but at the same time placed responsibility for action on a single individual rather than on the organisation as a whole. In the case of universities – and particularly the traditional universities of technology Chalmers and KTH, which were not engaging in any women's and gender research of their own – work at the organisational level to promote gender equality was consolidated and distributed outside the university's core activities.

In this regard, Luleå University, and its technical faculty, was a rare case. Here, a unit called *Forum för kvinnor i forskning och arbetsliv* (Forum for Women in Research and the Labour Market) was established already in 1982. Undergraduate, graduate and doctoral students studied technology with a feminist perspective early on. In contrast to Chalmers and KTH, Luleå engineering faculty was part of a larger university with faculties in the social sciences and the humanities, as well as technical and natural science faculties. More research is needed to analyse if and how the overall engineering curricula, and the research conducted by Luleå University technical faculty members, have been influenced long-term by this institutional difference.[233]

Early gender equality plans created by a variety of public authorities, and archived by the Government's labour market committee (*Statens arbetsmarknadsnämnd, SAMN*), support the conclusion that in general, gender equality efforts were conducted by

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[230] Interview with Alander.

[231] Departementsserien 1997:56 JÄST-gruppen, *Jämställdhet för kunskap, insikt och kvalitet: slutrapport från JÄST-gruppen* (Stockholm, 1997), 49–51, 113–114.

[232] Ibid., 113–114.

[233] In Trojer, *Genusforskning inom teknikvetenskapen*; personal communication with Trojer.

administrative staff members.[234] While the gender equality group at Chalmers would eventually include faculty, the management and faculty representatives kept a low profile when the group developed its first long-term plan and the first measures were implemented.[235]

Although legislation institutionalised work on gender equality plans, transforming the plans into actions was negotiable. When dedicated individuals like Inga Alander and Eva Ljungqvist kept the work going, the university kept taking action. If the enthusiasts were no longer active, the plans were nothing more than ink on a piece of paper. A tragic event at Chalmers would disrupt the progress of this work. After an illness rapidly progressed, Ljungqvist who was only in her thirties passed away in 1990. Her illness and passing deeply affected her colleagues. With key actors no longer present to keep up the work, any large-scale efforts to improve gender equality were put on hold until 1993.[236] The accomplishments of the group in the years before Ljungqvist's illness do, however, demonstrate decent improvement. In 1981 the gender equality group at Chalmers started in a modest way, funded by the university's central administration. Three years later the group was running weekend camps, schoolteacher training and information campaigns. In 1986 and in association with the Ministry of Employment, the group hosted a national conference that gathered 400 participants at Chalmers.[237] How was this possible given the limited support and interest from the university's central administration? The engagement of a few individuals, most importantly Alander and Ljungqvist, was a key factor. Enthusiasm was, however, not enough.

SURVEYING THE FEMALE ENGINEERING STUDENT

The growth in the focus on gender equality at Swedish universities of technology in the early 1980s was a response to external pressure. It was the outcome of a labour market offensive by the Social Democratic cabinet. To increase the number of women working in engineering industries, the cabinet, through the Ministry of Employment, provided all universities of technology with financial resources. Thus, engaged individuals at these

[234] NSA, SAMN archive, F3A:36–40.
[235] Interview with Alander.
[236] Ibid; interview with Christina Ullenius, 6 Oct. 2017.
[237] The work conducted between 1980 and 1985 is documented in Chalmers meeting minutes (footnote 218) and in the materials submitted to NSA, SAMN archive, F3A:39, F3A:69. On the conference, see Figure 3.5; conference invitation in CTH C-archive, C-Adm., 1978–1994; transcribed conference keynote talks in TAM, SAGE archive, F10Fa:7.

universities received the support needed for some of their ideas to materialise. While the major push came from the Government's campaign launched in 1983 to get more women into industry (*Fler kvinnor till industrin*), public funding for gender equality efforts was already available from the late 1970s. The "Gender Equality Million" (*Jämställdhetsmiljonen*) launched in 1978 was the first major public funding initiative through which the universities of technology could develop and implement their action plans.

The "Gender Equality Million" was made available to support public authorities to implement the required systematic measures. All public authorities were invited to apply for funding. Between 1978 and 1985 1 million kronor was distributed annually among the applicants (40 years later, equivalent to 4.2 million kronor or 420,000 euros).[238] The launch of the "Gender Equality Million" programme was characterised by experimentation and identifying best practices. Its guidelines stated that projects should be novel attempts that could have an immediate effect on gender equality.

> The principal used in assessing the applications were, first of all to ensure that they involved a trial of a project that could have a direct impact on gender equality. If this trial was successful, it could be made a permanent initiative by the council. The second principle was that funds would be distributed between as many different types of trials as possible, which would enable an assessment of which measures were effective.[239]

The experimentation set-up provides an opportunity to explore how engineering educators interpreted gender equality. Which problems did universities of technology address? What type of activities did these actors believe were likely to have the desired effect? Two activities – information campaigns and surveys – reoccurred in the universities' applications. These activities all centred specifically around "the female engineering student" (*den kvinnliga teknologen*).[240]

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[238] Equivalent to 4.2 million kronor (420,000 euros) in May 2021. The conversion made for year 1978 at https://www.scb.se/hitta-statistik/sverige-i-siffror/prisomraknaren/, 15 June 2021. SOU 1980:20 *Rapport om jämställdhet i statsförvaltningen: effekter och resultat av det statliga jämställdhetsarbetet 1976–1979*, 57; Antonsson, "Kartläggning av ett halvt sekels jämställdhetsinsatser i Sverige", 20–21. List of granted applications 1980–1983 in NSA, SAMN archive, F1A:34, Ärendegrupp 51. Individual responses in F1A:20 and F1A:27.

[239] SOU 1980:20, 57.

[240] The argument of this section builds mainly on the following sources: Monica Westman, ed., *Gnistor: från kvinnor-och-teknik-veckan våren 1982* (Stockholm, 1982); "Beviljade ansökningar Jämställdhetsmiljonen", TAM, SAGE archive, F10Fa:6; "Projektansökan Kvinnor i Tekniken",

At the national level, administration of the gender equality plans and the distribution of the "Gender Equality Million" were initially handled by the Treasury. In 1980 the Government's newly installed labour market committee (*Statens arbetsmarknadsnämnd, SAMN*) took over these tasks.[241] Whereas Anita Grandin, the Minister responsible for gender equality, and her staff at the Ministry of Employment argued that gender equality efforts should involve women *and* men, engineering actors almost automatically placed their focus on the female minority group. An overwhelming majority of the university applications described activities aimed at women.[242] To them, gender equality corresponded to an increased number of women in engineering. It was, in other words, a matter of representation. The experiences of female engineering students and professionals from educational institutions and workplaces would be mapped through surveys and interviews. If in the surveys one could identify women's values, choices, perspectives on technology and feelings towards the educational institution, the actors reasoned that the appropriate measures could be taken by the universities and thereby attract this particular student group. The need for information seemed immense.

Furthermore, through recruitment activities and information events, schoolgirls would learn that "technology is fun" and hopefully turn their interest towards engineering studies. Through a national campaign funding programme launched a few years after the "Gender Equality Million", the number of outreach activities targeting schoolgirls grew at the universities of technology. Before moving on to describe these campaign activities, this subchapter will first take a look at the surveys conducted.

Surveys and interviews aimed at female engineering students and female professional engineers were planned and carried out in the late 1970s and onwards at Linköping University, the Royal Institute of Technology, Chalmers University of Technology and by the professional engineering associations. Although not explicitly spelt out, the survey questions revealed that "the female engineering student" was considered radically different to the norm, that is, the male student. Questions included "Do girls have the same expectations for their studies as boys?", "Do female engineering students have the same view of technology as their male counterparts?" and "Is technophobia

8 October 1981, Linköping University, NSA, SAMN archive, F3A:38; "Anslagsansökan för jämställdhetsprojekt", 27 March 1981 (CTH), NSA, SAMN archive, F3A:39.

241 SOU 1980:20, 117; Antonsson, "Kartläggning av ett halvt sekels jämställdhetsinsatser i Sverige", 22.

242 NSA, SAMN archive, F3A:30–F3A:40.

(*teknikfientlighet*) a general tendency among women?".[243] Thus, a binary categorisation that separated male and female students into two distinct student groups underscored the surveys. One planned survey at Chalmers aimed to explore perspectives on technology among different academic groups: engineering faculty and faculty at other universities, and between men and women within the different groups. Perhaps female engineers and engineering students were also different to other women? [244]

While the objective of the first part of the Chalmers study was to identify what motivated female engineers to study engineering and to investigate their career patterns, the follow-up study had a different focus. It hoped to identify "categories of women" who could and wanted to push for engineering education reform; transformation that had the potential to impact technological development and "people's lives in the future".[245] In this regard, engineering actors who were pushing for more women to study engineering emphasised the possibility that women could "soften" technological development.[246] A common assertion at the time was that society was missing out on essential perspectives if women were left out of development processes that would result in potentially dangerous technologies.[247]

A survey conducted at Linköping University revealed other disturbing facts. It targeted current and former female mechanical engineering students at the university. The survey found that 20 percent of the women had dropped out before graduation, usually during their first year of study.[248] At the same time, most of the survey participants stated that they got along well with their classmates and their teachers. Based on these somewhat contradictory results, and probably also on prior assumptions, those conducting the surveys directed strong critique towards upper secondary school administrators and career counsellors. The survey results seemed to show that these actors had provided only

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[243] Westman, ed., *Gnistor*, 71–75, 84–98; "Beviljade ansökningar Jämställdhetsmiljonen", TAM, SAGE archive, F10Fa:6; "Projektansökan Kvinnor i Tekniken", 8 Oct. 1981, Linköping University, NSA, SAMN archive, F3A:38; "Anslagsansökan för jämställdhetsprojekt", 27 March 1981 (CTH), NSA, SAMN archive, F3A:39; Grant applications, "Referensgruppen Kvinnor och Teknik", 28 Nov. 1980 and 21 Feb. 1981, CTH C-archive, C-Adm., F2DA:3.

[244] Ibid.

[245] Grant applications, "Referensgruppen Kvinnor och Teknik".

[246] Ibid. Several contributions in Westman, ed., *Gnistor* from the "Women and Technology Week" in 1982 raised this point. See also Skolöverstyrelsen, *Vill vi, så kan vi, så gör vi det!: om skolans ansvar för att flickor och pojkar får lika kunskaper i naturvetenskap och teknik* (Stockholm, 1986); Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle* (Lund, 2016), 124–125.

[247] E.g. Westman, ed., *Gnistor,* 6.

[248] Ibid., 72.

limited information to their pupils and students on the possibilities of a career in engineering. This critique was one that had been made often by engineering actors since at least the 1970s. In addition to information campaigns aimed at schoolgirls, subsequent activities launched by the universities of technology would therefore also target upper secondary school career counsellors. Less effort went into making sure that students already enrolled felt motivated to finish their degrees.[249] Identifying scapegoats in this way exemplifies the tendency to find external explanations for the problem of gender inequality.

SEARCHING FOR "TECH-GIRL"

Among engineering educators, similar surveys and interview studies would multiply in the 1990s.[250] But engineering actors were not the only ones to conduct surveys aimed at female engineering students and professional engineers. Contemporary feminist social science scholars conducted similar studies.[251] Moreover, surveys of young people's relationship to science and technology were nothing new. Starting in the late 1960s, data collection had significantly expanded.[252] This was linked to the firm conviction that science and technology was the number one route to economic growth. State bureaucrats, educators and researchers began a detailed categorisation of schoolchildren and upper secondary school students. The surveys and data gathering resulted in categories such as "stayers" (*stannare*), "drop-outs" (*avhoppare*) and "programme swappers" (*linjebytare*). There were also gender-based categories such as "technology boys" (*Te-pojkar*) and "science girls" (*Na-flickor*).[253] As this "attitude research" expanded in the 1970s, girls emerged as a particular target group.[254] When engineering educators engaged in gender equality work

[249] For a 1980s' follow-up study of all university of technology campaign activities, see Chaib, *Modeller för rekrytering av flickor till tekniska utbildningar*. The critical role of career councillors and prior projects where they were targeted are discussed in Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 95–97. My interviewees also raised this concern, particularly former KTH Dean Ingrid Melinder, interviewed 15 June 2017.

[250] Salminen-Karlsson, *Bringing Women into Computer Engineering*, 20.

[251] Since the early 1980s, numerous academic studies of female engineers have been conducted in Sweden and internationally by scholars in various fields, discussed in Minna Salminen-Karlsson, "Att undervisa kvinnliga ingenjörsstudenter", *NyIng report No. 1* (Linköping, 1998), 7. An early example is Elin Kvande's article "Anpassning och protest" ("Adaptation and protest"), *Kvinnovetenskaplig tidskrift* 3 (1982): 3, 42–51.

[252] Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle*.

[253] Ibid., 61–63.

[254] Ibid.

in the early 1980s, they followed a path already taken by government agencies such as the National Board of Education (*Skolöverstyrelsen*) in the previous decade. The intensified science and technology recruitment policies launched in the 1960s had international equivalents and have been interpreted in terms of new modes of governing. Politicians, government agencies and experts did not only offer solutions but engaged in defining the very problems that needed to be solved.[255] Applying Carol Bacchi's theoretical framework, they thereby engaged in the "production" of the problem.[256] When defining the problem as "low interest in engineering among girls", with surveys confirming that career counsellors had limited knowledge and provided limited information, the obvious solution was to give these counsellors more and relevant information to communicate to students. If the point of departure had been an alternative problem definition – for example, the informal and exclusive networks of male engineers or the unconscious gender bias among teachers and the students themselves – the survey objectives and questions would have looked radically different. So too would the corresponding solutions.

In summary: early formal attempts at universities of technology in the area of gender equality promotion (*jämställdhetsarbete*) consisted of surveys and recruitment activities aimed at girls and young women. Thus, gender inequality was first and foremost interpreted as a quantitative issue, a problem of women's representation. To address this problem, more knowledge on the absent women was critical. In the process "the female engineering student" became a trope jointly constructed by those conducting surveys as well as gender equality advocates. The university administrations silently sanctioned the surveys and conducted them only when offered public funding such as through the "Gender Equality Million" programme. The same is true for the second type of activity in the form of outreach projects.

WAR OF THE ROSES

Several applications to the Government's labour market committee (SAMN) and the "Gender Equality Million" from universities of technology suggested they were interested in schoolgirl recruitment activities. The authority had limited funding capacity for those activities but acknowledged their necessity. Further national initiatives would therefore be

[255] Ibid., 63 f.

[256] Bacchi, "Introducing 'What's the problem represented to be?' approach".

considered.[257] These included the campaign to encourage more women to enter industry (*Fler kvinnor till industrin*) and its follow-up projects launched by the Ministry of Employment. How did the ministry justify such projects? Which actors could be entrusted to implement them? And what did the projects look like in practice? These questions will be explored shortly. But first, some of the contemporary tensions in national politics are outlined. I understand these tensions as central for the turn of events analysed in this chapter.

In the strained economy of 1982 and after four years of centre-conservative government, the Social Democrats returned to power, receiving 45.6 percent of the vote, a percentage that has not been matched since.[258] The 1970s had been economically and politically turbulent. After a second oil crisis, rationalisation in industries and large-scale conflict in the labour market, Sweden's economic boom years had ended. The re-election of the Social Democrats was not, however, the re-election of traditional socialist politics. Instead, a reformed party entered the stage with Minister for Finance Kjell-Olov Feldt notably influenced by emerging neo-liberal currents.[259] One example of the new direction was a council of young, business school educated economists who would support the Minister's financial reform policies. It was said that "Feldt's chaps" had taken over from "Palme's boys".[260] The saying signalled that an education in market-oriented business and finance now had superseded the ideal of the public intellectual within the party. This internal battle between more market-oriented reform policies and a strong welfare state continued throughout the 1980s and has been referred to as the "War of the Roses".[261]

As Katarina Tollin shows, the new direction would have a significant impact on gender equality policies. Overwhelming criticism of the public sector from the centre-conservative opposition, made up of the People's Party (*Folkpartiet*), the Centre Party (*Centerpartiet*), and the Moderate Coalition Party (*Moderata samlingspartiet*), came to dominate the governmental gender equality debate during the 1980s.[262] In the previous decade most political parties had a shortened working day – from eight to six hours – on their agenda. Even some conservative (Moderate Party) members of parliament

[257] NSA, SAMN archive, F1A:27.
[258] Östberg and Andersson, *Sveriges historia,* 307.
[259] Ibid., 306–314; Mats Benner. *Kontrovers och konsensus: vetenskap och politik i svenskt 1990-tal* (Stockholm, 2001), 37 ff.
[260] Östberg and Andersson, *Sveriges historia,* 309. "Feldts grabbar och Palmes pojkar".
[261] Ibid., 310.
[262] Tollin, *Sida vid sida*, 81 f.

supported such a reform.[263] The main argument for a shortened working day was to attain a more even distribution of working hours between those who worked more than was considered healthy and those who were unemployed. To some extent, politicians across the political spectrum envisioned that an equal distribution of household work between men and women would follow such a reform. This vision of a shorter working day was, however, losing traction as it was increasingly viewed as too expensive. Instead the opposition parties forcefully argued against expanding the public sector. Employment in the public sector was said to "lock women in".[264] The public sector placed a ceiling on women's salaries as well as on their career opportunities. Privatisation was, therefore, the political opposition's solution to achieving a gender-equal society. If only female-dominated sectors like the healthcare and education system were released from the boundaries of the "state monopoly", women would prosper through more job opportunities.[265] To the centre-conservative opposition the goal of gender equality did not require separate reforms but could be integrated into their overarching goal of cutting public spending. In line with this argument, parliamentary debates increasingly focused on women's representation in leading positions – in parliamentary committees, the Government, management positions and the high court. From then on the gender equality debate was frequently shifted away from the issue of economic equality towards representation.[266]

This shift can also be seen within the engineering communities. In the early 1970s, as briefly outlined in the introduction to this thesis, the gender equality council of the Swedish Association of Graduate Engineers (*Sveriges Civilingenjörsförbund, CF*) had launched a broad programme on achieving a more gender-equal profession and industry.[267] This council focused on women's career opportunities but also on issues such as housing services and distribution of household duties. In contrast, a few years later, and alongside the outreach projects of the universities of technology, CF launched the *Ungdom och teknik* (Youth and Technology) recruitment project.[268] In this way, CF redirected perceptions of

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263 Ibid., 103 f.; see below, sub-chapter "Securing Salaried Employment for Women".

264 Ibid., 101.

265 Ibid., 81 f., 85, 97–102.

266 Ibid., 96 ff., 111–113; Anita Gradin, "Samma rätt till arbete", *Svenska Dagbladet*, 29 Oct. 1982, in Swedish Labour Movement's Archives and Library, personal archive Anita Gradin, Artiklar och intervjuer, vol 1, 1982–1984.

267 TAM, SAGE archive, F10Fa:1–6; Nordvall, "The Resistant Profession".

268 CF launched the project "Youth and Technology" (*Ungdom och teknik*) in the early 1980s. TAM, SAGE archive, F10Fa:6.

gender inequality from socio-economic structures and gender-based discrimination in, for example, hiring processes towards notions of young people and particularly girls having limited interest in technology and also them making the "wrong" choices. In the mid-1980s this perspective overshadowed all previous explanations of gender inequality in the engineering and technical industries. Minister for Gender Equality Anita Gradin's industry campaign (*Fler kvinnor till industrin*) and the universities of technology partaking is a primary example of this situation.

CAMPAIGNING FOR MORE WOMEN INTO INDUSTRY

Prime Minister Olof Palme appointed Anita Gradin to his new cabinet as Minister for Immigration and Gender Equality.[269] At the time Gradin was the Swedish delegate to the European Council and the deputy chair for the Social Democratic Women in Sweden, known as the S-Women. While it took some persuasion from Palme's side for her to take on the responsibility for immigration – and resulted in Gradin's mother blurting out "Something terrible has happened" when announcing the news to Gradin's sister – the gender equality component of the post was a requirement from Gradin herself.[270] The new Minister, who was eager to get to work, saw it as her primary duty to ensure that women retained their status and footing in the labour market, a status she argued that they had established for themselves in the previous decade.

> When I became minister, I knew that the most important political issue for women is the right to work. Wherever you came in the electoral movement, women came forward and emphasised that. And they said that while there are hard times, and although there are forces trying to drive them back home, they will stay. Concrete efforts are required to ensure that jobs are guaranteed for them.[271]

Gradin and her staff would now work under the Ministry of Employment, a fact that underscored the Social Democratic view on where gender equality would emerge from. According to Gradin and the Social Democrats, and in contrast to the centre-conservative opposition, paid employment for women was at risk for three reasons in particular:

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269 Anita Gradin and Ranveig Jacobsson, *Från bruket till Bryssel: minnen från ett politiskt liv* (Stockholm, 2009), 87–88.

270 Ibid. The previous Minister for Immigration, Anna-Greta Lejon, had recently nearly been kidnapped.

271 Lena Näslund, *Säg ja! till tekniken: om kvinnor i tekniska yrken och utbildningar* (Malmö, 1985), 99.

computerisation, which would take over certain tasks; a slower pace of expansion in the public sector; and need in industry for employees with a technical education. These threats required urgent action. To address this, Minister Gradin launched the "10 million" campaign, later called *Fler kvinnor till industrin* (More Women into Industry) in the spring of 1983.[272] It was, however, a minor part of a 100 million kronor industry campaign. I therefore interpret this as being part of an active industry initiative from the cabinet rather than a gender equality reform move. This thesis stresses the frequency of such economic transfers, whereby successful negotiation for public funding for gender equality projects has often involved the resources being focused on science and technology.

The "More Women into Industry" campaign came to include a multitude of actors and measures. After the county administrative boards (*länsstyrelserna*), the universities of technology became the Ministry of Employment's primary partners in the campaign, with each receiving 500,000 kronor to be used within a year.[273] Municipalities, schools and private organisations applied and received grants as well.[274] The past recruitment efforts of the universities of technology formed the basis for Minister Gradin's decision to make them key partners. According to the Ministry of Employment, these universities had "for many years worked actively on recruiting upper secondary school girls".[275] As a result, the universities saw a marked increase in enrolment (Table 3.1). The Ministry saw the unequal conditions in the Swedish labour market as rooted in "traditional", gender-based, educational paths and understood that these needed to be disrupted, starting with school-age youths.[276] The universities were therefore now asked to expand their recruitment efforts aimed at secondary schools.

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[272] 10 million kronor equaled 28 million kronor (2.8 million euros) in Aug. 2021. Conversion made at https://www.scb.se/hitta-statistik/sverige-i-siffror/prisomraknaren/, 16 Aug. 2021. *Regeringens proposition 1984/85:130 om kvinnornas villkor på arbetsmarknaden* (Stockholm, 1983), 2–3; Gradin and Jacobsson, *Från bruket till Bryssel*, 88–89; Näslund, *Säg ja! till tekniken*, 99.

[273] Equivalent to 1.3 million kronor (130,000 euros) in Aug. 2021. Conversion made at https://www.scb.se/hitta-statistik/sverige-i-siffror/prisomraknaren/, 16 Aug. 2021. *Rapport från kampanjen för att rekrytera fler kvinnor till industrin* (Stockholm, 1984), 6. All university of technology project applications are gathered in one archival volume: NSA, M. of Emp., C-Archive, E2DA:150.

[274] Gradin and Jacobsson, *Från bruket till Bryssel*, 94; Chaib, *Modeller för rekrytering av flickor till tekniska utbildningar,* 7. Applications for campaign funding in NSA, M. of Emp., C-Archive, E2B:1–4 and E2DA:140–160.

[275] *Rapport från kampanjen för att rekrytera fler kvinnor till industrin*, 6.

[276] The ministry also stressed that the uneven, gender-based distribution of work tasks was a problem that required other measures. See "Arbetsmarknaden i Sverige starkt könsuppdelad", Press Release 29 June 1983, NSA, M. of Emp., C-Archive, B2:8.

The Ministry saw the increasing number of female applicants to universities of technology as a sign that the universities' past recruitment projects had been successful. Is there a different way to understand these statistics? The number of women in university engineering programmes had, in fact, increased significantly starting from the 1960s. Between the years 1920 and 1960 women in engineering programmes never made up more than 5 percent (Table 3.1). In the early 1980s their share approached 20 percent. Further research will be needed to analyse whether the increased enrolment was a consequence of the upper secondary schools' and universities' efforts to engage girls with technology or if it corresponded to women's increased enrolment at universities in general. One thing is certain: providing public funding for recruitment to science and technology education was nothing new.

YEAR	**39/40**	**49/50**	**59/60**	**69/70**	**76/77**	**77/78**	**81/82**	**87/88**	**97/98**
W (%)	1	2	5	8	14	13	18	19	28
M (%)	99	98	95	92	86	87	82	81	72
TOTAL	390	620	1,000	2,450	3,460	3,110	3,090	4,050	6,114

*Table 3.1. The total number of newly enrolled students and the percentage of female/male students in 4-year university engineering programmes (*civilingenjörsutbildning*) at Swedish universities of technology, architects excluded, between 1939 and 1997 (eventually 4.5-year programmes). Note that the number of years between each column differs. Source: Maria Stanfors,* Säkert och sakta*, 61.*

YEAR	**70/71**	**71/72**	**72/73**	**73/74**	**74/75**	**75/76**	**76/77**
W	202	259	264	301	315	320	401
M	2,444	2,653	2,491	2,565	2,664	2,675	2,870

*Table 3.2. The total number of newly enrolled female and male students in 4-year university engineering programmes (*civilingenjörsutbildning*) at Swedish technical universities, architects excluded, between 1970 and 1976. During the period, the number of women increased by 100 percent. Although the number of men increased by only 17 percent, the total number of men enrolled during this period was twice that of women. Source:* Utbildningsstatistisk årsbok 1978 *and* Utbildningsstatisk årsbok 1980.

INDUSTRY'S SERVANTS

Over the twentieth century the dominant discourse has linked natural science and engineering to national competitiveness and economic welfare. In this respect, the decision to assign a substantial budget for recruitment to technical education was in line with previous initiatives by the Government. Since the early 1900s educators and industry representatives have used the argument of international competitiveness to secure public funding to meet their ends. This was, for example, the argument used by actors who were pushing for the physical expansion of the Royal Institute of Technology and Chalmers University of Technology in the early twentieth century. They stressed that expanding higher technical education would meet to a national need.[277]

Meanwhile, other circumstances nuanced the strength of their argument. Foreign observers' appreciation of Swedish industrial products at the many industrial world fairs during that time indicated that Swedish industry was by no means "lagging behind" in international comparisons.[278] As much as genuine concern, this must therefore be viewed as an efficient argument for university actors to use to justify their need for funding. In 1985, almost a century later, Chalmers' management repeated this argument when pushing for a geographical expansion of the university. In a letter to the Gothenburg City Council (*kommunstyrelsen*) under the heading "The Future of Chalmers University of Technology", Vice-Chancellor Olving asserted the direct link between industrial competitiveness internationally and campus expansion into the Mossen area, a land reserve adjacent to the Chalmers campus.

> Sweden's status as a prominent industrial nation can only be preserved and developed if the country can, through its own initiatives and in a competitive way, participate in international knowledge development. Expertise and knowledge in the engineering sciences and natural sciences are essential key factors in this. Demand from people for significantly improved technology in a broad sense can only be met if the volume of science and technology engineering activity in society can be increased. In Sweden, for example, the Swedish Academy of Engineering Sciences recently published a study that recommends doubling the number of graduates with a Master's degree in engineering in Sweden within a decade. / Against this backdrop – but also for other reasons – it is fair to say that the Government must invest

[277] Björck, *Staten, Chalmers och vetenskapen*, e.g. 86, 134–136.

[278] The idea of "lagging behind" is further explored in Björck, "A distinguished scientific field?".

> substantially in expanding the universities of technology in Sweden in the decades ahead.[279]

Olving's reasoning is familiar. As discussed above, this type of rhetoric intensified in the 1960s. During that decade the connection between higher education in science and technology and economic growth was established as a fundamental aspect of the national economies of the Global North.[280] The Swedish State, universities of technology and engineering associations initiated an abundance of mainly short-term recruitment projects to increase student enrolment at upper secondary school science and technology programmes. From the late 1970s these projects increasingly focused on female students.[281] It is worth noting that Olving argued for the expansion by asserting people's demands for "improved technology in a broad sense". A generous interpretation could include various sorts of technological and social systems in such language. However, the interpretation narrows when the way forward for Olving was tantamount to an increased share of "technical and scientific engineering work". Other parts of society or knowledge disciplines were not required to reach this goal. Chapter 5 demonstrates how engineering actors in the late 1990s, in stark contrast to Olving, widened the scope of necessary engineering skills to meet societal and human needs. Such requirements were already being formulated at Chalmers in the early 1980s by the MTS group (human–technology–society) and Deputy Vice-Chancellor Tor Kihlman (see Chapter 5, sub-chapter "A Short History of Integrating the Humanities"). But Kihlman and his party had to wait for two decades before such statements became a critical part of official rhetoric on Chalmers' place in society. It would take even longer before it would have any substantial impact on the way the university was organised.

Education historian Daniel Lövheim, who has explored the new target group (girls) of the Government's recruitment efforts, confirms an increase in government spending

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279 "*Chalmers tekniska högskolas framtid*", 4 Nov. 1985, attachment to Chalmers University board meeting minutes 18 Nov. 1985, CTH C-archive, C-Adm., A1AA:5.

280 Benoît Godin, *Measurement and statistics on science and technology: 1920 to the present* (London, 2005); Benoît Godin, "The Linear Model of Innovation: The Historical Construction of an Analytical Framework," *Science, Technology, & Human Values* 31, No. 6 (2006): 639–667. For an overview of Godin's argument, see Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 27–29.

281 Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 81, 85–86. See also Hanna Markusson Winkvist, "Perspektiv på begåvningsreserven", in *Lychnos: årsbok för idé- och lärdomshistoria. 2014* (Uppsala, 2014).

during the 1980s.[282] While the idea of women's lack of skills and interest, the core of what I call the *recruitment logic*, nationally gained strength, Lövheim also recognises that different interests converged in science and technology recruitment. On the one hand, some members of parliament and state bureaucrats wanted to secure women's position in the labour market and improve their opportunities for well-paid employment. On the other, industry representatives and educators hoped to secure an influx of students to higher technical education. From the early 1980s, industry and employer organisations like the Swedish Employers' Confederation (*Svenska arbetsgivareföreningen, SAF*) and a national federation of industry associations (*Sveriges Industriförbund*) put pressure on government agencies to increase recruitment efforts. In publications such as "Where are the engineers that Swedish industry needs?" (*Var är teknikerna för svensk industry?*), these organisations lobbied for expanded public education within primary computing, electronics and telecommunications.[283] Similarly, the Royal Swedish Academy of Engineering Sciences published the report "Engineers for the Future" (*Ingenjörer för framtiden*) in 1985. As often before, the Academy stressed the need for more engineers. Its solution, however, was partly new: expansion of education and intensified recruitment activities aimed at schoolgirls.[284] In this way, the Social Democrats' concerns about women in the labour market and the demands of industry reinforced each other. As a result, recruitment efforts targeting girls and women gained momentum.

SECURING SALARIED EMPLOYMENT FOR WOMEN

The Government's campaign to get more women into industry was intended to encourage women to enter new fields in the labour market, as well as to make sure that women did not lose their jobs when computerisation changed tasks they traditionally carried out within the public sector. The arguments put forth in press releases, government bills, interviews and speeches by Anita Gradin and the Social Democratic cabinet underscore this fact.[285] Gradin and her staff stressed that the Swedish labour market was strongly gender-segregated; more so than in other industrialised nations. Women had care, service and administration jobs, mainly within the public sector, whereas men worked within

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[282] Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 120.

[283] Ibid., 119 ff.

[284] Discussed in § 13, Chalmers University board meeting minutes 28 Nov. 1985, A1AA:5.

[285] NSA, M. of Emp., C-Archive, B2:8; personal archive Anita Gradin, Tal vol. 3, 1983 / Pressklipp vol. 1, 1982–1983 / Artiklar och intervjuer, vol. 1, 1982–1984 / Korrespondens, vol. 1, 1982–1984.

manufacturing industry. In addition to working in different fields, men and women performed different tasks. They leaned on statistics that showed that "in occupations that demand professional education, men dominated, whereas women dominated in tasks of a more routine nature".[286] Not only was this a problem for women in that they had access to a smaller segment of the labour market than men, but it was also problematic for the national economy in general because of "limited circulation in the labour market", i.e. people (read women) did not move freely between different sectors to provide the workforce needed for economic growth.[287]

Furthermore, Gradin argued that new technology would significantly impact the tasks performed by women. A government commission on the effects of computerisation on employment and the working environment (*Dataeffektutredningen*), which handed over its final report to the cabinet in 1984, communicated the same message.[288] Since 1978, the commission had been analysing the future consequences of computerisation in the labour market and the necessary actions to combat its adverse effects. Technology historian Per Lundin has demonstrated how the labour movement from the 1970s, while having a positive view of technological development, feared the risk of lost jobs due to computerisation. It therefore took steps to ensure that workers gained the new knowledge needed. Lundin concludes that "rather than being a passive victim of automation, the worker should be an active participant in shaping technological change'.[289] To this end, committees, programmes of action and conferences were launched, such as a programme by the Trade Union Confederation (*Landsorganisationen i Sverige, LO*) on industrial democracy and data (*Företagsdemokrati*) in 1975 and somewhat later, the Social Democratic Party's Computers on the Conditions of Man (*Datorer på människans villkor*) in 1978 and Tage Erlander's Computer Symposium in 1980. As such, the gender equality rhetoric of Minister Gradin reinforced well-known arguments while expressing concern for women's financial independence.

At the same time, and in stark contrast to the political opposition, Gradin argued for continued expansion of the public sector. Child and elderly care provided by the State

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[286] "Arbetsmarknaden i Sverige starkt könsuppdelad", 1–2, Press Release 29 June 1983, NSA, M. of Emp., C-Archive, B2:8.

[287] Ibid.; "Samma rätt till arbete", copy of article in *Svenska Dagbladet*, 29 Oct. 1982, personal archive Anita Gradin, Artiklar och intervjuer, vol 1, 1982–1984.

[288] SOU 1984:20 Dataeffektutredningen, *Datorer och arbetslivets förändring: betänkande* (Stockholm, 1984), 91 ff.

[289] Per Lundin, "Computers and Welfare: The Swedish Debate on the Politics", IFIP International Federation for Information Processing, 2015, quotation page 7.

was critical to ensuring that women were not forced to leave the labour market just "because society has not planned for the social security" in the form of care for children or ageing family members.[290] But, according to Gradin and her party, a broadened labour market and continued expansion of the public sector were insufficient solutions to achieve gender equality. The Social Democrats now also revived the 1970s suggested reform on shorter working days and reactivated the parliamentary committee on working hours called DELFA (*Delegationen för arbetstidsfrågor*).[291] The committee would investigate the effects of a 6-hour working day in several occupations. In addition to the potential benefits for circulation in the labour market overall, the Ministry of Employment identified wins in household workload distribution. It was stated that "a large percentage of fathers with young children work more than 40 hours a week, while part-time work is common among women, and women still carry the primary responsibility for the care of children and household".[292] The Social Democratic agenda included redistribution of working hours, mainly from men to women, but also for other underrepresented groups in the labour market, such as "youth" and "immigrants".[293]

Thus, in addition to highlighting women as a specific group in need of public support, the public inquiries also identified other population categories with the same need. Men constituted such a category. Gradin stressed that a project for "The New Man" was just as important as efforts to expand employment opportunities for women.[294] The new Swedish man would take advantage of public insurance for parental leave to stay at home with his children for a period of time. He would also share household duties evenly with his partner. For the time being he was still a "bureaucratic vision". This vision was at the same time one that Swedish men, at least in theory, approved of. A fresh survey conducted by the Government reported that "in principle, Swedish men favoured an equal distribution of household work and childcare between men and women in general." Ironically, there were always individual reasons why this did not apply to them in their

[290] Press Release 6 December 1982, personal archive Anita Gradin, Pressklipp vol. 1, 1982–1983.

[291] Press Release 2 February 1983, 24 Feb. 1983 and 20 May 1983, NSA, M. of Emp., C-Archive, B2:8.

[292] Ibid.

[293] Ibid.

[294] Draft signed by Anita Gradin (authored by Bill Dampier) to *Sweden Now*, p. 2–3, personal archive Anita Gradin, Artiklar och intervjuer, vol. 1.

current situation.[295] Although only a visionary goal so far, reforms like parental insurance were in place to enable this shift. To the gender equality minister, diversifying women's options in the labour market and increasing men's household responsibilities went hand in hand. Similarly, a decade earlier the engineers active within the CF gender equality council, the engineering association's feminist body, had considered the need for expansion of childcare, a shortened working day and the redistribution of household tasks between men and women.[296] In the 1980s the universities of technology did not pick up on this aspect of the political gender equality debate.

Finally, to justify funding provided under the campaign to those not convinced by emancipatory arguments, Gradin activated an argument echoed in numerous government reports, corporate gender equality plans and university reform projects: gender equality to promote Swedish prosperity. In the national daily press, the Minister called for a revaluation of resources provided to men and women. Since men and women had "different experiences" and therefore "a different outlook on things", they contributed to different aspects of working life. These differences were to be considered a potential source of value that the labour market, not least the private sector, and society should tap into.[297] In summary, Minister Gradin saw women's paid employment as the number one measure to achieve her goal, and all means were available to this end. Although the engineering and technology industry was not well-known for its willingness to employ women, this sector was most likely to recover well from the economic downturn. Computerisation would inevitably cause structural change, diminish sectors where women were traditionally employed at the time and increase the need for skilled labour in industry.

Consequently, it was necessary for industry to accept a new workforce just as it was necessary for women to understand the prospects offered by a technical education. The "More Women into Industry" campaign was launched to support and ease these transformations. The following subchapter investigates how the campaign played out at Chalmers University of Technology.

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[295] Press Release 20 May 1983, NSA, M. of Emp., C-Archive, B2:8. For an historical analysis of the 1970s emerging discourses on men, see Helena Hill. *Befria mannen!: idéer om förtryck, frigörelse och förändring hos en svensk mansrörelse under 1970- och tidigt 1980-tal* (Diss. Umeå, 2007).

[296] TAM, SAGE archive, F10Fa:1–6; Nordvall, "The Resistant Profession".

[297] "Samma rätt till arbete", copy of article in *Svenska Dagbladet*, 29 Oct. 1982, personal archive Anita Gradin, Artiklar och intervjuer, vol. 1, 1982–1984.

Initially, the campaign was to last for a year, starting in September 1983. Inga Alander was elected as project manager and Eva Ljungqvist as project administrator for the campaign at Chalmers.[298] Alander had a deep interest in pedagogical development. As part of her (not completed) doctoral studies, she explored the latest research on gendered teaching and learning and the link to science and technology education. She also participated in reforming the architecture programme at Chalmers in the early 1970s.[299] Starting in 1986 she became responsible for distributing public funding to small-scale pedagogical projects at Chalmers. The funding enabled teaching staff who wished to develop their course curricula or their pedagogical skills to apply for funding.[300]

Building on this experience, Alander and Ljungqvist were convinced that generating enthusiasm among children for science and technology was a critical factor for them to develop an interest later in life. They had considered a technology workshop for young children to familiarize and engage with technology. Prior to the campaign Chalmers' management had been reluctant to finance such an initiative. With the additional campaign funding of 500,000 kronor from the Ministry of Employment – a more than twentyfold increase of the internal annual gender equality budget – the duo saw new possibilities arise. The office of the Vice-Chancellor was helpful in finding a venue for the workshop, but there were no signs of the Chalmers leadership providing additional funding for it at that point.[301] However, after a successful first year, central management decided to provide an additional 130,000 kronor (roughly 400,000 kronor or 40,000 euros

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298 Vice-Chancellor's office meeting minutes 15 March 1983, CTH C-archive, C-Adm., A1DA:3.

299 Interview with Alander. Alander's book collection from this time includes titles by pedagogical scholars such as Ference Marton, Ingrid Pramling Samuelsson (e.g. her doctoral thesis from 1983, *The child's conception of learning*), and Svein Sjøberg. *Godmorgon pojkar och flickor: om 101park och kön i skolan* (Good Morning Boys and Girls: on language and sex in school) by Jan Einarsson and Tor G. Hultman from 1984 was one of the titles that particularly stressed gendered practices and hierarchies in the classroom.

300 On the history of pedagogical development projects at Chalmers from 1968, including the reform of the architecture programme, see attachment to Chalmers University board meeting minutes 23 Nov. 1981, CTH C-archive, C-Adm., A1AA:4. Project applications for pedagogical development and final reports in CTH C-archive, C-Adm., F2DB:3–10. Alander as "pedagogical consultant" in F2DB:9.

301 Vice-Chancellor's office meeting minutes 1 Sep. 1983, CTH C-archive, C-Adm., A1DA:3. The Chalmers gender equality group budget for 1981/82 and 1983/84 (campaign work excluded) was 3,000 kronor and 23,000 kronor respectively (roughly 900 and 7,000 euros in Oct. 2021), in the Vice-Chancellor's office meeting minutes 24 May 1981, CTH C-archive, C-Adm., A1DA:2, and 10 Oct. 1983, A1DA:3.

in 2021) for a second year of the campaign.[302] Fragmented documentation from the Vice-Chancellor's office suggests that the matter was not a top priority within Chalmers' leadership.

Figure 3.2. The head of national gender equality policies, Minister Anita Gradin, and a future engineer shakes hand, overseen by Chalmers Vice-Chancellor Sven Olving. Recruitment efforts targeting women built on the mutual engagement of the state and the universities during the 1980s and 1990s. Photo from Chalmers campaign kick-off conference. Courtesy of the National Swedish Archives, the archive of the Government's labour market committee, F3A:39, Pamphlet "Ett läsår med FART: flickor, arbetsmarknad teknik", 2.

A workshop aimed at young children was also a deviation from the Ministry of Employment campaign guidelines, which specifically requested support for secondary school teachers and recruitment activities aimed at girls in secondary school. The Chalmers project group therefore included two significant areas in addition to the technical workshop: first, supporting schoolteachers in their pedagogical capabilities, and second, information events aimed at secondary school girls, secondary school teachers and school administration. The different subprojects strongly focused on promoting the

[302] The Vice-Chancellor's office discussed the campaign extension on 20 June 1984, but it was postponed, § 12, Vice-Chancellor's office meeting minutes 20 June 1984, CTH C-archive, C-Adm., A1DA:3. In Näslund, *Säg ja! till Tekniken,* 35, it is stated that the Chalmers management decided to add 140,000 kronor for continued campaign work in the coming year, 1984/85.

benefits of science and engineering studies to girls. The projects also involved the adults around the girls, such as parents, career counsellors, teachers and school administrators. Many of these recruitment models reappeared in campaign work at the other universities of technology.[303]

The thematic lesson plans developed to support teachers in the classroom exemplify how contemporary gendered views on technology played out. For this subproject, Alander and Ljunqvist involved primary school teacher P-O Staberg, a pedagogical enthusiast from a local school. Staberg's contribution included teaching materials on themes such as *The Energy Project*, *Technology for the Laid Table* and *Packaging*. The materials were ready-made for the participating teachers to bring back to their classrooms.[304] A rationale that identified girls as a group with specific interests guided the themes; girls required or benefitted from a certain kind of approach. One of the subsequent project evaluations stressed that "by choosing technical examples from the girls' areas of interest and building on the connection between people's needs and technical solutions, the theoretical knowledge is perceived as more meaningful to the girls".[305] This was exemplified by themes relating not only to the labour market, but also to the domestic sphere. At Rydskolan in Skövde the pupils were tasked with working on the theme "The Laid Table" and according to one of the teachers "measuring vessels for baking and cake tins" were among the items produced.[306] The assignment required the use of "several special tools".[307]

In addition, the campaign at Chalmers included a variety of information activities. The campaign workers launched information days for school staff such as school principals, career counsellors and teachers, aimed at equipping them to better support the pupils' future career choices. Chalmers female students and female professional engineers

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[303] Interview with Alander. Chalmers pre-project group set up in Vice-Chancellor's office meeting minutes 15 August 1983, CTH C-archive, C-Adm., A1DA:3. Project applications and project plans from all technical universities in NSA, M. of Emp., C-Archive, E2DA:150. Chalmers project summary and evaluation in NSA, SAMN archive, F3A:39. Press releases on individual projects funded by the campaign, including the Chalmers project in NSA, M. of Emp., C-Archive, B2:8. Summaries and evaluations of campaign projects at Chalmers and other universities of technology in Chaib, *Modeller för rekrytering av flickor till tekniska utbildningar*; Näslund, *Säg ja! Till tekniken*, 25–46; *Rapport från kampanjen för att rekrytera fler kvinnor till industrin*. See also Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 125–136.

[304] Chaib, *Modeller för rekrytering av flickor till tekniska utbildningar*, 21, 23; *Rapport från kampanjen för att rekrytera fler kvinnor till industrin*, 10–12; interview with Alander.

[305] Chaib, *Modeller för rekrytering av flickor till tekniska utbildningar,* 23.

[306] Ibid.*,* 24.

[307] Ibid.

provided information sessions in secondary school classrooms. Secondary school girls were invited to study visits to various industries in the field, and to the Chalmers workshop. Finally, the campaign staff offered camps at Chalmers to a limited number of secondary school girls. At the camps, which were organised over the Easter break and the summer holidays, the girls invited met with female Chalmers students and female faculty and professors, went on industry visits and familiarised themselves with various kinds of engineering and the environment at a university of technology.[308]

The organisers concluded that shifting the focus towards girls had been beneficial. A total of 400 girls had attended the programming drop-in events (*datastugor*) during the winter break. Alander and Ljunqvist commented that "almost all of the girls in the group were pleased with the set-up whereby the course was only for girls".[309] They were also optimistic about the presence of female-only supervisors. Participants' comments on the latter included that "girls understand girls better than boys do" and "it shows that girls can handle technology as well as boys".[310] This feedback strengthened the conviction that female role models were critical for girls to develop an interest in engineering. Female teachers were considered necessary for girls to feel properly understood. More importantly, the girls found that "ordinary girls choose higher technical education".[311] These so-called ordinary girls were those who, for example, had expressed doubts before commencing their engineering studies.

The engineering educators at Swedish universities of technology were by no means alone in targeting girls and young women specifically. The 1980s saw a boost of activity within the field of "women and engineering" in Sweden and internationally (often termed *kvinnor och teknik* in Sweden).[312] Daniel Lövheim has explored some of the activities at the Royal Institute of Technology (KTH) within the "More Women into Industry" campaign and similar initiatives of actors outside universities of technology. As mentioned earlier, the engineering association CF initiated a recruitment campaign called "Youth and

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[308] Act J 3235/83, 8, NSA, M. of Emp., C-Archive, E2DA:150; NSA, SAMN archive, F3A:39.
[309] Alander and Ljungqvist quoted in Näslund, *Säg ja! Till tekniken,* 35. See also Chalmers brochure "Ett läsår med FART", in NSA, SAMN archive, F3A:39.
[310] Näslund, *Säg ja! Till tekniken,* 35.
[311] Ibid.
[312] Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 128–136. For the US and to some extent European case, see ongoing work by Bix, *Recruiting Engineer Jane and Astrophysicist Amy: American STEM Advocacy for Girls, 1965-2015* (forthcoming book).
Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 128–136.

Technology" (*Ungdom och teknik*).[313] The liberal women's organisation The Fredrika Bremer Association, in collaboration with the weekly engineering journal *Ny Teknik,* and *Styrelsen för teknisk utveckling, STU* (a national board for technical development at the time), organised a "Women and Technology Week" including a conference in 1982 at the National Museum of Science and Technology (*Tekniska Museet*) in Stockholm.[314] This event returned for several years during the decade. A different event took place in Gothenburg. For a few days in early May 1984, a convention titled "Women Can Do It" (*Kvinnor Kan*) took off at the Swedish Exhibition & Congress Centre. A foundation with the same name that represented the interests of self-employed women organised the convention. The Ministry of Employment thus joined forces with universities of technology, industry representatives, NGOs, trade union organisations and professional associations, as well as museums, with increasing intensity during the 1980s. The constantly growing need in industry for skilled labour could here be combined with gender equality objectives.[315] It is important to point out that most actors – universities of technology and others – limited their gender equality efforts to focus on the issue of women's representation.

The *recruitment logic* had thus gained momentum by the mid-1980s, both at Chalmers and at Swedish universities of technology in general.[316] Prominent guests such as the Minister for Gender Equality Anita Gradin and the Minister for Education Lennart Bodström visited Chalmers conferences to launch recruitment programmes and give keynote speeches.[317] If the Government had not concerned itself with the wellbeing of Swedish industry and women's employment, the visions of the Chalmers gender equality group would most likely never have materialised. Public funding and regulations from the national level were critical drivers of the activities developed at Chalmers during the 1980s.

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313 TAM, SAGE archive, F10Fa:6.

314 Westman, ed., *Gnistor*; Rosalia Guerrero Cantarell, "Technology as a Woman's Call: The Efforts of the Fredrika Bremer Association to Promote Women's Education in Technology 1978–1999", *Nordic Journal of Educational History* 9, No. 2 (2022): 125–147.

315 Ibid. Funding applications submitted to the Ministry of Employment from the organisation *Kvinnor kan* in Ministry of Employment, Central archive, E2B:31; Barbro Hellberg, ed., *Boken om den fantastiska kvinnomässan i Göteborg 3–6 maj 1984* (Gothenburg, 1985).

316 The work of the universities of technology is documented in the material submitted to SAMN between 1980 and 1985. In NSA, SAMN archive, F3A:36–40, F3A:69.

317 In association with the Ministry of Employment, the gender equality group at Chalmers hosted a national conference that gathered 400 participants on the theme of More Girls into Technical Education in 1986. See Figure 3.5. Transcribed keynote speeches in TAM, SAGE archive, F10Fa:7. Anita Gradin's visit in brochure on "FART" *(Speed)*, in NSA, SAMN archive, F3A:39.

The recruitment rationale was embodied and shaped in this way by politicians, industry representatives, public authorities and engineering educators alike.

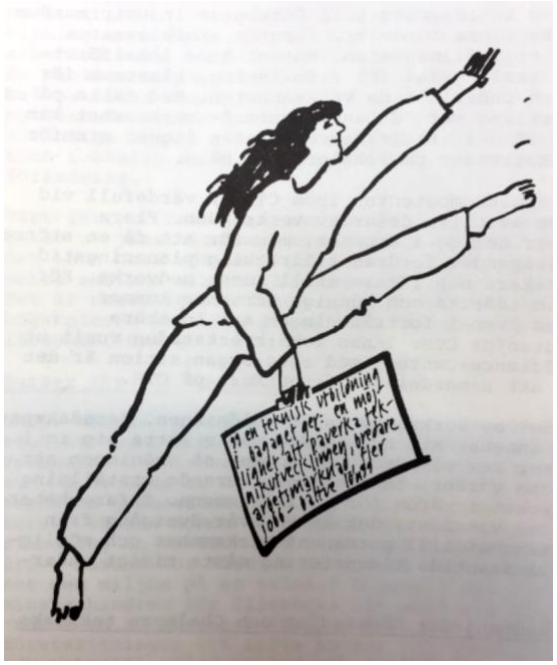

Figure 3.3. Person with long hair and bag in hand moving upward/forward. Text on bag: "A technical education provides: an opportunity to affect the technological development, broader labour market, more work opportunities – better salary" (En teknisk utbildning i bagaget ger: en möjlighet att påverka teknikutvecklingen, bredare arbetsmarknad, fler jobb – bättre lön). *Courtesy of the National Swedish Archives, the archive of the Government's labour market committee, F3A:39, Pamphlet "Ett läsår med FART: flickor, arbetsmarknad teknik"* (A Year with Speed: Girls, Labour Market, Technology)*, 20.*

TARGETING THE MINORITY, AVOIDING CONFRONTATION

The abundance of work done by dedicated actors such as Inga Alander, Eva Ljungqvist and numerous other women around the country – and they were almost exclusively women – was highly appreciated by the people affected. However, despite the activities' inclusive motivations, the specific focus on the female engineering minority did, at times, have the opposite effect. Female students at Chalmers who were active within the student union expressed their frustration in the engineering journal *Ny Teknik/Teknisk tidskrift* in 1982 over the fact that so much emphasis was placed on distinguishing girls as a particular group. They argued that women who choose engineering education are "often somewhat tougher" than the average woman and questioned the image of female engineering students being bullied by their male counterparts.[318] As a young student at Chalmers in the early 1980s, engineering education researcher Kristina Edström remembers the vulnerable position that gendered surveys put people in.[319] Despite being one of only a few women in the computer science and engineering programme, she had never questioned whether her interest in engineering and technology was sufficient for her to

[318] Wallerius, "Vi fick en chock", 78–79.

[319] Personal communication with Kristina Edström, 15 Sep. 2016.

belong there. However, when it was repeatedly brought up by "gender experts and their surveys", the minority position was brought into focus. The survey questions often revealed assumptions that she was expected to be having difficulties, for instance with mathematics or the social environment. Many years later the memory of this treatment still makes her feel angry.[320]

Such assumptions did not come out of the blue. Some students stated that female engineering students were targets of sexual insults, harassment and gender-based discrimination. Another article in the 1982 volume of *Ny Teknik/Teknisk tidskrift* pointed out the misogyny in the student culture and the atmosphere of silence surrounding it. Kia Swartling and Carolina Svensson–Hult, engineering physics students at the Royal Institute of Technology, reported that they were especially shocked by events during "freshers' month" (*nollningen*), which was their first encounter with the university. They argued that, although the misogyny at other times was subtle, the songs, leather whips and in particular the degrading labels given to female first-year students during the first month revealed the inherent sexism in the engineering student culture.[321] An ethnographic study by Olle Hagman at Chalmers only a few years later painted a vivid picture of this extraordinary month.[322] One particular event was the traditional contest where participants, all first-year students or, as called by their senior peers, "zeroes" (*nollor*), competed in drinking a bottle of beer as fast as possible (*Nollhävet*). Hagman's first-hand account should be consulted to appreciate the full experience and the numerous rituals surrounding the event. Here, I give a short review. For the electrical engineering students, the event took place in the large student union basement. With a large audience of more senior electrical engineering students who formed a tight circle around the stage, the "contestants" entered and stood in the centre, one by one. Among the rituals involved in the contest was the audience shouting various chants. When female participants came on stage, the crowd yelled "suck-zero, suck-zero" or the even more vulgar variants "we want zeroes with holes", "suck it slowly" or "vagina heave" (*vaginahäv*).[323] Hagman concludes that because of the clear male dominance at Chalmers, it was assumed within some student societies (*sektioner*) that all "zeroes" were boys. In these societies, the female engineering students sometimes complained of a "military service atmosphere" (*lumparstämning*). One girl in the civil

320 Ibid.

321 Wallerius, "Vi fick en chock", 78–79.

322 Hagman, *Nollan blir nymble,* 42–43.

323 Ibid. Following Ulf Mellström's translation of the Swedish word *häv* in Mellström, *Engineering Lives*.

engineering programme concluded that in military service, "boys are turned into men; here they are trying to turn women into men as well." [324]

Efforts by engineering educators to improve gender equality in the 1980s never targeted these practices. The engineering male majority and the discriminatory practices were by and large left alone. To many outsiders and insiders, these rituals were considered repulsive and intimidating, irrespective of gender identification. While only vaguely known to the public, these practices most certainly discouraged some, but also attracted potential students of all genders to enrol at technical universities.[325] The vigour with which these rituals have been defended, and continue to be defended, by Chalmers students and alumni should be paid special attention.[326]

While gender equality activities in the 1980s did not target these rituals, the prevalence of gender-based discrimination was addressed, albeit in a different way. Seminars to raise awareness were arranged to better equip, first and foremost, the female minority – female engineering students and female faculty – to handle the sometimes hostile environment. Among the measures proposed was providing employees and students with courses and seminars to develop their opportunities and skills "despite the idea on gender roles".[327] One example was a course entitled "Discover your Opportunities" (*Upptäck dina möjligheter*). The invitation to attend stated that the course would improve self-confidence and reveal personal resources in women of different occupations and ages. The aim was to enable women "in a more active way, to take responsibility for their own working environment".[328]

The seminar series would also highlight formal and psychological obstacles preventing women from entering certain positions. Since "gender equality work largely involves making use of existing resources to increase efficiency" which was "often prohibited by prejudice regarding what is seen as male or female", a seminar series would "challenge traditional thinking on gender roles in female and male occupational fields".[329]

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[324] Hagman, *Nollan blir nymble*, 46.

[325] This thesis Chapter 5, sub-chapter "A Call for Gender Analysis".

[326] Personal communication with Chalmers Student Union management, 26 Nov. 2019 and with Chalmers engineering physics graduate Julia Ravanis, 23 Oct 2019; the private archive of Julia Ravanis private.

[327] "Förslag till verksamhetsplan för jämställdhetsarbetet under budgetåret 1983/84", attachment to Vice-Chancellor's office meeting minutes 10 Oct. 1983, CTH C-archive, C-Adm., A1DA:3.

[328] Ibid. Course invitation in NSA, SAMN archive, F3A:39.

[329] Vice-Chancellor's office meeting minutes 10 Oct. 1983, CTH C-archive, C-Adm., A1DA:3.

To this end, women with an engineering degree who had already entered the labour market would be invited to Chalmers to "share their experiences regarding breaking into an occupational field that was traditionally non-female" with undergraduate and doctoral students. This would not only challenge attitudes on gender roles but also provide female students with examples and role models.[330]

Raising awareness was not a strategy only adopted by actors at Chalmers; numerous companies, municipalities and government agencies applied for government funding to launch courses in self-confidence training and public speaking.[331] Here, ideas around gender roles and attitudes shed light on how issues relating to the work environment became the responsibility of the mistreated. Members of parliament, education bureaucrats and educators argued that if discrimination were a result of attitudes, these attitudes would eventually change when women "breaking the glass ceiling" (*brytare)* – women entering male-dominated industries – challenged traditional gender roles.[332] It was a matter of getting rid of attitudes remaining from a prehistoric era that for some unexplained reason had stayed around in the new modern age where men and women were considered equals.[333] In the words of historian Yvonne Hirdman, young women would be trained to manage everything – from sexual harassment to pure hostility and slander – "with a calm and superior smile" (Figure 3.4).[334]

Not only were women to be convinced to enter fields they would not necessary choose, but in addition, they themselves would be responsible for handling a potentially hostile work environment.[335] But there was also criticism of the increased recruitment

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330 Ibid. The first finalised Chalmers Gender Equality Plan did acknowledge that hiring processes needed to be affected as well. No specific measures are mentioned. In NSA, SAMN archive, F3A:39.

331 Applications in NSA, SAMN archive, F1A:27, Ärendegrupp 51.

332 Ibid. "Breakers" (*brytare*) and "breaking" projects (*bryt-projekt*), in the sense of breaking the glass ceiling, was the commonly used term for individuals who entered sectors dominated by the opposite sex, and initiatives to promote the same behaviour in the Nordic region during the 1970s and 1980s. The majority of projects concerned male-dominated sectors although projects to convince men to enter female-dominated sectors also occurred.

333 Tollin, *Sida vid sida*, 62.

334 Yvonne Hirdman, *Vad bör göras? jämställdhet och politik under femtio år* (Stockholm, 2014), 70.

335 For further accounts of sexism and gender-based discrimination in Swedish engineering during the twentieth century, see for example Berner, *Sakernas tillstånd*; Kerstin Hanzon, "Jasså, teknologen är en flicka", *CF-tidskriften* 4 (1972), 70–71; Karlqvist, *Från eftersatt till eftersökt*; Frida Lund, "Chalmers stöter bort kvinnor: dolt regelverk av traditioner gynnar manliga studerande", *Göteborgs-Posten*, 25 April 2000; Wahl, *Könsstrukturer i organisationer*; "Chalmers against sexism", newsletter from the Chalmers Student Union, https://chalmersstudentkar.se/wp-

activities. In a national daily newspaper a woman with a civil engineering degree (*väg- och vattenbyggnad*) protested about having to try to convince women to enter engineering at all, and especially to study for a civil engineering degree: Why convince women to invest in a long university education when employers were not willing to hire them? [336]

Figure 3.4. Girl at workshop. Hirdman, Vad bör göras?, *70. Reprinted with permission of the author.*

The Social Democrats were, in fact, concerned about this situation. Minister Gradin and Minister for Education Lennart Bodström warned against contradictory demands on women, calling for unions and employers to combat sexism in the workplace. In a

content/uploads/2017/11/chalmers_against_sexism_incl_stories_171124.pdf?utm_campaign=cmp_768056&utm_medium=email&utm_source=getanewsletter, retrieved 26 Nov. 2018.

[336] "Lura inte flickorna att bli byggtekniker" (*Do not fool the girls into being construction engineers*), copy of article in *Dagens Nyheter* 13 Feb. 1975, TAM, SAGE archive, F10Fa:4.

newspaper article, Gradin confirmed that sexual harassment was not uncommon in male-dominated workplaces – a situation normally not experienced in workplaces with equal numbers of men and women.[337] But while Gradin acknowledged that the situation was different for women, she placed the responsibility for action on the trade unions and employers, rather than on the Government and its agencies. Gradin stressed that employers should make sure they did not hire just one woman, but hire several women at the same time since "it is not easy for one woman alone to endure the pressure!"[338] The response was in line with twentieth-century Social Democratic labour market politics, in which collective agreements between employers and trade unions have always been the first instruments of choice to solve labour market conflicts. The Social Democratic cabinet would not interfere with this order before everything else had been tried. As such, the Social Democratic cabinet was highly reluctant to enact a law against gender-based discrimination in the 1970s.[339] On a similar note, at the "More Girls into Technical Education" conference at Chalmers in 1986, Minister Bodström asked a rhetorical question about the ethics of trying to convince girls to enter technical education when the labour market did not welcome them. His speech recognised the dichotomy of, on the one hand, the significant demand for a qualified workforce in technical industries and the urgent need for Swedish industry to keep up with fast-paced international technological development, and on the other, the untapped pool of potential female students and graduates. It also raised concerns regarding widespread gender-based discrimination.[340]

The outreach projects launched by the 1980s campaigners, engineers and politicians to convince young girls, their parents, career councillors and school principals that "technology is fun" and that the girls only needed to understand this fact, therefore raised questions. Neither the discriminatory practises in student social activities, in teachers' treatment of students, in industry's hiring practices, nor in the social environment of the engineering workplace was addressed through the campaign guidelines or the local activities that took place.[341] Upcoming chapters further elaborate on how to understand this situation.

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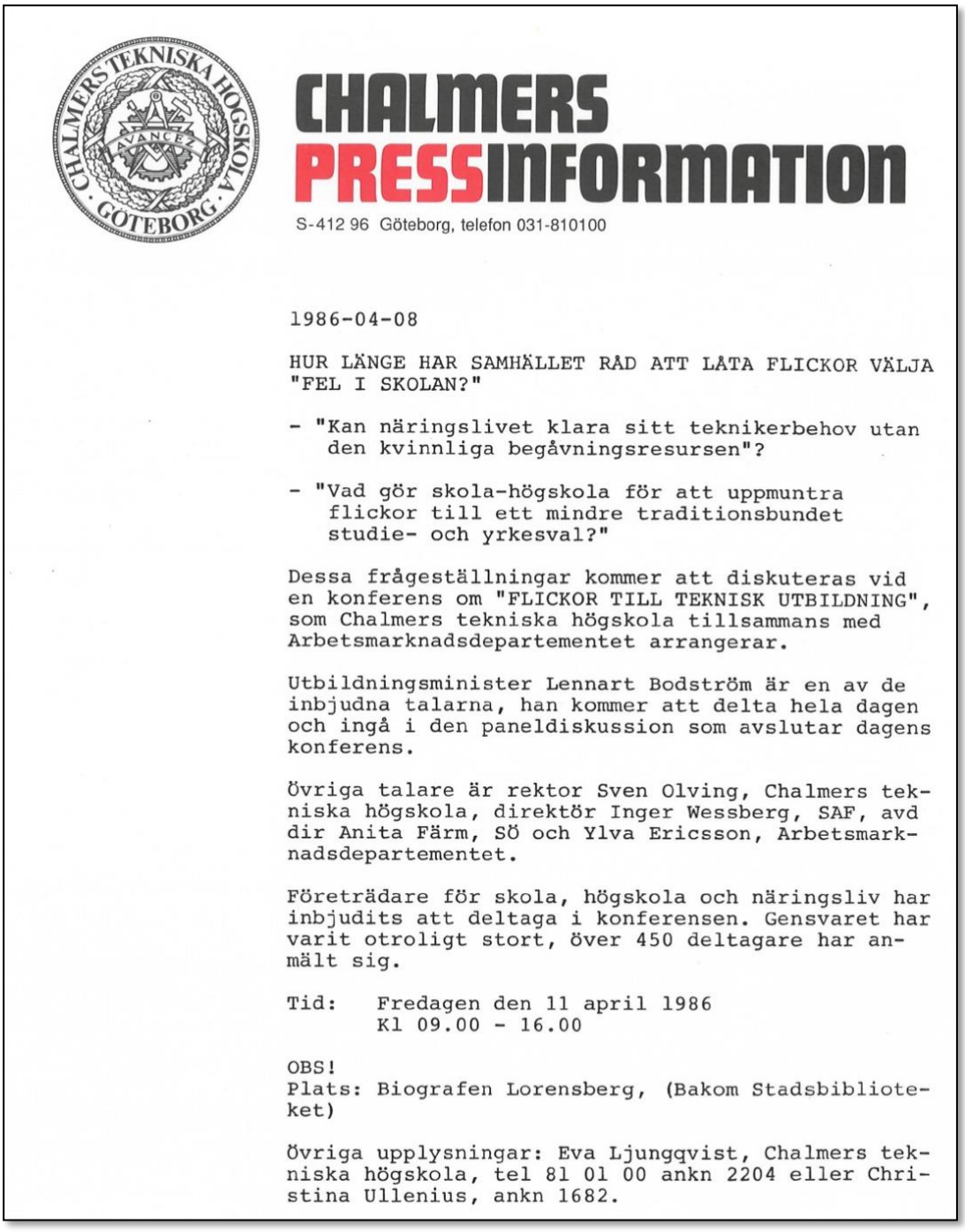
337 "*Samma rätt till arbete*", copy of article in *Svenska Dagbladet*, 29 Oct. 1982, personal archive Anita Gradin.

338 Ibid.

339 Tollin, *Sida vid sida*, 66.

340 Transcription of Lennart Bodström's conference keynote in TAM, SAGE archive, F10Fa:7.

341 Hiring practises at Chalmers were listed as among the processes to be developed in the Chalmers long-term gender equality plan. In documents from the gender equality group at Chalmers, however, I cannot find any measures of this kind. The work of the Chalmers hiring



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1986-04-08

HUR LÄNGE HAR SAMHÄLLET RÅD ATT LÅTA FLICKOR VÄLJA "FEL I SKOLAN?"

- "Kan näringslivet klara sitt teknikerbehov utan den kvinnliga begåvningsresursen"?

- "Vad gör skola-högskola för att uppmuntra flickor till ett mindre traditionsbundet studie- och yrkesval?"

Dessa frågeställningar kommer att diskuteras vid en konferens om "FLICKOR TILL TEKNISK UTBILDNING", som Chalmers tekniska högskola tillsammans med Arbetsmarknadsdepartementet arrangerar.

Utbildningsminister Lennart Bodström är en av de inbjudna talarna, han kommer att delta hela dagen och ingå i den paneldiskussion som avslutar dagens konferens.

Övriga talare är rektor Sven Olving, Chalmers tekniska högskola, direktör Inger Wessberg, SAF, avd dir Anita Färm, SÖ och Ylva Ericsson, Arbetsmarknadsdepartementet.

Företrädare för skola, högskola och näringsliv har inbjudits att deltaga i konferensen. Gensvaret har varit otroligt stort, över 450 deltagare har anmält sig.

Tid: Fredagen den 11 april 1986
Kl 09.00 - 16.00

OBS!
Plats: Biografen Lorensberg, (Bakom Stadsbiblioteket)

Övriga upplysningar: Eva Ljungqvist, Chalmers tekniska högskola, tel 81 01 00 ankn 2204 eller Christina Ullenius, ankn 1682.

Figure 3.5. Invitation to Chalmers Conference. Courtesy of CTH C-archive, Chalmers Central Administration (Förvaltningens arkiv för Chalmers Tekniska Högskola, 1978-1984).

committees and HR department must be consulted for this purpose. Affirmative action is mentioned as a legitimate measure (according to the Gender Equality Act) in the Chalmers Gender Equality Plan of 1984, "Plan för jämställdhetsarbetet vid Chalmers Tekniska Högskola", attachment to Chalmers University board meeting minutes 9 April 1984, CTH C-archive, C-Adm, A1AA:5.

CONCLUSION

Starting in the 1970s the Female Engineering Student (*den kvinnliga teknologen*) developed as a distinct trope. This had several consequences. Girls and young women did indeed become aware of engineering studies as a possible educational choice and career path, but it also had a more troublesome outcome. The "faulty" choice made by the female minority was established as the standard narrative for why the numerical gender imbalance in engineering prevailed. As such it directed the vision away from the homosocial engineering majority culture; the response was the outcome of engineering graduates' and universities of technologies' practices of professional boundary work. This thesis interprets this narrative – dominant in proposed policy solutions and the universities' internal gender equality plans – as the only possible answer in an environment permeated by traditional professional engineering norms, values and convictions. The *recruitment logic* nourished the idea that girls and women were misinformed regarding what working in engineering and technology would involve.

This logic thus motivated marketing and outreach activities under the banner "technology is fun" and placed the responsibility for change on the female minority rather than confronting the sources of discrimination, sexist practices, formal and informal exclusionary engineering networks and communities, and the inherently gendered coding of technology. The recruitment logic has prevailed among politicians and particularly within the engineering majority into the twenty-first century. Its workings and consequences are unpacked in the final chapter of this thesis.

The consolidation of the recruitment logic during the 1980s must be understood in a contemporary context. The Swedish government launched and funded multiple projects to convince women to enter the male-dominated industry. Government agencies such as the labour market committee (SAMN) and the Ministry of Employment coordinated state-run programmes and local initiatives among public employers, spurred on by industry representatives. The Social Democratic cabinet argued that women had to secure their position in the labour market by moving into the expanding and transforming technological sector. The opposite – convincing men to enter female-dominated areas – was not nearly as common. To industry, women were considered a potentially untapped pool of skilled labour. Lobbying for recruitment projects went hand in hand with lobbying for the expansion of state-funded higher technical education in general. Overall, the activity rate was intense. Numerous local, regional, and national projects surveyed, informed, engaged, inspired and educated women to abandon their "gender-role

patterns" and take personal responsibility for their careers. Activities spelt out and motivated in the technical universities' gender equality plans can therefore be understood as the contemporary discourse on achieving gender equality within male-dominated education and workplaces. But practises of professional boundary work consolidated this understanding of gender equality within the engineering majority. When new gender ideologies in other parts of society challenged this understanding, the universities of technology – or most of its representatives – did not follow suit.

Finally, this chapter has argued that marginal actors – human resource staff, administrators, educators and, only occasionally, engineering faculty – at Swedish universities of technology carried out the gender equality groundwork of the 1980s. It stresses the enthusiastic and intense actions of many engaged individuals should be understood as a previously overlooked form of feminist activism. Inga Alander, Eva Ljungqvist and their counterparts at universities of technology around the country were vital in making science and technology studies comprehensible to many children and adolescents – and perhaps especially to girls.

4

Reforming a World of Men: The Battlefield of Engineering Curricula

Before the summer break in 1984 the Vice-Chancellor's office at Chalmers University of Technology appointed a new chair of the university's gender equality group.[342] Christina Ullenius, PhD in chemical engineering and also one of the pioneering women on the Chalmers faculty council (*fakultetsnämnden*), was hand-picked for the role. She was far from excited about her new position. Her questioning of activities that put the spotlight on the women and gender inequalities had recently challenged the entire basis of gender equality efforts at Chalmers.[343] Highlighting female engineers because of their gender identity was not always welcomed by the individuals targeted. They saw themselves primarily as professional engineers, not as representatives for a minority group. In the years to come Ullenius would take a different position. As Chair of the gender equality group and working closely with Eva Ljungqvist and Inga Alander – the protagonists of Chapter 3 – Christina Ullenius eventually became a leading actor in the quest for gender equality at universities of technology.[344]

A decade later, in September 1993, Swedish university administrators and academic faculty gathered for a national conference. The launch of a national reform programme for higher education in science and technology had brought them to the university city of Lund. The programme had a dual purpose: to raise educational quality and increase gender equality. The organisers – one of them being Christina Ullenius – did not miss the opportunity to add to an atmosphere of novelty:

> Today, the girls have difficulties finding the social benefits of technology. Their requirements, focusing on holistic and social relevance, depart considerably from the technology-fixated boys. During the 1980s, we worked from hypotheses that the girls lacked self-confidence, role models and information about engineering and

342 Vice-Chancellor's office meeting minutes No. 42 1983/84, 15 June 1984, CTH C-archive, C-Adm., A1DA:3.

343 Interview with Alander; interview with Ullenius.

344 Ibid. (Ullenius). In collaboration with Åse Lidbeck from the Ministry of Employment, Christina Ullenius and Eva Ljunqvist were the main organisers. Work notes in TAM, SAGE archive, F10Fa:7.

> science education. Instead, we must conclude that they deliberately reject the programmes.[345]

To Ullenius and her fellow conference organisers the reason for the low percentage of women in engineering education was clear. The engineering programmes at universities had been designed with "technology-fixated" boys in mind. When women rejected these programmes they were making a rational choice. This was not an outcome of their limited insights into engineering education. Ullenius and her collaborators argued that the opposite was true: women and other students who turned their backs on engineering had a clear-sighted view of the universities and their programmes.

This chapter takes us into the early 1990s and new university reform politics. At the universities of technology, the efforts of leaders like Christina Ullenius, with their curricular reform agenda, gained momentum. With the national economy in severe crisis, the Swedish voters had given a centre-right cabinet a chance. The cabinet emphasised state minimisation and marketisation, including reforming the university funding structure. This reform put pressure on engineering educators to ensure that students completed their degrees. To a minority of "elite" engineering educators, one solution to this new situation was curricular reform. This chapter outlines such an attempt, involving reform of science and engineering programmes. It was called the "Five Gender-Inclusive Projects" initiative (hereafter FGIP). This chapter focuses on events at Linköping University and Chalmers, the two universities where 4.5-year engineering programmes (*civilingenjörsutbildningar*) were granted FGIP funding.

In the FGIP initiative, various gender equality advocates – cabinet ministers, state bureaucrats and a small circle of university educators – saw an opportunity to fulfil a new goal. They viewed curricular reform as a measure to attract more women to science and engineering studies while also increasing educational quality overall. To these actors the definition of the gender inequality problem had thus shifted focus: from failures on the part of potential female students to the universities' insufficient curricula and pedagogy. The *recruitment logic* was challenged by *reform logic*. The reformers at Chalmers and Linköping University were initially celebrated, successful as they were in their ambition to transform engineering education. In the long-term, however, their efforts were silenced or forgotten. Once again, professional norms explain this situation. Practises of

[345] Ullenius is quoted in the journal *Universitetsläraren*, Sep. 1993, p. 2, copy in private archive of Bertil Svensson. The article reviewed the meeting in Lund.

professional boundary work made engineering educators fall back on the recruitment logic, which by no means had disappeared within the universities. An analysis of the curricular battle taking place within two Chalmers' programme committees (*linjekommittéer*, previous *linjenämnder*) highlights the competing ideas on how to reach the dual goal of educational quality *and* gender equality. This chapter thus provides an example of how the status quo is maintained at a university of technology.

The chapter plays out in three different arenas to uncover the link between national gender equality policies and professional engineering ambitions. At the national level, emerging neo-liberal economic policies, the transformation of the higher education system and national complaints about university professors' teaching skills form the context for what simultaneously was taking place at the universities of technology. The chapter shows how the FGIP initiative became a national compromise responding to diverse demands – at the national level and locally at the universities of technology. Thus, the chapter identifies the specificities of the Swedish 1990s: the juxtaposition of governmental gender equality debates, new pedagogical ideas and a belief at the national level in science and technology as the route to economic growth. This chapter also describes the expression of the still widespread recruitment logic at Chalmers. While curricular reform through FGIP funding preoccupied the management of the computer science and engineering programmes, the management of the electrical engineering programme fell back on outreach campaigns targeting upper secondary school girls. Their information campaign called "The New Elite to E" did not only embrace the gender-binary recruitment logic, it was also rooted in a century-old professional identity: engineers with a degree belonged to an elite echelon in society.

The chapter is dense and the short introductory outline is thus there to help the reader. The chapter begins by examining an early report that argued for educational reform to increase gender equality – an argument that the educators favouring reform relied on. The following sub-chapter describes the Swedish economic crisis of the 1990s and its effects on the State Cabinet's discourse and policies. Before analysing the local events at Chalmers University of Technology and Linköping University, the chapter outlines the context of national initiatives, starting with Minister for Education Per Unckel's motivation for university reform efforts, the new council he formed to focus on the renewal of undergraduate education (*Högskolans grundutbildningsråd*) and the council's call for programme reform. The next sub-chapter discusses another government body that was key to the launch of the reform initiative, namely Minister Unckel's advisory

committee on gender equality in higher education and research, JÄST (*JÄST-gruppen, Arbetsgruppen för jämställdhet i högre utbildning och forskning*). The sub-chapter presents competing gender equality ideologies in the Swedish government debate of the 1990s. National feminist experts with more radical visions rejected the new reform logic of the centre-right government and among elite engineering educators. The final sub-chapter outlining national events presents a key commission appointed in 1989 to focus on higher education (*Högskoleutredningen*).[346] The sub-chapter demonstrates how pedagogical and educational criticisms expressed by this commission intersected with concerns about gender inequality in the university system, as presented by the JÄST committee, leading to Unckel's reform to achieve gender equality and educational quality. The national context is vital for an understanding of the new position taken by local gender equality advocates at universities of technology. A new *reform logic* among engineers which advocated curricular and pedagogic renewal gained momentum and challenged the previously ubiquitous recruitment logic that focused on information and outreach campaigns.

A new rationale among gender equality advocates in higher technical education had thus entered the stage. If "technology is fun" was the leitmotif of the recruitment logic, "gender equality for increased quality" echoed among 1990s gender equality advocates. Londa Schiebinger has identified that, internationally, "fixing the women" was succeeded or supplemented by "fixing the institutions" in gender equality policies around STEM (science, technology, engineering, mathematics).[347] Swedish processes largely follow this pattern. However, national specificities must be analysed to understand the mechanisms at play. Engineering faculty at Swedish universities of technology still hung onto the older recruitment logic. Although its underlying assumptions were increasingly challenged, its hold on faculty made reform efforts, in most places, laborious. This chapter explores an early national expression of this shift and the tensions within engineering education it entailed.

The chapter is based on various sources – both written and oral. Official publications and a total of eight interviews inform the overall analysis in the chapter. Written, mainly unlisted, materials from the Chalmers Central Archive, in combination with interviews

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346 SOU 1992:1 Högskoleutredningen, *Frihet, ansvar, kompetens: grundutbildningens villkor i högskolan: betänkande* [Freedom, Responsibility, Competence: Report of the Swedish Higher Education Commission] (Stockholm, 1992), 3.

347 This thesis, Chapter 1, sub-chapter "Three Fixes: Women, Institutions, Knowledge"; Palm, "Det är inte bara image", 12–14; Stanfors, *Säkert och sakta*, 91.

with members of project leadership at Chalmers and Linköping University, and the private archives of these individuals, form the basis for analysing the processes at the universities. But that analysis also includes printed sources, notably a doctoral thesis from that time by Minna Salminen-Karlsson, a gender and engineering scholar, and pedagogical scholar Inger Wistedt's FGIP initiative evaluations. Salminen-Karlsson's analysis and Wistedt's evaluations provide theoretical perspectives on why the FGIP initiative failed to reach its goal in the long term. Their findings are discussed in-depth and expanded on in the final sections of this chapter. Chapter 5 further highlights Salminen-Karlsson's role as an essential contemporary actor in arguing for the integration of gender analysis into Swedish higher technical education.

FEMALE FACULTY: ADVANCING STRUCTURAL PERSPECTIVES

In the early 1990s Christina Ullenius had risen in the university ranks. She was now a member of the council aimed at renewing undergraduate education (*Högskolans grundutbildningsråd*), the organising body for the initiative that was launched at the conference in Lund in September 1993. In her new leadership role as Pro-Vice-Chancellor, Ullenius had overall responsibility for educational development at the university. Vice-Chancellor Anders Sjöberg had given her a mandate to work on programme reform and stimulate change.[348] The sequence of events in this chapter makes Christina Ullenius one of the key figures in this story, perhaps *the* key figure. Her position can be interpreted as a node in a network of actors: public authorities, university leadership and gender equality workers. Through her broad experience from different positions within the Swedish system for universities of technology, she gave voice to a perspective that stressed the fruitful combination of curricular reform, pedagogical renewal and gender equality. Also, in a broader perspective, on her recommendation, public funding was once again steered towards male-dominated science and technology education.

Ullenius's conference statement in Lund positioned gender equality efforts in stark contrast to the activities of engineering actors during the 1970s and 1980s. Inspired by emerging pedagogical and feminist scholarship, a limited yet influential number of engineering educators like Ullenius now called for new strategies. Past gender equality advocates had highlighted women as a marginalised group; a group that these advocates

[348] Interview with Ullenius. See also article in *Universitetsläraren*, Sep. 1993, p. 2 (private archive, Svensson).

often belonged to themselves. But the 1980s pioneers had done more than just take a few minor first steps towards a gender-equal university; they had influenced the engineering faculty in their vicinity. Christina Ullenius holds that Eva Ljungqvist and Inga Alander sparked her feminist awakening. At first she had been reluctant to accept an offer from the Chalmers Vice-Chancellor to take up the position as Chair of the university's gender equality group in 1984. However, the awareness and knowledge possessed by Eva Ljungqvist and Inga Alander would later substantially influence Ullenius's engagement in the coming decades.[349]

During the 1990s there was powerful criticism of the perspective of "women's faulty choices". Scholars interested in gender and STEM education distinguished between individual and structural perspectives.[350] To these reform advocates the engineering educational system was a gendered system, and in this situation, individual solutions targeting the female engineering student (Chapter 3) were inadequate. The problem was structural and had to be addressed as such. Furthermore, a recent external evaluation of the Swedish university system suggested that more women in academia as well as feminist perspectives could improve educational quality.[351]

> At an intellectual level feminist perspectives have enriched history, literature, social science and, to a lesser extent, science and technology. At an organizational level the recruitment of more women lecturers may shift the balance of academic effort away from research and towards teaching, because women have a people-centred rather than power-centred orientation, or because they are less likely to receive research grants through a peer review system dominated by men.[352]

It held that women were more likely than men to support proposals for pedagogical training for professors – not because of biological nurturing traits but because of their supposed sensitivity to reproducing male hegemonies, which the otherwise informal initiation into male academia implied. Additionally, the evaluation report suggested that

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[349] Interview with Ullenius.

[350] E.g. Svantesson, *Tjejer till tekniska utbildningar eller tekniska utbildningar för tjejer?;* Salminen-Karlsson, *Bringing Women into Computer Engineering*; Ek-Nilsson, *Teknikens befäl.*

[351] Peter Scott, *Higher Education in Sweden: a look from the outside* (Stockholm, 1991), 76–77. See also Departementsserien 1992:119, *Jämställdhet i högre utbildning och forskning* (Stockholm, 1992), 16, and Departementsserien 1997:56, 102.

[352] Scott, *Higher Education in Sweden,* 76–77.

female professors were more aware of biases built into examination methods and discussion seminars. More female faculty would likely improve overall educational quality.

> In pedagogical terms women are more likely to support the proposal that all teachers should be trained (because they suspect informal initiation into the academic profession reproduces male hegemonies?); the presence of more women students may also lead to a more radical re-evaluation of teaching and examination methods (men dominate seminars while women are better at written assignments?). Finally it is claimed that a higher proportion of women, both students and teachers, improves the ethos of institutions. Equal opportunities, therefore, are a quality issue, although their influence is a matter of controversy.[353]

In conclusion, the report author deemed Sweden – known internationally as a forerunner in gender equality reforms – surprisingly backwards in realising the relationship between gender equality and educational quality. Similarly, a growing number of internal university surveys and qualitative studies suggested that female students were more likely than their male counterparts to emphasise the importance of the teaching capabilities of professors. The connection between gender equality and pedagogical and educational renewal thus echoed an emerging theme in contemporary social science studies and university survey results.[354]

Informed by such critique, the 1990s engineering gender equality advocates built their arguments. They targeted fragmented engineering curricula, sloppy teaching and instrumental perspectives on technology. To them, technology's social aspects were largely missing in engineering education.[355] To attract and retain students who did not immediately have engineering as their first choice, a holistic view of technology was vital, but so too was pedagogical renewal. The actors stressed that engineering and technology

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[353] Ibid., 77.

[354] See e.g. reference to studies conducted at Chalmers by Agneta G. Göransson and Inga Alander in Peter Jansson, *D++ Projektet. Förnyelse av datateknikutbildningen för jämställdhet och kvalitet* [The D++ Project. Renewal of Computer Engineering Education to Improve Gender Equality and Quality] (Gothenburg, 1998), 61. An early account of this perspective in Kvande's article "Anpassning och protest" ("Adaptation and Protest").

[355] Jansson, *D++ Projektet*; Peter Jansson, *Projekt D++. Datautbildning i förändring* [Project D++. Computer Engineering Education in Transformation] (Gothenburg, 1995); Salminen-Karlsson, *Bringing Women into Computer Engineering*; Inger Wistedt, *Gender-Inclusive Higher Education in Mathematics, Physics and Technology: Five Swedish Development Projects* (Stockholm, 1996); Wistedt, *Five Gender-Inclusive Projects Revisited.*

were about more than nuts and bolts. However, current engineering curricula failed to capture such nuances. If new student groups – especially women – were to be counted on to enrol, the actors argued that educators must integrate the social and human aspects of technology into engineering education. Curricular and pedagogical renewal would benefit female students and also positively impact educational quality overall. But the major push for reform came from events outside the universities of technology.

PEDAGOGICAL RENEWAL FOR POST-INDUSTRIAL TIMES

The summer of 1990 saw the first signs of the collapse of the Swedish economy. Only after the overheated and speculative economy of the 1980s fell apart did the vulnerability of the economy become clear to the Swedish majority.[356] In the first few years of the 1990s the real estate market collapsed, mortgage interest rates skyrocketed, post-war manufacturing industries went under and unemployment rates reached unprecedented levels. The cabinet stepped in with public funding to save numerous banks from bankruptcy. More than half a million people lost their jobs and suddenly almost everyone knew someone who had been affected. Some people suffered severely.[357] Twenty-five years later Swedish public radio reported that 25,000 or more Swedes still struggled with debt left over the from the crisis in the 1990s – debt that had now grown substantially.[358]

Whereas most sectors in the Swedish economy were bleeding, the effect of the situation on the university system was entirely different. According to scholars Sverker Sörlin and Gunnar Thörnqvist, the higher education system was the only public sector that was not affected by the budget cuts in the aftermath of the crisis.[359] In the 1980s, when public sector cuts and computerisation transformed the Swedish labour market, the Government had pinned its hopes on engineering and technology industries, on universities of technology and on increasing people's technical skills through education in engineering and technology. A decade later, when Swedish trade and industry broke down, the cabinet once again looked to higher education institutions as the actors that could turn the economy around. The post-industrial economy, the phase which

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[356] Sverker Sörlin and Gunnar Törnqvist, *Kunskap för välstånd: universiteten och omvandlingen av Sverige* (Stockholm, 2000), 104–105; Östberg and Andersson, *Sveriges historia*, 314 ff.
[357] Sveriges Radio, "90-talskrisen", P3 dokumentär, 12 Oct. 2008, https://sverigesradio.se/avsnitt/87426, retrieved 26 Jan. 2021.
[358] Sveriges Radio, "Tusentals svenskar skuldsatta 'för evigt'", Ekot, https://sverigesradio.se/artikel/6285043, retrieved 26 Jan. 2021.
[359] Sörlin and Törnqvist, *Kunskap för välstånd,* 105.

industrialised nations were now said to have entered, was a "knowledge economy", an economy that demanded an overall boost in the education of the Swedish population.[360] In the new economy, citizens could not count on spending their entire life working for one employer. The Ministry of Education saw an expansion of the higher education system as an urgent priority. Additionally, the universities' new "third mission", that of ensuring that academic knowledge was utilised to benefit society, was intended to motivate researchers to commercialise their research results.[361]

Per Unckel, Minister for Education and Research of the centre-right crisis cabinet was the first to push for university expansion and commodification. Through interviews with Unckel and his colleagues, sociologist Mats Benner shows how market liberalisation ideas, including those of neo-classical economist Friedrich von Hayek, heavily influenced Unckel and bureaucrats in his Ministry. The Ministry had one primary goal: to minimise state bureaucracy and let universities, in cooperation with the Swedish private sector, decide what research to conduct. Public commissions should be limited to a minimum.[362]

During much of the 1990s, unemployment rates stayed high at the same time as university enrolments continuously increased. From 1990 to 2000, 165,000 students doubled to 320,000.[363] Several scholars have discussed this massive expansion in enrolment, which continued throughout the decade.[364] On the one hand they recognise it as a consequence of the economic recession: more people enter university when job opportunities are scarce. On the other hand it is seen as a result of university policies of the 1990s state cabinets. These policies targeted the educational level of the Swedish population.

A NATIONAL CALL FOR ACTION: FIVE GENDER-INCLUSIVE PROJECTS INITIATIVE

Per Unckel became the first cabinet minister to officially establish a connection between educational quality and gender equality. In February 1993 Unckel presented his higher

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[360] *Regeringens proposition 1992/93:1 om universitet och högskolor: frihet för kvalitet* (Stockholm, 1992); *Regeringens proposition 1992/93:169 om högre utbildning för ökad kompetens*, (Stockholm, 1993).

[361] *Högre utbildning och forskning: utdrag ur regeringens budgetproposition 1996/97:1 (Utgiftsområde 16)* (Stockholm, 1996), 47–48.

[362] To this end, the centre-conservative cabinet transformed the employee funds, or wage-earner funds (*löntagarfonderna*), into research councils. Benner, *Kontrovers och konsensus*, 37 ff.; Widmalm, "Kun(d)skapssamhället".

[363] Sörlin and Törnqvist, *Kunskap för välstånd,* 95.

[364] Ibid.; Andrén, *Visioner, vägval och verkligheter*; Benner, *Kontrovers och konsensus.*

education bill to the cabinet.[365] For posterity, Unckel's cabinet period marks the starting point for new university governance, variously referred to as neo-liberal governance, new public management or corporate academia.[366] Several measures in the bill caused these labels: a university reform which would substantially restructure funding for higher education; decentralisation of university decision-making from the Government to university leadership; and alongside this, a redistribution of decision-making power from the collegial faculty level to departmental managers and university administrations.[367] The funding reform is significant to the turn of events analysed in this chapter. Previously, public funding had been in proportion to the number of enrolled students. Under the funding reform, half the amount granted would be tied to the number of students graduating. This placed additional pressure on universities to raise their degree completion rates. The bill also introduced another novelty: it emphasised a strong connection between gender equality and educational quality.[368]

Following the bill's rationale, the cabinet proposed that the council for the renewal of undergraduate education (*Högskolans grundutbildningsråd*), a recently established body, would launch a programme to "take appropriate steps to ensure increased recruitment of female students to the departments of science and technology". A few months later the council presented a reform initiative for STEM education.[369] An invitation to participate was distributed to all vice-chancellors of Swedish higher education institutions. It reiterated the message in Unckel's bill that gender equality and increased educational quality were interlinked. It further stated that substantial curricular reform was needed to qualify for funding. The overarching aim of the reform programme should be to attract female students.

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365 *Regeringens proposition 1992/93:169*.

366 Andrén, *Visioner, vägval och verkligheter*; Mats Benner, *Kunskapsnation i kris?: politik, pengar och makt i svensk forskning* (Stockholm, 2009); Benner, *Kontrovers och konsensus*; Mats Benner and Sven Widmalm, *Kunskap* (Malmö, 2011); Sörlin and Törnqvist, *Kunskap för välstånd*; Widmalm, "Kun(d)skapssamhället". For an overview see Karlsohn, ed., *Universitetets idé*, 30 ff.

367 *Regeringens proposition 1992/93:169,* 89–92.

368 Ibid. See Departementsserien 1997:56, 15, and Departementsserien 1992:119, 15–17, regarding connecting gender equality to education quality.

369 The national call for reform projects is described in Wistedt, *Gender-Inclusive Higher Education in Mathematics, Physics and Technology*. Quote in "council call, 13 Sep. 1993" (Appendix D), attachment to meeting minutes LKE (*linjekommittén för elektoteknik*) No. 1 1993/94, 29 Sep. 1993, in Chalmers central archive, Board of the Department of Computer and Electrical Engineering (*Sektionsstyrelsen för Elekto- och Datateknik*, SSED) [from now on CTH C-archive, SSED], A2:10.

> After receipt of applications from the *management* of each university, the council will grant some of the universities project funding to implement a thorough review of one of their education programmes (or corresponding subject studies) within technology (incl. engineering programmes) and science faculty for the purpose of making education more attractive to women students.[370]

The council would spend 15 million kronor over the course of three years on a limited number of local STEM curriculum reform projects selected in a competitive process. A high priority would be given to 4.5-year education programmes with a low percentage of women, "e.g. computer science and engineering".[371] STEM programmes with many female applicants, such as chemistry would not be considered.[372] The council invited interested parties to a conference in Lund to learn more about the details of the initiative.

Thus, in September 1993 academic administrators, STEM programme committee chairs and interested faculty members met in Lund to learn more about "technology-fixated boys", "girls making rational choices" and the possibility of tossing the old order overboard. Officially, the launch of this national initiative was a response to declining upper secondary school results among applicants to university STEM programmes, and to the low rate of women among these applicants. The concern about school results was also shared by university faculty members.[373] The issue of the disproportionate ratio of male and female incoming students was, on the other hand, mainly a concern (at least for the universities) only because of external pressure from education authorities, such as the Government's council on undergraduate education.

The Lund conference set off the application process. In subsequent evaluations of the national programme, one specific sentence was highlighted as essential for how the different projects turned out: the suggestion of integrating problem-based learning methods.

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370 "Council call, 13 Sep. 1993" (Appendix D).

371 Equivalent to 20.8 million kronor or 1.9 million euros in Sep. 2020. Conversion from https://www.scb.se/hitta-statistik/sverige-i-siffror/prisomraknaren/, 10 Sep. 2020.

372 "Council call, 13 Sep. 1993" (Appendix D).

373 *Regeringens proposition 1992/93:169*; article in *Universitetsläraren*, Sep. 1993, p. 2 (private archive, Svensson); meeting minutes LKE No. 1 1993/94 (Appendix C) and meeting minutes LKD (*linjekommittén för datateknik*) No. 1 1993/94, 5 Oct. 1993, CTH C-archive, SSED, A2:10.

> The projects must therefore address the entire educational programme, not merely one or a few courses. They should focus on both content and teaching methods. In the opinion of the council, *it should therefore be considered whether it would be appropriate to base this more on problem-based learning approach than what is common today* [my italics].[374]

Several educators understood this as meaning that problem-based learning methods were a prerequisite for being considered for funding.[375] Successful applicants were announced the following December. Out of 17 applications submitted the council selected five projects.[376] Two 4.5-year engineering programmes were among them, at Chalmers University of Technology and Linköping University. Chalmers, or rather the Chalmers computer science and engineering programme committee, received the largest grant among the five projects selected, for their proposal titled "Project D++". The purpose of the project was a thorough reform of the computer science and engineering programme at Chalmers. At Linköping University, a project group led by a professor of information theory, Ingemar Ingemarsson, was funded to set up a new 4.5-year engineering programme called "The IT Programme".[377]

The national council had required a fast launch process, and in the 1994 spring term, the five universities involved in projects began their planning phases. Intense work processes were initiated. Project managers formed working groups consisting of professors, students and industry representatives. The national council arranged seminars with experts from Europe and the US to inspire project participants and provide them

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374 "Council call, 13 Sep. 1993" (Appendix D).

375 Salminen-Karlsson, *Bringing Women into Computer Engineering*, 107; interview with Bertil Svensson, 22 May 2017; interview with Ingemar Ingemarsson, 14 June 2017.

376 Wistedt, *Gender-inclusive Higher Education in Mathematics, Physics and Technology*, 8. Each local project was granted between 2.7 and 3.8 million kronor which was intended to cover costs over three years. The amounts were equivalent to between 3.7 and 5.3 million kronor in Aug. 2020 (between 360,000 and 510,000 euros). Conversion from https://www.scb.se/hitta-statistik/sverige-i-siffror/prisomraknaren/, 10 Sep. 2020. Within the field of mathematics and natural sciences, the processes to set up two new programmes were granted funding; the "Scientific Problem Solving" programme at the University of Gothenburg (3.5 million kronor), and "The Project Programme" at Stockholm University (3.1 million kronor). Karlstad University, one of the younger, regional universities, was granted funding for its "Women in Engineering Education" project (2.7 million kronor), for reforming three 3-year engineering programmes. Chalmers was granted 3.8 million kronor for "Project D++", Linköping University 3.2 million kronor for "The IT Programme".

377 See interview with Ingemarsson; Wistedt, *Gender-Inclusive Higher Education in Mathematics, Physics and Technology*, 8.

with new teaching tools. Project managers took part in conferences and courses, and elaborated on reform philosophies.[378]

The fast and seemingly unproblematic start-up phase is intriguing. How come the response of the usually change-resistant engineering universities like Chalmers was positive? And how come the centre-right cabinet, with its focus on budget cuts, was willing to spend public money? Although politicians across the political spectrum argued for the need to improve gender equality in the labour market, willingness to spend public money to fund such a goal had often been largely linked to ideology. I want to highlight four actors in Government as being of immediate importance to the launch of the Five Gender-Inclusive Projects initiative and its dual purpose – educational quality and gender equality. These actors were: Minister for Education and Research Per Unckel; Unckel's advisory committee on gender equality in higher education, JÄST (*JÄST-gruppen, Arbetsgruppen för jämställdhet i högre utbildning och forskning*); the government commission on higher education (*Högskoleutredningen*), which brought to light the weaknesses in teaching in the higher education system; and finally, the council for the renewal of undergraduate education (*Högskolans grundutbildningsråd*).

Analysing the mandates, norms, values, beliefs, concerns and activities of these four actors is imperative to understand why and how a state-run programme for gender equality in higher education came about in a financial recession. Such analysis is also key to understanding how the reform logic developed among engineering educators and, at least for a time, challenged the well-established recruitment logic. The following two sub-chapters thus examine the four actors involved to demonstrate how the national reform programme's interlinked objectives – gender equality and educational quality – were created as two seemingly non-conflicting goals. The professional norms of engineering associations, and the trade and industry sector, steered the debate on gender equality towards the issue of getting more women into the private sector – primarily in the fields of science and technology. As such, the focus of the debate steered away from overarching political reforms targeting the conditions for men and women in the Swedish labour market and in society overall.[379]

Whereas actors inside the process saw "more women in STEM" as a move towards gender equality in higher education, other commentators criticised the programme as

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[378] Wistedt, *Gender-Inclusive Higher Education in Mathematics, Physics and Technology*, 8, 13; Jansson, *D++ Projektet* (1998).

[379] Also discussed in Tollin, *Sida vid sida*, 115 ff.

being biased.[380] Instead of funding a broad programme to improve gender equality in academia, which had been suggested at first, public funds were once again spent on raising educational quality in a field mainly inhabited by men. This was far from how feminist scholars interpreted gender equality. I return to their critique presented in the public inquiry "The Will to Know and the Will to Understand" (*Viljan att veta och viljan att förstå*).[381] But to understand the transformation of the programme objectives, it is critical to also analyse the various actors involved in the processes leading up to the call for project proposals.

REFORMING CURRICULA FOR GENDER EQUALITY

Per Unckel's push for gender equality as intimately linked to educational quality had its origin in one of his advisory groups, the newly formed special advisory committee on gender equality in higher education and research, JÄST.[382] Led by Liberal Party MP Margitta Edgren, the advisory committee gathered representatives from university administration, professors and representatives from the Ministry of Education. With a broad mandate, JÄST addressed topics such as career patterns in academia, course curricula and textbook content, pedagogical methods, gender imbalance in various university programmes, and examination practices – "anything that had to do with gender in academia".[383] Their first report, published in 1992 to inform Unckel's bill discussed above, proposed a grant of 20 million kronor to be distributed to universities over a three-year period for wide-ranging work on gender equality issues. JÄST published its final report in 1997. A sub-report compiled by the Royal Institute of Technology (KTH) professor Harriet Ryd outlined contemporary ideas on the link between gender equality and quality of education.[384]

Informed by these ideas, Minister Unckel's bill on higher education presented his rationale for a gender-inclusive reform project. Unckel argued that the development of

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[380] Salminen-Karlsson, *Bringing Women into Computer Engineering*; SOU 1995:110 Utredningen om insatser för kvinno- och jämställdhetsforskning, *Viljan att veta och viljan att förstå: kön, makt och den kvinnovetenskapliga utmaningen i högre utbildning: slutbetänkande* (Stockholm, 1995).

[381] SOU 1995:110.

[382] Directions in Departementsserien 1992:119.

[383] Ibid.; Salminen-Karlsson, *Bringing Women into Computer Engineering,* 102; interview with Flodström.

[384] Sub-report "Gender Equality as a Factor in University Quality Assessment" (*Jämställdhet som faktor i högskolans kvalitetsarbete*) in Departementsserien 1992:119; *Regeringens proposition* 1992/93:169. See also Salminen-Karlsson, *Bringing Women into Computer Engineering*, 101 ff.

higher education must be a process that is both "qualitative and quantitative".[385] Regarding the quantitative increase, some fields of education were of more interest than others. Here, Unckel placed the spotlight on engineering education. The 4.5-year engineering programmes (*civilingenjörsutbildningen*) would be expanded "to strengthen long-term industrial competitiveness" whereas there should be no more expansion of two-year engineering programmes.[386] To Unckel, one means of increasing educational quality involved identifying women as a "competence resource". This goal was dressed up in language that contemporary actors could agree upon – gender equality for increased educational quality. Unckel could thus stress that…

> intensified *gender equality initiatives* will be necessary if we are to achieve sufficiently high quality in undergraduate education while at the same time increasing the proportion of university graduates.[387]

But his bill made clear that Unckel's understanding of gender equality was limited. A continuous increase in student enrolment while also ensuring high educational quality – a national goal – required expanded recruitment activities. Unckel seemed to equal improved gender equality with a quantitative increase of the number of women in STEM education. Increasing the number of women was a means of meeting the quality goal.

Unckel and his cabinet certainly argued for an "increased focus on gender equality", but it was an ambition incorporated in the overarching goal of expanding the private sector while shrinking the public sector.[388] This chapter points out that this was a useful argument to motivate raising funding for higher education in science and technology. Supporting such a claim is the fact that gender equality was a concern only when it came to male-dominated university programmes. As often before, educational fields with few men were not mentioned in the same realm. This was also brought up by a commission on gender equality in academia, KVINS, who published their final report only two years later, "The Will to Know and the Will to Understand" (*Viljan att veta och viljan att förstå*).[389] In their public inquiry, literature professor Ebba Witt-Brattström and her co-authors

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[385] *Regeringens proposition 1992/93:169,* 5.

[386] Ibid., 3. Sweden was said to have a low percentage of its young population in undergraduate education (*grundutbildning*) when compared internationally.

[387] Ibid., 12.

[388] See Tollin, *Sida vid sida,* 115 ff.

[389] SOU 1995:110.

fiercely rejected contemporary quantitative measures – such as Unckel's proposed reform programme – as a mere cover-up. Achieving real gender equality in Swedish society demanded a focus on the "inherent systematic gender discrimination in higher education".[390] Previous measures were criticised for their lack of power perspectives.

> The method chosen by the Government over the past 20 years to address gender inequality was in particularly pressing cases to provide extra, so-called earmarked funds. One example is when *proposal 1992/93:169 on higher education to increase the talent pool* proposed allocating 5 million kronor within the framework of the council on undergraduate education. The funds were to be used to "correct the students' past faulty choices", which meant women choosing not to apply for university science and technology programmes. The measures came about against a backdrop of an established decline in relation to the parliament's goal set four years earlier of at least 10 percent in programmes where the underrepresented gender made up 5 percent, except for engineering programmes where it was believed possible to reach 30 percent. […] KVINS has aimed to create the necessary conditions for a discourse where no one is afraid of speaking frankly. When a diverse range of experiences for the first time interacts, knowledge is created that results in selective measures seemingly being overplayed, whether is it 30 appointed "Tham professors" or a few extra million kronor for engineering programmes for women.[391]

The "Tham professors" was an affirmative action initiative launched by Minister for Education, Carl Tham, Unckel's successor, in 1995 to raise the number of female professors in research positions in academia.[392]

Unckel (and later Tham) was, however, far from alone in activating such rhetoric. Contemporary actors evoked the message of gender equality to improve educational quality time and again. Engineering educators, experts on governmental commissions, advisory committees and the cabinet shared a common language. Chalmers' final project report described women as a "competence resource", substituting the older concept of "talent reserve", a term the actors involved argued was misleading. Studies on high school students suggested that adding female students had the potential to compensate for the

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[390] Ibid., 5.

[391] Ibid., 9.

[392] Birgitta Jordansson, *Jämställdhetspolitikens villkor. Politiska intentioners möten med den akademiska världen: exemplet Thamprofessurerna* (Gothenburg, 1999), Törnqvist, *Könspolitik på gränsen*.

loss of high-performing male students. But in line with KVINS critique, the Chalmers Project D++ report stressed that the earlier assumption, which blamed women's low self-confidence and uncertainty about technology and engineering, had been debunked. Now, these engineering educators understood that women were actively opting out of engineering programmes because of the curricula. Departing from conclusions of the student surveys, which supposedly showed what women as a (homogenous) group wanted, there was a belief that the programmes had to be reformed so that Swedish society would not miss out on this untapped pool of talent.[393] This and other criticism was referred to by the Swedish commission on higher education in a weighty public inquiry.

REFORMING CURRICULA FOR EDUCATIONAL QUALITY

In 1988, five years before the educational reform initiative was launched in Lund, the Swedish student association delivered a petition to the Government. It contained massive criticism of the teaching capabilities of professors and pointed to several areas where improvement was needed. Teaching qualifications were undervalued in faculty recruitment processes. Professors lacked teaching skills; many of them were "bad teachers not capable of communicating knowledge in a comprehensible manner to the students".[394] They claimed that teaching was structured in a way that encouraged merely taking in details without reflexivity, and that exam procedures were badly aligned with learning objectives. Finally, there were almost no course evaluations taking place, or if they were, they were implemented inadequately.[395]

As a response, the 1989 Cabinet appointed a commission on higher education (*Högskoleutredningen*) which in 1992 published a final report under the heading "Freedom, responsibility, competence".[396] Criticism of education was not a new phenomenon, but the report authors stressed that recently it had become more warranted. A key term used in this criticism was "schoolification" (*gymnasifiering*) referring to a type of teaching closely modelled after upper secondary school pedagogics rather than guiding students towards intellectual independence.[397]

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[393] Jansson, *D++ Projektet* (1998); article in *Universitetsläraren*, Sep. 1993, p. 2 (private archive, Svensson).
[394] SOU 1992:1, 68.
[395] Ibid.
[396] Ibid., 65 ff.
[397] Ibid., 68.

The special investigator for the commission on higher education, Peter Scott, emphasised that this situation had implications for gender equality. Female faculty members were considered more concerned about pedagogical renewal than their male colleagues. Similarly, female students were said to have less tolerance for poor teaching standards than their male classmates. Any attempts at raising the standard of teaching and pedagogical renewal would therefore have implications for gender equality – at the faculty level as well as among undergraduate students.[398] The commission found other actors also worried about the quality of Swedish higher education. In the previous decade representatives of Swedish trade and industry had increasingly expressed concerns about what they considered to be a steady decline in the quality of university education in Sweden and they expressed concern about its effect on national competitiveness. Organisations such as the Royal Swedish Academy of Sciences (*Kungl. vetenskapsakademien, KVA*) and the Royal Swedish Academy of Engineering Sciences (*Kungl. Ingenjörsvetenskapsakademin, IVA*) had voiced similar concerns.[399]

To raise the status of teaching the Government's commission on higher education suggested targeted measures in four areas: greater emphasis on teaching qualifications in hiring processes; mandatory basic teaching courses for all university educators as well as the possibility of further professional training; providing substantial resources for educational development work; and, strengthening the connection between research and teaching.[400] The lower status of teaching-related activities relative to research-related activities at Swedish universities was an important concern. According to the commission, "the status of teaching and undergraduate education [*grundutbildning*] at our universities is considerably lower than that of research, and its status has deteriorated gradually over the past few decades".[401] One specific proposal was therefore to establish a new council to coordinate and spread new knowledge about pedagogical development. A critical function of the council would be to distribute funds for such activities. Shortly thereafter, Minister Unckel appointed the council for the renewal of undergraduate education (*Högskolans*

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398 Scott, *Higher Education in Sweden*, 76–77. See Departementsserien 1992:119, 16, and Departementsserien 1997:56, 102.

399 SOU 1992:1, 69. A sub-study from the commission on higher education found that representatives of Swedish trade and industry, as well as the Royal Swedish Academy of Sciences (*Kungl. Vetenskapsakademien, KVA*) and the Royal Swedish Academy of Engineering Sciences (*Kungl. Ingenjörsvetenskapsakademin, IVA*) had repeatedly expressed concern in the media. No sources are given regarding the media debate analysis conducted.

400 Ibid., 15, 84.

401 Ibid., 15.

grundutbildningsråd).[402] The proposals from the commission on higher education on how to proceed were thus central to the establishment of the council, and for its strong focus on a renewal in teaching methods, increased educational quality, as well as for council-run programmes such as the Five Gender-Inclusive Projects (FGIP) initiative.

The renewal council must be viewed in the light of already well-established Swedish research councils. Since the 1940s, research councils had been critical in providing Swedish academic faculties with substantial public funding in a funding structure that emphasised research over education.[403] The new council's objective was to achieve a balance in that system.[404] It would distribute grants to provide professors with high teaching ambitions and their departments with much sought-after funding. In doing so it would ensure that faculty members who spent time and effort on developing educational curricula and pedagogical approaches were encouraged and recognised by the academic system. In this manner, the council would strengthen one of the university's core missions, which for a long time had been cast aside in favour of research expansion.[405] As stated by the special investigator on the commission on higher education, Peter Scott, the divide between research and teaching was a gendered divide.[406]

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[402] Ibid., 257. The establishment of the council is a classic example of what previous researchers have said about Swedish bureaucracy (see e.g. Per Lundin, *Bilsamhället*): Experts in government commissions have regularly remarked on the need for a particular public agency. The agency is then established, with the experts who saw the need for it in the first place in a leadership position. Following this pattern, Mårten Carlsson, Vice-Chancellor at the Swedish University of Agricultural Sciences (SLU) and expert member of the commission on higher education was elected Chair of the Government's council for the renewal of undergraduate education. The council was established for a trial period in 1990 and was made permanent in 1992. Nine members representing faculty from four different types of universities and three student representatives made up the council. After a trial period, the commission and the Minister recommended that the cabinet make the council a permanent and independent government agency. See *Regeringens proposition 1992/93:169*, 11–12.

[403] Hans Weinberger, *Nätverksentreprenören: en historia om teknisk forskning och industriellt utvecklingsarbete från den Malmska utredningen till Styrelsen för teknisk utveckling* (Diss. Stockholm, 1996). For an overview see Mats Benner, "Svensk bioforskningspolitik: vägen mot 'New Big Science'", in *Det forskningspolitiska laboratoriet: förväntningar på vetenskapen 1900–2010,* ed. Anna Tunlid and Sven Widmalm (Lund, 2016).

[404] SOU 1992:1, 255 ff. See also Rådet för grundläggande högskoleutbildning, *Börjar grundbulten rosta?: en debattskrift om grundutbildningen i högskolan* (Stockholm, 1999), 112.

[405] Ibid.

[406] Scott, *Higher Education in Sweden,* 76–77.

With overall responsibility for undergraduate education (*grundutbildning*), Chalmers Pro-Vice-Chancellor Christina Ullenius was keen to involve Chalmers in the launch of the renewal council's reform initiative. Ullenius was by no means impartial. As a member of the council for the renewal of undergraduate education, and in her leadership position at Chalmers, she had been responsible for turning public funding for gender equality into a reform initiative for higher education in science and engineering.[407]

Feminist technology scholar Minna Salminen-Karlsson at the time analysed the dynamics of this transformation. Her analysis revealed widespread prejudice on qualitative studies as falling outside objective science, or real knowledge, among engineering leaders.[408] When the JÄST committee in 1992 proposed a grant of 20 million kronor to be distributed among universities for wide-ranging efforts to address gender equality, the committee suggested the council for the renewal of undergraduate education to oversee such a programme. However…

> it soon became obvious that the Council – the chairman and the secretary who was contacted – was not interested in administering this money. They had to be pushed. (…) they saw gender as an area where there were differing, competing opinions – nothing substantial and indisputable to implement [into education]. Besides, they tried to point out that they, as men, were hardly suitable for carrying out the task.[409]

The council leadership questioned the possibility of obtaining objective and systematic knowledge on questions related to gender and therefore challenged whether it was possible to integrate such knowledge into existing undergraduate curricula.[410] However, when the JÄST representative insisted, the council leadership started to expand on various ways to address gender inequalities. They could relate to recruitment projects in mathematics, science and technology – activities they were already sponsoring through some ongoing minor projects.[411] Council member Ullenius was consulted at this point. When approached by council leadership about the JÄST committee proposal, Ullenius emphasised the importance of the national programme – an initiative she at that time

[407] See sub-chapter "Female Faculty: Advancing Structural Perspectives".
[408] Salminen-Karlsson, *Bringing Women into Computer Engineering,* 103.
[409] Ibid.
[410] The hesitation to take on state cabinet-imposed programs should also be considered. See Rådet för grundläggande högskoleutbildning, *Börjar grundbulten rosta?,* 112.
[411] Salminen-Karlsson, *Bringing Women into Computer Engineering,* 103.

understood as being an attempt to address gender inequalities within science and engineering.

> /The secretary of the council /called me after he had met /the chairperson of the advisory committee [JÄST] /in a confused state and told me about this in somewhat ridiculing terms. He didn't think we should get involved, but I was really enthusiastic and expounded at length to him about why I thought that the Council should get involved in this. It was about technology and science and that the Council should support projects. [Salminen-Karlsson:] **But in the advisory group's little green book [JÄST report from 1992] it actually says nothing about technology**. All right, but since I became so enthusiastic so quickly, there must have been some mention of it in my conversation with /the secretary /, it was in tune with what I have been working for the whole time. It was natural that I then took so much responsibility for this in the Council. (MC)[412]

Salminen-Karlsson adds that after this point, Ullenius was the council member taking the most interest in the proposed national initiative. The council decided to accept the JÄST proposal if they could do it their own way. Salminen-Karlsson argues that "consequently, the Minister for Education in his budget statement stressed the need to recruit women into science and technology."[413] This despite concerns from the parliamentary standing committee on education (*Utbildningsutskottet*). In this way, "the central authorities managed to reformulate the political document of general gender equality in academia into one which they felt was easier to handle, the relatively well-defined problem of recruitment of women into science and technology" and, Salminen-Karlsson continues, "defining gender equality as 'more women into technology' is well in accordance with the Swedish gender equality discourse, which to a great extent is based on liberal feminism and where equality quite often is measured in numbers".[414] Fixing the number of women in science and technology was not only a rationale in academic engineering contexts, it also permeated the Swedish state feminist discourse.

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412 Ibid., 103–104. The abbreviation MC = "(the female) member of the National Council interviewed".

413 Ibid., 104.

414 Ibid., 102–106, quotation pages 104–105. In "The Technology Question in Feminism", Wendy Faulkner emphasises the connection between liberal feminism and recruitment projects to enrol more women in engineering.

UNIVERSITY PROGRAMME COMMITTEES AS CURRICULAR BATTLEFIELDS

When the council's call for project funding applications reached the Chalmers faculty, Christina Ullenius had already begun her reform plans. In the early 1990s she was vital in Chalmers' hiring of Bertil Svensson, a professor in computer science and engineering. Svensson, another key actor in this chapter, who would soon lead the Chalmers section of the FGIP initiative, the Project D++.

To Ullenius, Svensson's "reform mindset" was critical to his recruitment.[415] He quickly became the Chalmers representative in a national evaluation of the computer science and engineering programmes at Swedish universities of technology.[416] In 1993 Svensson was elected the new Chair of the Chalmers computer science and engineering programme committee. Historian Svante Lindqvist has described how research qualifications had trumped teaching skills in the hiring of professors at universities of technology since the 1930s.[417] In hiring Svensson, Ullenius and Chalmers had recruited a person who excelled in both areas. Based on the work of historians Svante Lindqvist, Arne Kaijser, and Bruce Seely, this chapter points out that the struggle between the *recruitment logic* and the *reform logic* among 1990s engineering educators was a struggle played out on a century-old curricular battlefield.[418] The issue of different pedagogical ideals was becoming a serious one in this battle.

At Chalmers University of Technology the battle played out in the engineering programme committees. The programme committee was the primary body for maintaining and developing the respective engineering programme at the university.[419] Two or three times each semester the committee gathered to manage programme budgets, regulation of teaching hours, curriculum coordination and course development. At the Chalmers Department of Computer and Electrical Engineering, which offered the computer science and engineering programme, (from now on CSE), and the electrical engineering programme, (from now on EE), teaching faculty, students, study supervisors

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415 Interview with Ullenius.

416 Interview with Svensson; Per Jacobsson, *Quality review-D: Swedish M.Sc programmes in computer science and engineering* (Stockholm, 1994).

417 Lindqvist, "Ideology and Institutional Structure".

418 See this thesis Chapter 1, sub-chapter "Theoretical Frameworks and Main Concepts".

419 The materials from the committee work are collected in CTH C-archive, SSED, series A2. The material analysed concerns programme committee work between 1985 and 1993. After 1993 the material is largely unlisted.

and, from time to time, industry representatives assembled at committee meetings.[420] The curricular battlefield of these two committees is the arena explored in this sub-chapter.

In late September and early October 1993, two meetings that would determine the committee work for years to come took place at the department: each programme committee held its first meeting of the semester. At the time the two committees were struggling with numerous problems with varying degrees of urgency. Decreasing school results among admitted first-year students threatened degree completion rates.[421] National and external evaluations criticised outdated teaching methods, low levels of course alignment and the ongoing issue of a low percentage of female students.[422] Students complained of lacking communication between programme management and students.[423] Adding to these problems was the fact that the national economic reform announced in Per Unckel's bill on higher education would rearrange the financial structure of the Swedish university system. Public funding had in the past been determined by the number of enrolled students. Under the reform bill, half of the funding would instead depend on the number graduating.[424] As explained above, this placed additional pressure on universities to raise the degree completion rate. Against this backdrop, the invitation from the renewal council to apply for programme funding landed with the committees in September 1993.

Christina Ullenius had set her mind to convincing the chairs of the Chalmers two programme committees to submit project applications to the new council.[425] Consequently, both committee chairs, Bertil Svensson (CSE) and Kjell Jeppson (EE), joined her at the council conference. At their respective committee meetings, which took place shortly thereafter, they both addressed the council's call for reform project funding applications. The information was, however, dealt with a very roundabout way by the programme committee chairs. Bertil Svensson, Chair of the CSE committee, who had

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[420] Ibid.

[421] See LKE No. 1 1993/94 (Appendix C) on falling entry requirements.

[422] On the need for course alignment in internal and external evaluations, see Jacobsson, *Quality review-D* and attachments to LKE and LKD meeting minutes during the early 1990s, CTH C-archive, SSED, series A2. On the low share of women see LKE No. 1 1993/94 (Appendix C); Peter Jansson, *D++ Projektet* (1998); SSED marketing brochure, private archive of Svensson (Figure 4.4).

[423] Jacobsson, *Quality review-D*.

[424] *Regeringens proposition 1992/93:169,* 89–92.

[425] Interview with Ullenius.

been recruited to Chalmers just a few years earlier was possibly less restricted by the university's educational practises and norms.[426]

At the time of the programme committee meeting in autumn 1993, Svensson had already composed and submitted a project proposal to the renewal council "as desired by the Vice-Chancellor".[427] In contrast, the EE programme committee discussed the funding application call at its meeting but decided not to participate (Appendix C). Instead, and at the same meeting, committee Chair Kjell Jeppson suggested a different approach to solve the future challenges of his programme: a privately developed project with the ambitious title "The New Elite to E" (Figure 4.1).[428] Before taking a closer look at this idea, a few points should be made about the day-to-day work of the engineering programme committees. In this context, the council's call for substantial curricula reform appeared as something foreign to the engineering majority.

The existence of conflicting interests *within* each committee was more a rule than an exception.[429] Courses – elective as well as mandatory – were frequently suggested, launched, modified (e.g., prolonged, condensed or transferred within the annual cycle), removed and sometimes reintroduced. Course size had financial consequences for the programme committees in the same way as for the divisions providing the course and subsequently also had consequences for the position of the individual faculty in charge of the course. Hours dedicated to a course corresponded to a fixed amount of money. The abovementioned consequences were hot topics for debate and sometimes led to harsh conflict. To support their case, professors had to argue for their individual subjects.[430] To engineering historians, the professors' arguments followed a familiar theme: the need for applied knowledge to match the needs of industry and thereby ensure Sweden's competitiveness; the importance of a balance between applied and theoretical courses and the order in which they appeared within the programme structure; and the emphasis of discipline-specific knowledge rather than the inclusion of broader subjects.[431]

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426 Ibid.; interview with Svensson.

427 LKD No. 1 1993/94; interview with Svensson. The full application is included in Jansson, *D++ Projektet* (1998). Sketch application in the private archive of Svensson.

428 LKE No. 1 1993/94 (Appendix C).

429 Meeting minutes and attachments between 1985 and 1992 from the two programme committees in CTH C-archive, SSED, A2:6–7.

430 Ibid.

431 This thesis Chapter 1, sub-chapter "Curricula, Student Culture, Inertia".

Kjell O Jeppson

September 23, 1993 2.

Projekt "Nya Eliten till E"

Dekanus har identifierat rekryteringsfrågan som ED-sektionens viktigaste fråga när det gäller grundutbildningen. Ett projekt bör startas omedelbart och presenteras på nästa SSED (14/10).

Problem: Intagningspoängen på E-linjen är Chalmers lägsta - 3,9 p. Det betyder att kunskapsnivån hos de sist intagna är Chalmers lägsta vilket i sin tur kan innebära problem med att hålla en hög genomströmning. Det betyder också att flera av de som kommer till E-linjen inte har valt linjen i första hand - vilket också påverkar motivationen och kanske leder till studieabrott (avhopp). De låga intagningspoängen kan också skrämma bort studenter med höga poäng som inte vill "slösa bort sina poäng", vilket försämrar såväl genomströmning som doktorandrekrytering.
I framtiden hotar dessutom minskande ungdomskullar vilket kan leda till svårigheter att fylla det höga platsantalet på E. Speciellt anmärkningsvärd är den låga andelen flickor bland de antagna studenterna. I hotbilden finns också att Chalmers ledning kan komma att flytta platser från E till linjer med högre antagningspoäng, t ex F.

Önskemål: Det vore önskvärt att fler studenter - med höga betyg - valde E-linjen i första hand så att en utjämning mellan sektionerna kan ske. Speciell satsning på flickor.

Hur: Ingen kan tala så bra för en vara som den som är nöjd med den[1]... Ingen kan svara så uppriktigt och engagerat på frågor som den som själv upplevt (upplever) svaren.
Ett beprövat sätt är att låta teknologer återvända till sin gamla skola och berätta om sitt nuvarande "jobb". Ett annat sätt är att förmedla delvis samma information skriftligen.

Bäst är givetvis en kombination:

50 teknologer (varav så stor andel flickor som möjligt) återvänder till sina gamla skolor och talar opretentiöst men väl förberett för tre klasser var om E-linjen (ev gemensamt med D-linjen). De lämnar efter sig en lättsam, tilltalande trycksak med fakta om linjen, institutionerna, teknologerna m m. Olika ämnesinriktningar måste speglas: medicinsk elektronik, mikroelektronik, data, kraft, företagsledning, forskning, kvinnliga förebilder etc.

Denna drive upprepas nästa år igen för att få full genomslagskraft. Trycksaken kan också utdelas vid 9:ornas dag på Chalmers.

Kanske ska man speciellt vända sig till de som läser tekniskt basår på Chalmers?

[1] Z-linjen genomförde ett liknannde projekt i våras. 60 teknologer besökte sina gamla skolor när de ändå var hemma under påskuppehållet. Kampanjen slog väl ut. Trots fördubblat antal platser (35→70) blev antalet förstahandssökande per plats högt och intagningspoängen hög (4.3).

Figure 4.1. "Project the New Elite to E". Draft by the electrical engineering programme committee Chair Kjell Jeppson. Courtesy of CTH C-archive, SSED A2:10, attachment to § 8, LKE No. 1 1993/94.

From a distance, these battles look like a constant, small-scale push for reform going around in circles, where professors from different divisions and departments competed for space in a curriculum landscape too small to accommodate them all. Conflicts were played out and different needs weighed against each other, all against the backdrop of professional ideals. Within the electrical engineering programme, the question asked repeatedly was: "What does the basic electrical component consist of?". The arguments put forward focused on the professional needs of the electrical engineer. That this engineer would be tailored for the technology industry rather than, say, to work in the public sector or for a non-governmental organisation was rarely up for discussion. Despite the constant discussion and debate, extensive curricular reforms were rarely implemented. But the computer science and engineering programme was only 10 years old. As an offshoot from the electrical engineering programme, it can be seen as the result of an educational reform. Creating a new engineering programme has often been more successful than reforming an existing one. A number of the winning submissions to the national council's call for project proposals indeed suggested establishing completely new programmes – not suggestions to reform existing ones.

The curricular battlefield situation highlights the inertia that made anything except small-scale changes within well-defined borders seem impossible. The two Chalmers programme committees for CSE and EE were curricular battlefields where engineering faculty members fought for their professional identity, i.e. where they practised *professional boundary work*. Here, engineering norms and values were brought to the fore, tested and contested. And gender permeated the battle.

RECRUITING A NEW ELITE TO ELECTRICAL ENGINEERING

The Chalmers electrical engineering programme committee's rejection of the national call for gender equality projects is, at first glance, something of a puzzle. The head of the Chalmers Department of Computer and Electrical Engineering had required an immediate response on how to address the falling recruitment rates among top-achieving upper secondary school students.[432] Furthermore, when the programme committee received the invitation for curricular reform proposals, a task force within the committee had already been working on an independent reform proposal during the previous term. This so-called "E94 Reform Project" was informed by literature on pedagogical renewal

[432] LKE No. 1 1993/94 (Appendix C).

which communicated a message like that of the Government's council for undergraduate education renewal.[433]

The programme committee had assigned the E94 working group to rethink the way the curriculum was organised to make the programme more coherent. The initiative tapped into an ongoing discussion about the programme structure – which courses should be offered by which programme area, and which divisions would be assigned the courses and the resulting status and funding, which subjects should be mandatory and which should be elective. In a mind map the E94 working group visualised several reasons for reform (Figure 4.2a). The mind map is a concrete example of what practises of professional boundary work can look like.

The drawing summarised and connected six different areas, including internal and external reform motives. External motives included societal change, such as the needs of local, national and European stakeholders, and changes within the private sector, society in general and the research community (Figure 4.2a [1]). These changes created a demand for more engineering graduates (*civilingenjörer*) (Figure 4.2a [2]) and for quality education (Figure 4.2 [3]). The definition of quality was, it seemed, up for discussion. External motives also included the variety of raw materials that the engineer was supposed to work with and varying degrees of processing of these materials (Figure 4.2a [4]). The final areas highlighted were the university's internal motives, such as the low rates of programme completion (Figure 4.2a [5]) and the upcoming national economic reforms (Figure 4.2a [6]).

One might imagine that, after some minor tweaks, it would have been possible to submit the reform plans already started to the Government's council for the renewal of undergraduate education. Christina Ullenius's strong support for reform gave them a good chance to be granted funding. From this perspective the national reform initiative looks like a win-win situation for EE. The low proportion of women would be addressed, as required by the head of the department.[434] As an additional bonus, the programme could easily be granted funds for a process already initiated. Still, the committee decided to decline the council's invitation. Instead of a curricular reform project, the committee, led by Jeppson, decided to go down a well-trodden path: launching an information campaign under the heading "The New Elite to E".[435] By sending out representatives

[433] Attachment to § 8, meeting minutes LKE No. 5 92/94, 4 May 1993, CTH C-archive, SSED, A2:10. Figures 4.2 and 4.3.
[434] LKE No. 1 1993/94 (Appendix C).
[435] Project "The New Elite to E" (Figure 4.1).

from the student body (preferably women) to their former upper secondary schools and equipping them with a marketing pamphlet, the committee hoped that new groups of students (preferably women) would enrol.[436] Informed to some extent by the 1980s "More Women to Industry" campaign and how it was manifested at universities of technology, this proposal was based on the same binary assumptions on women, men, technology and university engineering education. Jeppson and his committee surely argued that attracting "the new elite" to electrical engineering, which in the committee's view meant high-achieving girls, would more likely happen through marketing than through enduring the institutional and bureaucratic headache of curricular reform (Figure 4.1). Such a measure was, however, a traditional engineering fix for a complex social problem. It is an outcome of demarcation of professional boundaries dedicated to keeping existing educational structures and pedagogics intact.

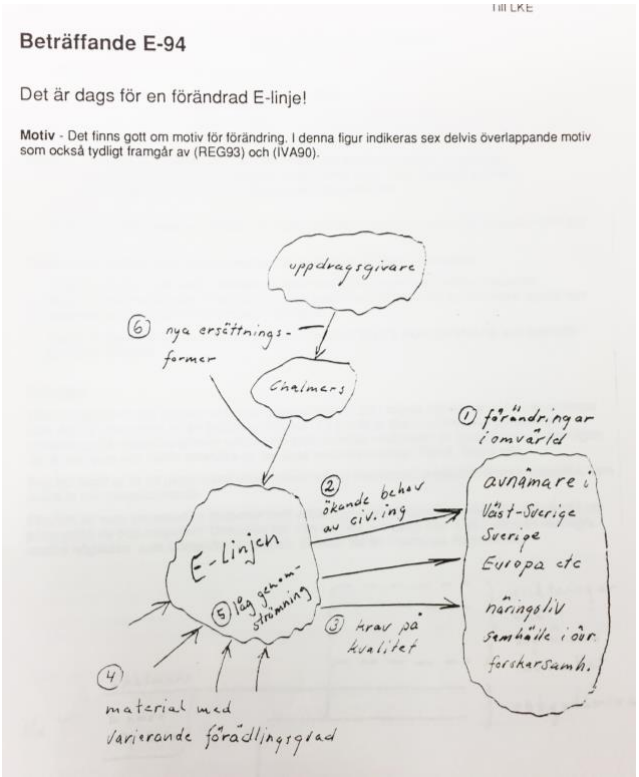
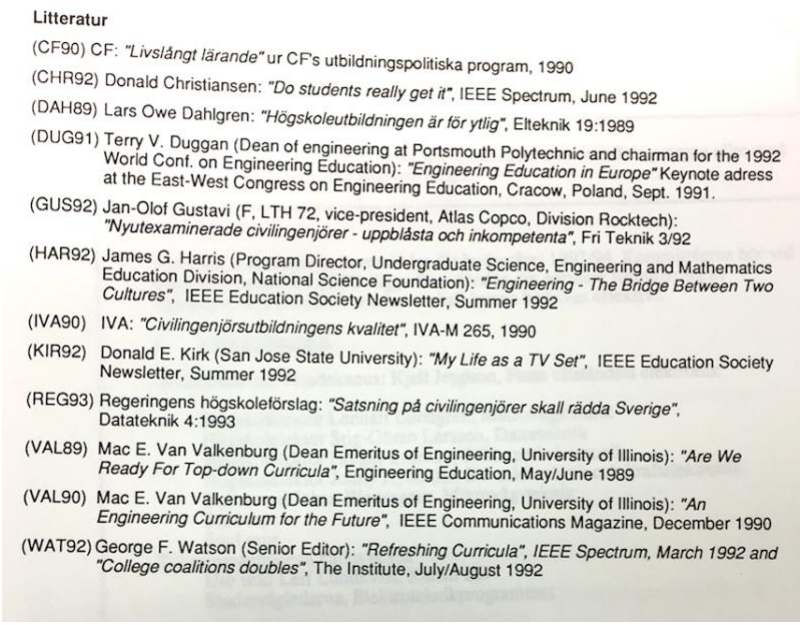


Figure 4.2a. Project E94. The title reads "It is time for a reformed E-programme", followed by "Motives – There are plenty of motives for change. This picture indicates six partly overlapping motives that also (REG93) and (IVA90) clearly support".

[436] Ibid.



Litteratur

(CF90) CF: *"Livslångt lärande"* ur CF's utbildningspolitiska program, 1990

(CHR92) Donald Christiansen: *"Do students really get it"*, IEEE Spectrum, June 1992

(DAH89) Lars Owe Dahlgren: *"Högskoleutbildningen är för ytlig"*, Elteknik 19:1989

(DUG91) Terry V. Duggan (Dean of engineering at Portsmouth Polytechnic and chairman for the 1992 World Conf. on Engineering Education): *"Engineering Education in Europe"* Keynote adress at the East-West Congress on Engineering Education, Cracow, Poland, Sept. 1991.

(GUS92) Jan-Olof Gustavi (F, LTH 72, vice-president, Atlas Copco, Division Rocktech): *"Nyutexaminerade civilingenjörer - uppblåsta och inkompetenta"*, Fri Teknik 3/92

(HAR92) James G. Harris (Program Director, Undergraduate Science, Engineering and Mathematics Education Division, National Science Foundation): *"Engineering - The Bridge Between Two Cultures"*, IEEE Education Society Newsletter, Summer 1992

(IVA90) IVA: *"Civilingenjörsutbildningens kvalitet"*, IVA-M 265, 1990

(KIR92) Donald E. Kirk (San Jose State University): *"My Life as a TV Set"*, IEEE Education Society Newsletter, Summer 1992

(REG93) Regeringens högskoleförslag: *"Satsning på civilingenjörer skall rädda Sverige"*, Datateknik 4:1993

(VAL89) Mac E. Van Valkenburg (Dean Emeritus of Engineering, University of Illinois): *"Are We Ready For Top-down Curricula"*, Engineering Education, May/June 1989

(VAL90) Mac E. Van Valkenburg (Dean Emeritus of Engineering, University of Illinois): *"An Engineering Curriculum for the Future"*, IEEE Communications Magazine, December 1990

(WAT92) George F. Watson (Senior Editor): *"Refreshing Curricula", IEEE Spectrum, March 1992 and "College coalitions doubles"*, The Institute, July/August 1992

Figure 4.2b. The literature reviewed by the E94 project group (includes REG 93 and IVA90). Most publications were internal to the engineering community, including publications from representatives from the Institute for Electrical and Electronics Engineers (IEEE), as well as the Swedish journals of the community. Courtesy of CTH C-archive, SSED A2:10, attachment to § 8, meeting minutes LKE No. 5 92/94, 4 May 1993.

The grounds for the programme committee's decision to reject the national call for reform projects are not made explicit in the committee's meeting minutes:

> Measures were discussed on how to get more women to apply for the E programme. The Swedish Council for the Renewal of Undergraduate Education has money that will be invested in some form of change in the education structure in such programmes that recruit few girls, e.g., E and C. Kjell Jeppson has discussed this with Christina Ullenius. The programme council suggests that the E programme does not submit an application.[437]

But the committee's doubts are reflected if we read between the lines. At the time, programme enrolment statistics were grim. In that term new students to the electrical engineering programme had the lowest minimum entry requirements among all Chalmers programmes (3.9 on a grading scale of 1 to 5).[438] This worried the EE committee. Its

[437] LKE No. 1 1993/94 (Appendix C).

[438] Ibid.; "Project the New Elite to E" (Figure 4.1), attachment to LKE No. 1 1993/94. Upper secondary school students' results required for entry were set on a scale from lowest 1 to highest

members feared that the incoming students would not have the abilities to complete the demanding programme.[439] As noted above, such a situation would from now on cause substantial financial problems. The programme was struggling for survival – or at least against a severe cutback in student spaces – a situation that eventually might impact faculty numbers too. A reduced state income for educators would have an overall negative effect on the finances of the department, and in the long run have consequences on the amount of research that could be conducted. Furthermore, not only would the low number of students applying impact the department's finances, the faculty argued, it would also risk reducing the pool of future top candidates from which to draw PhD students.[440]

Jeppson communicated a proposal for a new recruitment brochure and outreach campaign as an obvious solution to a quantitative problem. In contrast, the qualitative reform project proposed by the undergraduate education renewal council was presented with much less certainty, as "some form of change in the education structure".[441] This seemed far from satisfying to the programme committee when the primary objective was to attract top students.[442] Accordingly, they believed marketing their programme would be more efficient. The information campaign draft emphasised that a girl enrolling in the electrical engineering programme was guaranteed an elite professional status and could look forward to a rewarding career. In contrast to this rhetoric, the proponents of the *reform logic* held that renewed pedagogics and a reformed curriculum were critical to ensuring that students could meet the future demands of the job market. The tension was thus a result of the new reform logic challenging older professional norms embedded in engineering education and repeatedly reproduced by generations of engineering faculty members.

The rejection of internal change and redirecting the focus to external measures illustrates what this thesis calls gendered professional boundary work, and exemplifies the *recruitment logic*. The core idea here, which is explored further in the concluding chapter (Chapter 6), includes the notion of technology as something neutral. According to this logic, men and women (or "girls and boys") had inherently different relationships with technology and engineering. The recruitment problem was thus shifted away from the

5. With a set number of student spaces in the university degree programme, the minimum required level varied each year depending on the number of applying students.

439 "Project the New Elite to E" (Figure 4.1).

440 Ibid.; article in *Universitetsläraren*, Sep. 1993, p. 2 (private archive, Svensson).

441 LKE No. 1 1993/94 (Appendix C).

442 Ibid. The Department Board (SSED), led by the dean, wanted suggestions within two weeks.

engineering profession and its institutions: girls' different – and faulty – interests were leading them to make the wrong choices – be it because of different biology, a lack of female role models or different socialising patterns in their upbringing. As far as engineering curricula and professional culture were concerned, they could not be blamed for what women chose to study at university. The "New Elite to E" campaign reveals more about engineering faculty and university engineering education. Echoing nineteenth-century professional ideals, electrical engineering faculty members and students still viewed themselves as part of an elite group in society; a position noted in twentieth-century post-war studies of the Swedish engineering profession.[443] This thesis's final chapter attempts to unpack the gendered implications of such positioning.

REFORMING COMPUTER SCIENCE AND ENGINEERING

The Chalmers computer science and engineering programme committee hardly questioned the elite status of university-educated engineers. But the programme committee Chair Bertil Svensson belonged to the minority of engineering faculty who were convinced that curricular reform was necessary for the universities of technology to keep their high social standing.[444] The reform logic materialised in Svensson's programme committee.

The first computer science and engineering programme at a Swedish university of technology was established in 1976 at Linköping University.[445] The creation of such a programme was by no means a matter of course. At the time, a debate regarding its usefulness – and placing computer hardware, an object, at the core of the curriculum – took place at several Swedish universities.[446] As has been the case for other new engineering programmes since then, it was both ridiculed and deemed unnecessary. At the Royal Institute of Technology (KTH) programme proponent Yngve Sundblad struggled for several years before the university administration was finally convinced to start a computer engineering programme in 1983. By then, it was the last among all Sweden's universities of technology to do so. Sundblad's dean was one of the strongest opponents: "We have never had a programme to learn how to use a slide rule, why should we have one for computers?" [447]

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[443] E.g. Ek-Nilsson, *Teknikens befäl*; Mellström, *Engineering Lives*.
[444] Jansson, *D++ Projektet* (1998), 8–9.
[445] Interview with Yngve Sundblad, 16 May 2017; interview with Ingemarsson.
[446] Ibid.
[447] Interview with Sundblad.

The underlying critique was partly connected to widespread agreement that engineering university curricula should be science-based (physics, electronics, chemistry, mechanics). To place an object at the centre of an engineering university programme challenged well-established hierarchies.[448] Technology was to many engineering faculty members perceived as an applied science and not as a separate knowledge tradition.[449] By tradition, theoretical knowledge and science was ranked the highest. A related view connected to this resistance was one with gendered connotations. At KTH, the electrical engineering professors argued that the intellectual challenge was *building* the computers not *programming* them. They reasoned that programming did not require a specialist education; some precision and being detail-oriented was all that a programmer needed. Historically, women had carried out such tasks.[450]

In 1993, a decade after its establishment at both Chalmers and Linköping universities, students, faculty members and the public all considered computer engineering programmes to have strong masculine bias. Not only did men dominate the student body, the curricula and the student culture surrounding the programmes was also heavily masculine.[451] Although the programmes were only about a decade old, they were permeated by the professional norms reproduced within the walls of the universities of technology. The teaching methods, the curricular structure and the student culture mirrored those of the century-old engineering programmes. The student rituals within this programme have at times distinguished it as having the worst reputation on campus.[452] As Nathan Ensmenger, among others, have suggested, computer engineering students at universities of technology developed a specific masculinity detached from traditional ideals such as muscle strength or leadership, but instead based on ideas of genius, sometimes referred to as "black art", accompanied by neglect of the body.[453] But rather than identifying these ideals as socially constructed, insiders and outsiders alike viewed them as inherent in the individuals excelling in the field of programming.[454]

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448 Ibid.; interview with Ingemarsson.

449 On the "scientific curriculum" see Berner, "Educating Men" and Torstendahl, *Teknologins nytta*. See also Jonathan Harwood, "Engineering Education between Science and Practice: Rethinking the Historiography", *History & Technology* 22, No. 1, 53–79.

450 Abbate, *Recoding Gender*; Hicks, *Programmed Inequality*. See this thesis Chapter 1, sub-chapter "Previous Research", for literature on programming's masculinisation process in the US and Britain. The Swedish story is yet to be written.

451 Ensmenger, "Beards, Sandals and Other Signs of Rugged Individualism".

452 Ottemo, *Kön, kropp, begär och teknik*.

453 Ensmenger, "Beards, Sandals and Other Signs of Rugged Individualism".

454 Ibid.; Hicks, *Programmed Inequality*.

The proponents of the reform logic, at Chalmers most prominently represented by Christina Ullenius and the Chair of the CSE committee Bertil Svensson, and at Linköping University by information theory professor Ingemar Ingemarsson partly challenged such norms. They leaned on pedagogical research that demonstrated how gendered dynamics and biases played out in the classroom.[455] Teaching methods, reference examples, textbooks and the choice of subjects taught – everything was potentially gendered. The newly appointed CSE programme and D++ project secretary at Chalmers, Peter Jansson, an electrical engineer and psychologist by training, summarised the project management's understanding of gender and gender equality efforts in the final project report.[456] His chapter was based on a survey conducted among Chalmers students and on a minor report on pedagogics by Chalmers educator Inga Alander. These enthusiasts did not oppose using gender analysis as a point of departure for their work. However, the analysis they relied on emphasised a gender dualist framework. Just like in the 1980s, as explored in Chapter 3, the management of Project D++ at Chalmers perceived girls as a homogenous group with special needs in relation to technology. Emerging research which analysed the co-production of gender and technology did not find its way to these reformers. At Linköping University "The IT Programme" project team was very enthusiastic about problem-based learning (PBL) but had little experience with gender analysis.[457] The PBL focus thus guided the process of developing their new programme.

Reshaping engineering professional ideals was possible, at least temporarily, through a combination of individual enthusiasm and strong support from university leadership. The reformers at both Chalmers and Linköping University imagined substantial change – on the numerical gender balance but also on student and teacher satisfaction in general.[458] With regards to project management and other key actors, some individual successes and personal gains can be identified: in the short-term Project D++ at Chalmers resulted in programme curriculum reform, new university buildings, wide-spread project enthusiasm at the university and a diminished gender gap. The Government, Chalmers' central administration and Chalmers faculty all celebrated the changes implemented. Project manager Bertil Svensson, as well as his supporter Christina Ullenius in Chalmers

[455] Jansson, *D++ Projektet* (1998), 52–53, outlines the gendered understandings of the project management.
[456] Ibid.; interview with Peter Jansson, 19 June 2017.
[457] Wistedt, *Five Gender-Inclusive Projects Revisited*; Salminen–Karlsson, *Bringing Women into Computer Engineering*.
[458] Ibid.

management, were recognised as positive forces for change.[459] When female student enrolment once again declined, these reformers had already left Chalmers for new positions elsewhere. Svensson transferred to Halmstad University at the end of the 1990s.[460] In 1995 Ullenius was recruited to the position of Vice-Chancellor at Karlstad University.[461] This chapter is thus a story of key actors pushing professional boundaries and temporarily destabilising an organisation marked by strong inertia.

At Linköping University the situation looked somewhat different. As we will see in Chapter 5, Ingemar Ingemarsson immediately took on a new reform project, this time on a national scale. The outcome for the university overall, and for the national engineering education system, must, however, be interpreted as limited in terms of progress on "gender-inclusiveness". Chapters 5 and 6 elaborate this situation.

DISRUPTING INERTIA…

Qualitative knowledge has often been rejected by quantitative-oriented scientists and engineers.[462] That the engineering majority was ignorant about, and sometimes resistant towards, this type of knowledge is therefore not surprising. More intriguing is the fact that qualitative knowledge gained sufficient ground among some in the engineering communities, such as within the Chalmers computer science and engineering programme committee and at Linköping University, and would thus come to disrupt well-established structures. So how come a comprehensive educational reform process could be launched at Chalmers and rise above, at least temporarily, the curriculum battlefield? How did one minor group of curricular stakeholders manage to destabilise processes characterised by inertia within the CSE programme committee?

Three factors should be highlighted. First, and as a continuation of the preceding chapter, this chapter points out that *external pressure* drove reform efforts. Financial incentives in combination with a Government initiative for reform, constituted the driver. From now on the extent of government funding for education would depend just as much on the number of graduating students as on the number of enrolled students, which placed a new type of pressure on the programme committees. Second, there were local

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459 Interview with Svensson; interview with Ullenius; Jansson; *D++ Projektet* (1998).
460 Ibid. (Svensson): "And I belive that was 1998".
461 "Christina Ullenius tilldelas Karstads universitets hedersmedalj", https://www.kau.se/nyheter/christina-ullenius-tilldelas-karlstads-universitets-hedersmedalj, retrieved 26 Jan. 2023.
462 E.g. Janken Myrdal, *Om humanvetenskap och naturvetenskap* (Uppsala, 2005), 100–102.

incentives for curriculum reform, such as the results from an external audit of the of all Swedish computer science and engineering programmes.[463] A combination of organisational and individual factors thus led the CSE committee at Chalmers to respond positively to the national call for reform projects despite institutionalised resistance towards large-scale change. Hiring external faculty for engineering programme renewal appears to have been a significant factor. Bertil Svensson was recruited to develop the CSE programme according to new quality standards. In addition, the former and long-term committee secretary was replaced by Peter Jansson, a person who was happy to take on coordination of the Project D++. Traditional processes were not disrupted in the same way within EE, at least not in 1993. But when the benefits of the D++ reform project became evident, EE followed the same path as CSE (Figure 4.4).[464] At Linköping University, Ingemar Ingemarsson was a PBL enthusiast and a gender equality advocate, as well as a long-term faculty member and therefore enjoyed a certain degree of status in the academic hierarchy. Yet he admits that the "new IT programme" project was run by an isolated group of enthusiasts and did not substantially influence the technical faculty overall.[465] The following chapter returns to this circumstance. Finally, and perhaps most importantly, environmental and social justice movements, which had grown from strength to strength in Swedish society from the 1960s, had to a small yet significant extent entered departments at universities of technology since the early 1980s. That process is detailed in Chapter 5. These changes influenced the gender equality discourse and expanded the range of solutions considered relevant at a technological university. New perspectives challenged the established professional boundaries.

…BUT MISSING THE TARGET

In contrast to engineering education in the US, the development and reform of Swedish engineering curricula in the twentieth century has not been explored to any significant extent. Available overviews suggest that notable reform is lacking.[466] Modifications to

[463] Jacobsson, *Quality review-D*.

[464] Interview with Svensson; marketing booklet from the Department of Computer and Electrical Engineering, private archive of Svensson (Figure 4.4).

[465] Interview with Ingemarsson.

[466] For curricular changes and their ideological basis in the early twentieth century, see Berner, *Sakernas tillstånd* and Björck, *Staten, chalmers och vetenskapen*. Elisabeth Ferm analysed the development of the electrical engineering programme over the twentieth century in her master's thesis, see Elisabeth Ferm, *Elektroteknisk utbildning under 100 år: utvecklingen av*

curricula have been limited to adding or replacing individual courses. As already noted, the minutes from the programme committee meetings at Chalmers in the 1980s and 1990s indicate that engineering educators were focused on annual budget proposals and small-scale changes within individual courses. When the computer or electrical engineering educators suggested attempts at broader reforms, the established structures effectively slowed down the process. The bureaucratic process was more likely to curtail new suggestions than to incorporate them.[467]

In some respects, the government grants for gender-inclusive reform work successfully disrupted this inertia. The computer science and engineering programme at Chalmers and the faculty at Linköping University launched unprecedented reform processes.[468] But in terms of curricular changes and the inflow of new students, the long-term results were limited. The final programme evaluation concluded that "at Chalmers the changes were more modest, mainly adapted to the demands of the labour market, such as the need to improve the students' communication skills".[469] Education scholar Inger Wistedt had an official mandate from the Government's council for the renewal of undergraduate education to evaluate all projects concerned and she did so on two occasions – at the early stages of the FGIP initiative launch and five years later. Wistedt's verdict after interviewing enrolled Chalmers students was not an optimistic one: "Even if they phrased their descriptions of the Chalmers culture differently, using attributes such as 'stiff' and 'rigid', or 'bureaucratic' they all gave a picture of an institution resistant to change." [470] Education and gender scholar Minna Salminen-Karlsson came to a similar conclusion. In her doctoral project, she closely observed the processes in Project D++ at Chalmers and in the new IT programme at Linköping University.[471] In their respective conclusions, Wistedt and Salminen-Karlsson stressed that the projects of the computer science and engineering programmes failed in achieving their gender-inclusive goal. Wistedt emphasised that pedagogical reform was only partly implemented at Chalmers. Not all professors were comfortable with the new methods proposed. Salminen-Karlsson,

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elektroteknikutbildningens innehåll vid KTH under 1900-talet (Stockholm, 1989). Arne Kaijser discusses developments in engineering education (and lack thereof) in "Vad är en ingenjör?".

467 Programme committee work between 1985 and 1993 in CTH C-archive, SSED, series A2.

468 Wistedt, *Five Gender-Inclusive Projects Revisited*, 81.

469 Ibid.

470 Ibid., 88.

471 Additionally, the Chalmers project group produced their own reports of the project processes and outcomes.

on the other hand, highlighted limited or non-existing knowledge on gender structures on the part of the renewal council as well as within local project leadership.[472]

To have even the slightest chance of disrupting the informal cultural and structural barriers facing women and other non-traditional students, Salminen-Karlsson argued that knowledge on how gender structures play out is critical. Building on Bourdieu's theories on educational habitus, and Hirdman's theory on historical gender contracts, her thesis emphasised that women are not "weak females in need of support, but losers in an institutional power contract".[473] Engineering education and universities of technology were masculine domains, unaware of their inherent values and exclusionary mechanisms. The concealment of these values, and at the same time their reproduction, were at the centre of Salminen-Karlsson's critique. Progressive reformers with good intentions but with little knowledge about the built-in connections between technology and gender could not escape this habitus reproduction. But she also noted a paradox: to destabilise engineering culture and to make changes with lasting effects, reform had to come from within the profession. While including external experts – experts on gendered issues and people from other disciplinary fields – was fundamental for a successful outcome, working with external experts introduced a new type of uncertainty as social science scholars ran the risk of not being given the necessary authority.[474] Knowledge created within the social sciences discipline has often been disparaged by engineers and natural science scholars.[475] Integrating people from other disciplines than engineering in reform work, but also providing them with a position of authority, was thus imperative. Wistedt instead saw a possibility in creating alternative cultures by establishing engineering programmes for women only. This approach had been tested at Luleå University of Technology.[476] There were, however, difficulties associated with this approach as well, since the programme, and its subsequent graduates, ran the risk of not being accepted as "real" engineers.[477]

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[472] See Salminen-Karlsson, *Bringing Women into Computer Engineering*, 215 ff.
[473] Ibid., 26.
[474] For more recent analysis highlighting similar situations, see Andersson and Landström, "The Sole Engineering Genius" and Anna Grzelec, "Doing Gender Equality and Undoing Gender Inequality–A Practice Theory Perspective", *Gender, Work & Organization* (2022).
[475] Myrdal, *Om humanvetenskap och naturvetenskap*, 100–102.
[476] See Wistedt, *Five Gender-Inclusive Projects Revisited*, 115 ff., and Inger Wistedt, *Datateknisk ingång för kvinnor. En utvärdering.* [Female Entry to Computer Science and Engineering. An Evalutation] (Luleå tekniska universitet, 2000).
[477] Wistedt, *Five Gender-Inclusive Projects Revisited,* 119.

Wistedt and Salminen-Karlsson both stressed that in the "engineering gender contract", women can never fully embody an engineering identity, as being a woman and at the same time an engineer carried internal contradictions.[478] The traditional engineer was a man. Research on gender and technology had from at least the 1980s stated that femininity and technical proficiency was not a notion that was comprehensible in post-war industrial societies. Since technology was interpreted as masculine, women's interest in it had often been overlooked, *and not been recognized as interest in technology*. To solve this equation, women in engineering careers had to downplay their gender identity to convince the males around them of their technical skills and knowledge.[479]

Interestingly, Wistedt's and Salminen-Karlsson's critique and advice largely escaped the leaders of the projects at Chalmers and Linköping universities. In interviews with the project leaders 25 years later, neither Bertil Svensson nor Ingemar Ingemarsson can remember the content of the critique.[480] Early victories might partly explain this situation. During the first few years, the percentage of women in the new programmes reached unprecedented levels. The recruitment numbers were celebrated and highlighted on numerous occasions by university leadership, and this role model position generated positive attitudes within the reform project management groups. A few years later, the percentage of women dropped. As noted above, actors responsible for the results at Chalmers had already left the university by then. Reflecting back during our interviews, Svensson and Ingemarsson were still optimistic, despite falling numbers. To them, the educational renewal was a necessary measure to increase educational *quality* – to align engineering education with pedagogical research and to adjust the subjects taught to engineering professional life. The reform was therefore deemed valid in itself. Project D++ project manager Bertil Svensson holds that external factors outside of their control, such as the bursting of the tech bubble, should be blamed for the rollback.[481] Ingemar Ingemarsson, project leader in Linköping, stresses the resistance to teaching reform among most engineering professors.[482] He strongly criticises the lack of pedagogical training among engineering professors. But any self-criticism or reflection on the

[478] Ibid., 115 ff.; Salminen-Karlsson, *Bringing Women into Computer Engineering*, 226–241.
[479] See e.g. Ibid. (Salminen-Karlsson), 46–49, on Kanter and tokenism.
[480] Interview with Ingemarsson; interview with Svensson.
[481] Wistedt partly confirms the influence of external factors. The new programs had competition from expansion of other engineering programmes, a national launch which Wistedt suggests counteracted the Five Gender-Inclusive Projects initiative.
[482] Interview with Ingemarsson.

professional culture and the values they themselves upheld are not immediately apparent. Since the 1990s, throughout their professional careers, Ingemarsson and Svensson have been dedicated to integrating both women and men in decision-making and development processes. However, none of them reflects on a need for more knowledge on gendered dynamics in professional and engineering culture.[483] Why did the results from the evaluations and studies not have a bigger impact on these individuals, or on the engineering faculty overall? This thesis does not attempt to fully answer such questions, but clues can be found in it and are elaborated on in Chapter 6, the concluding chapter.

Within a few years, the electrical engineering programme committee at Chalmers also turned to curriculum reform. The reform logic can thus be interpreted as hegemonic by the late 1990s. Now, the EE committee communicated the same message as previously the Project D++ management. A marketing booklet from the Department of Computer and Electrical Engineering presented the reform processes that were initiated (Figure 4.4). The booklet, which contains optimistic interviews with Bertil Svensson as well as Kjell Jeppson, erases all previous hesitation from the EE programme committee regarding "gender-inclusive" curriculum reform.

What dynamics explain the fact that although actors increasingly embraced "gender-inclusive" reform over time, at least at Chalmers, this produced relatively little change – neither in the numerical gender balance nor in curriculum content and structure? Salminen-Karlsson's interpretation of an engineering habitus where masculine values are concealed is undoubtedly valuable. Two decades later, many engineering educators with social justice ambitions are still blind to their habitus. One striking example is a university of technology project launched in 2019 and analysed by scholars Kai Lo Andersson and Catharina Landström.[484] In the project conducted at a high-profile Swedish university of technology, gender inequalities – at the faculty level – were to be resolved through measures proposed by a group of engineering faculty members with limited knowledge of gendered dynamics. Andersson and Landström highlight project leaders' questioning

[483] Ibid.; interview with Svensson.

[484] Andersson and Landström, "The Sole Engineering Genius". The article anonymise the name of the university.

Figure 4.4. Front cover (top left) and content in marketing booklet from the Department of Computer and Electrical Engineering. Headlines: "More Women to electrical and computer engineering" (top), (middle), and "Join us for a Girl's Weekend" (bottom). Courtesy of Bertil Svensson, private archive.

of the value of qualitative gender studies. The professional boundaries guarding what counts as valid and objective knowledge have not changed significantly since the 1990s.[485]

In 1997 Linköping University, backed by the Minister for Education, launched a project to reconsider and reform *all* Swedish university engineering programmes. As the next chapter demonstrates, the values, norms and ideals of the reform logic permeated Project New Engineering Education (*Projekt NyIng*). With Ingemar Ingemarsson once again as project manager, pedagogical renewal was at the project core. But more so than within the FGIP initiative, Project New Engineering Education questioned the traditional structure of engineering curricula. To the project managers, art, design and practical trial and error were just as critical to engineering education as mathematics and physics. Moreover, gender analysis was given a novel position. Minna Salminen-Karlsson's analytical skills would this time be activated to highlight gendered structures in engineering education overall. Chapter 5 explores the consolidation of the reform logic among a minority of elite engineers. It also details the introduction of gendered analysis of technology as a disciplinary field at Swedish universities of technology in the late 1990s.

CONCLUSION

This chapter has explored the tension between two rationales in the 1990s on how to achieve gender equality in engineering education. It has examined how the established *recruitment logic*, as outlined in the previous chapter, was challenged by *reform logic* in the early 1990s. Not only did the focus of gender equality efforts differ from those in the 1980s, the position of the 1990s engineering reformers diverged from that of the actors previously involved. At the core of this chapter has been a group of university reformers – faculty and university leadership – who made the reform work happen. A national council represented by university faculty, such as Christina Ullenius, Pro-Vice-Chancellor at Chalmers, and Mårten Carlsson, Vice-Chancellor of the Swedish University of Agricultural Sciences (SLU) launched the reform programme. At the universities of technology, engineering faculty members chairing the programme committees planned and led the practical reform work. Established researchers, professors and numerous engineering students were heavily involved in the work carried out as well. The position and visibility of issues relating to gender inequality thus gained a more prominent position than in the decade before. It is, however, notable that the less visible work of Inga Alander

[485] See sub-chapter "Men are Hardly Suitable".

and Eva Ljunqvist in the early 1980s influenced Christina Ullenius to engage in questions of gendered engineering. Without Ullenius' commitment and the long-term pedagogical support of Inga Alander, it is less likely that Chalmers would have engaged in a reform programme for gender equality in the early 1990s. At Linköping University, Anders Flodström, the new Vice-Chancellor from 1996 and reform-oriented faculty members such as Ingemar Ingemarsson were convinced that the engineering curriculum required substantial transformation. The Five Gender-Inclusive Projects (FGIP) initiative was the first move in that direction. Chapter 5 elaborates on the basis for such convictions and explores how the reform processes continued throughout the 1990s.

The push for gender equality improvement in the 1990s did, however, originate in political concerns for national competitiveness and prosperity, just as a decade earlier. During the severe economic recession, the cabinet considered expanding the higher technical education system as the way out of the crisis. Once again, just like in the 1980s, national economic concerns among political actors sparked a process to bring about change. And once again, only a minority of engineering faculty members got involved. However, in contrast to the recruitment activities ten years earlier, it was representatives from the engineering faculty and university leadership who this time around got involved in gender equality efforts at the universities of technology. This chapter has demonstrated how the engineering majority's embracing of the *recruitment logic* effectively put the brakes on any reform process.

The next chapter analyses a national reform programme taking engineering curriculum reform a step further. Professor Ingemar Ingemarsson now had the chance to try out his ideas on problem-based learning (PBL) in a national context. Project New Engineering Education, or "Project NyIng", which Ingemarsson was appointed to lead, aimed to reform the entire university engineering system. In addition to PBL, integrating gender analysis into science and engineering became one pillar on which the Project NyIng rested. Social sciences, the humanities and the arts were as crucial as the traditional STEM subjects. The significant professional boundary crossing that this project group engaged in can be viewed as a visionary approach in engineering programme reform. The obstacles that Project NyIng faced and the slow progress made after the 1990s are discussed in Chapter 6, the concluding chapter. The practises of engineering professional boundary work, and the commitment to the recruitment logic among the engineering majority, went hand in hand with market-oriented national economic policy that aimed to minimise public spending and decentralise university decision-making. Political initiatives

for university reform no longer appealed to cabinets with decentralised ambitions. The corporate university, particularly universities of technology, would, in the coming decades, be managed like and funded by industry rather than through cabinet reform initiatives.[486]

[486] On the corporate university see Shirin Ahlbäck Öberg, Li Bennich-Björkman, Jörgen Hermansson, Anna Jarstad, Christer Karlsson and Sten Widmalm, *Det hotade universitetet*, 1. ed., (Stockholm, 2016).

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Challenging Professional Norms: A Call for the Arts, Humanities and Practice

In May 1996 Linköping University landed yet another ministry grant to renew engineering education.[487] The "New Engineering Education Project" (*Projekt NyIngenjörsutbildning*), hereafter Project NyIng, would not be limited to a few local engineering programmes; it aimed to rethink the complete Swedish engineering education system. Professor Ingmar Ingemarsson, the creator of "The IT Programme" explored in the previous chapter, got the opportunity to lead the national reform initiative. The small circle of engineering enthusiasts assigned the task were excited; their intentions were clear. Engineering curricula needed radical transformation: from technically narrow and overly "scientific" to a curriculum suited for what they called the Modern Engineer.[488] Kent Hartman, a member of the project management team, found it of serious concern that adolescents, often not more than 19 years old, were locked into a heavily scientific, 4.5-year curriculum without much chance of changing their professional path, or even their engineering sub-field, if the student had second thoughts. According to Hartman, project management "was fighting against a view of engineering development that was strange, almost grotesque; it was not about developing people".[489] To train the modern engineer, a curriculum based on the natural and engineering sciences would not suffice. On the contrary: this renewed engineer would bridge the two cultures – the sciences and the humanities – when humanist and social sciences became integrated into engineering university-education.[490] Furthermore, practical, entrepreneurial and communication skills would accompany the theoretical knowledge. Project management was convinced that this type of curriculum would attract a broader range of students, particularly female ones.

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[487] "Uppdrag till Linköpings universitet att genomföra ett projekt syftande till förnyelse av ingenjörs- och civilingenjörsutbildningarna", Cabinet Decision 6, 23 May 1996, U96/1794/UH, Ministry of Education Central Archive E1A: 4135(1).

[488] Ingemar Ingemarsson and Ingela Björk, eds., *Ny Ingenjörsutbildning. Slutrapport* (Linköping, 1998).

[489] Interview with Kent Hartman, 15 June 2017.

[490] Ingemarsson and Björk, eds., *Ny Ingenjörsutbildning*, 11. The concept of "the two cultures" was made influential by British scientist C.P. Snow in his 1959 Rede Lecture. For a Swedish discussion on the theme see Myrdal, *Om humanvetenskap och naturvetenskap*.

This chapter analyses the actors engaged in Project NyIng, their values, actions and the challenges they faced in realising their reform ambitions. It emphasises the vision that a small group of engineering reformers had and pushed for in the final years of the twentieth century. The challenge posed by gendered professional boundaries for the actors is at the core of the analysis presented. Similar to Chapter 4, this chapter also shows how the link between the national economic crisis and public funding for higher technical education made the reform process happen. The public funding was provided based on the cabinet's hope that university engineering education would turn the Swedish economy around. This chapter therefore begins by recapping the state of the Swedish economy in the 1990s and its effects on university policies. It describes how the 1997 Social Democratic budget bill emphasised university expansion and particularly developing education. The following sub-chapter details a conference at the Ministry of Education in 1995 that gathered elite university educators. At the conference, the invited scholars emphasised the need to scrutinise the masculine culture in science and engineering academia and pushed for thorough educational and cultural reforms. Such arguments aligned with the government directive which shortly after gave Linköping University a unique opportunity to develop a national reform project for engineering programmes.

Before describing what took place at Linköping University, the expansionist visions of politicians and educators in the city of Norrköping are detailed in this chapter. Their dream of transforming this former textile industry city, which by then had experienced decades of unemployment, included a new university campus offering cutting-edge engineering programmes. Projekt NyIng became a minor part of a bigger vision for the renewal of a working-class city degraded by decades of transnational migration in industry and the business sector. The chapter then turns its attention to the Project NyIng set-up at the local level. It analyses project team constellations as well as project ambitions and activities. The interdisciplinary project team dived right into challenging professional boundaries; the project members not only challenged the content of engineering knowledge and the structure of engineering curricula at universities, but also reviewed and spread literature on gendered science and technology through printed publications and conferences.

In addition to Project NyIng, the chapter details two parallel processes of research and education development that took place at Swedish universities of technology in the twentieth century. The first is the frequent calls to integrate the humanities and social sciences into the engineering curriculum starting back in the late 1800s. The second

process, which took place much later on, involves the introduction of gender analysis in science and technology research and in engineering education, which in Sweden peaked in the late 1990s before coming to a standstill. In the chapter conclusion I discuss how both the Ministry of Education and Project NyIng management overestimated the possibilities for radical curricular change.

Juxtaposing the analysis in this chapter with Londa Schiebinger's three policy fixes demonstrates how the NyIng reformers aligned with Schiebinger's third fix: "fixing the knowledge". Schiebinger refers to this perspective as an "equality approach through gender analysis".[491] To make engineering education inclusive and create the necessary conditions for student diversity, Project NyIng members argued that the content of engineering programmes and research, i.e. the knowledge, needed to be diversified. "Fixing the number of women" and "fixing the institutions" had to be supplemented by interdisciplinary engineering curricula and interdisciplinary research.[492] Project NyIng consulted and summarised research along these lines, hoping for it to spread within the engineering community. But for the entire engineering university system to transform, the engineering majority needed to follow. This did not occur. Institutional change occurred at Linköping University and at a few universities of technology, but in most engineering departments, no gender analysis of education and research was carried out. The norms of traditional pedagogy, curricular content and research remained intact.

Like Chapter 3 and 4, the analysis in this chapter is based on both written and oral sources. Kent Hartman's private archive provided the minutes of project meetings and additional project materials.[493] Interviews with Ingemarsson, Hartman and former Linköping University Vice-Chancellor Anders Flodström, combined with printed project publications, reveal the process at Linköping University leading up to the project launch. My review of the movements at Swedish and US universities of technology to incorporate the humanities and social science, as well as the historiography of feminist science and technology research, are based on the literature of the contemporary research communities focusing on the history of technology, the history of science, and science and technology education.

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[491] Schiebinger, "Gender Science and Technology", 4.

[492] See this thesis Chapter 1, sub-chapter "Three Fixes: Women, Institutions, Knowledge".

[493] When I called Hartman about my research project, his archive was just about to go down the trash because of his coming retirement.

UNIVERSITY EXPANSION TO COMBAT UNEMPLOYMENT

As detailed in Chapter 4, the Swedish economy faced a severe recession starting in the summer of 1990. The economic decline had a peculiar effect on the higher technical education system: it grew. When the national economy went downhill, expansion of the higher technical education system once again became a key government measure to turn things around. This impacted gender equality debate and activities within the Government and among engineering educators. Political and university leaders argued that the "knowledge economy" would have a positive impact on society. In this economy, citizens needed to raise their educational level, preferably within the higher technical education system. The Swedish Government needed to activate all "competence resources". Gender, age and socio-economic status could no longer stand in the way of getting an education in engineering and technology.[494] The 1991 centre-conservative cabinet set a course in this direction and the 1994 Social Democratic cabinet remained on the same path.

After the 1994 election, contemporary commentators pictured the new Social Democratic Minister for Education, Carl Tham, trying to turn the clock back regarding research policies. Subsequent commentators have instead emphasised the similarities in approach between centre-conservative minster Per Unckel and Carl Tham, referring to a period of "instrumentalism", where universities had to serve the needs of society.[495] While Unckel's primary reform objective was economic growth, Tham added lower unemployment and greater regional sustainability. When industries failed, former industrial cities saw their younger population leave. Meanwhile, university cities were thriving. Establishing new institutions of higher education in regional cities thus became a distribution tool for the Social Democratic cabinet to address the unequal consequences of the crisis.[496]

Since the mid-1980s about half of all new university students had entered science and engineering programmes.[497] To industry representatives and the cabinet, this was a welcome trend but not one that was sufficiently strong. The 1997 draft budget referred to a recent industry report by the national industry federation (*Sveriges Industriförbund*) entitled *Kunskap och kompetens: industrins behov av högskoleutbildade* (approx. "Knowledge and Competence: the Industry's Demand for University-Educated Engineers") which argued

494 This thesis Chapter 4, 117–119.
495 Sörlin and Thörnqvist, *Kunskap för välstånd,* 105.
496 *Högre utbildning och forskning*, 49–50, 52.
497 Ibid., 50.

that the need for qualified engineers in industry was still two times higher than the supply.[498] Moreover, the industry's need for people skilled in electronics and information technology was four times the supply. The draft budget announced a "powerful expansion" of higher education with 30,000 new study seats.[499] These would predominantly benefit the "small and mid-sized" universities.[500] Expanding the university system at the present speed presented new issues and highlighted old ones. As outlined in the previous chapter, a growing number of actors – engineering faculty members, university administrators, industry representatives, state bureaucrats and members of parliament – stressed from the early 1990s that the higher technical education system urgently needed renewal, and in particular pedagogical renewal. Such needs had first been voiced by the national student union and were repeated in an increasing number of university programme evaluations.[501]

The budget bill emphasised this situation. It was, in part, about concern about the students and their learning processes. But it was also concern about their future employers. Traditional engineering curricula were not adapted for the needs of the emerging post-industrial society. To foster innovation and entrepreneurship, skills were required other than those applied in past manufacturing processes. Now, the Swedish economy required multidisciplinary engineering programmes combining technology with economics, languages, environmental studies and the arts.[502] In addition, the massive expansion of higher education required new measures to secure educational quality; pedagogical renewal was critical. The bill stated the needs in general terms, but when it came to concrete measures, it only addressed the higher technical education system. Linköping University would become a key beneficiary. The cabinet granted Linköping University funding to set up a second campus in the nearby city of Norrköping.[503] A smaller yet prestigious assignment was the task of running a national project focusing on pedagogical and curricular renewal of all engineering programmes in Sweden.[504] The official objective did not diverge from the traditional argumentation: the Swedish industry

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498 Ibid., 52, 58; Sveriges industriförbund, *Kunskap och kompetens: industrins behov av högskoleutbildade* (Stockholm, 1998). Scholars have noted a tendency for bias in such reports, see Lövheim, *Naturvetarna, ingenjörerna och valfribetens samhälle,* 29.

499 *Högre utbildning och forskning*, 52.

500 Ibid., 52, 58.

501 This thesis Chapter 4, sub-chapter "Reforming Curricula for Educational Quality".

502 *Högre utbildning och forskning*, 49 ff.

503 Ibid., 53.

504 Ibid., 60; "Uppdrag till Linköpings universitet".

of technology was essential for economic growth and provided industry with relevant and sufficient talent. But in times of structural transformation, engineering skills and curricula needed to be reviewed and updated. Industry was said to be radically transforming. There were buzzwords such as automation, innovation and entrepreneurship being used when referring to the ongoing transformation. In the post-industrial era, employees would need the ability and flexibility to take on new tasks.

To increase the number of students, universities of technology would need to continue their quest for broadened recruitment. As expressed already in the arguments for the Five Gender-Inclusive Projects initiative analysed in Chapter 4, cabinet and industry increasingly viewed women as a significant talent reserve. This is an argument examined in the previous chapter. But the cabinet expressed an increasing awareness that recruitment to these universities was skewed in other ways. Students from non-academic or non-engineering homes were less likely to enrol in upper secondary school science and technology programmes and subsequently apply to university for study in these fields.[505]

The bill echoed concerns that had been raised since the late 1980s by the Government's commission on higher education, its council for the renewal of undergraduate education and the leaders of the FGIP initiative (Chapter 4). A more recent event also reinforced such concerns. In October 1995 the Ministry of Education and Research held an "idea conference" for the renewal of higher technical education attended by several elite actors in the sphere of higher education. University leaders from most of the prominent universities, including Chalmers' Pro-Vice-Chancellor Christina Ullenius, representatives from industry, professional organisations and student unions, higher education bureaucrats, education scholars and also media representatives, all gathered at the Ministry for Education to identify the most pressing needs and what steps to take moving forward.[506] The issues brought up at the conference formed the basis for the proposals in the 1997 draft budget, including the proposal in focus in this chapter: funding for a project for pedagogical and curricular renewal at Linköping University.

A CALL FOR GENDER ANALYSIS

At the conference, Christina Ullenius highlighted the ongoing projects under the Five Gender-Inclusive Projects initiative for computer science and information technology

[505] *Högre utbildning och forskning*, 58–59.

[506] "Tekniska högskoleutbildningar - Dokumentation från ett idéseminarium den 24 oktober 1995", Ministry of Education Central Archive, E2E:61, 73.

programmes at Chalmers and Linköping University.[507] In addition to Project D++ (Chalmers) and the new IT programme (Linköping), Luleå University of Technology was trying out a women-only preparatory study year in computer engineering. Overall, project outcomes looked promising. At the same time, Ullenius, who had been one of the main drivers to make the projects materialise, expressed some criticism and concerns regarding the limitations of the new engineering programs. Those running the projects had not sufficiently addressed the masculine *culture* that dominated the universities of technology.

> What is difficult to address in these projects is, of course, the culture that exists in engineering education. / In the long run it is important to raise awareness of the fact that the environment is to an extremely large degree characterised by masculine values. Women participate in engineering education on men's terms but are seldom themselves aware of it. The reason is, of course, that these values exist in society and women have themselves to a large extent accepted them.[508]

Ullenius's reflections were supported by a sociological study conducted at Chalmers. Sociologist Agneta Göransson had been assigned to examine how gender played a role in enrolled students' perceptions of engineering education.[509] Her study mapped responses from an equal number of male and female students in three different Chalmers programmes: electrical, mechanical and chemical engineering. The results described a university where female students, but not male, were visible because of their gender identity in ways perceived as both positive and negative. It also stressed that 40 percent of the female students were critical of the narrow technical focus of the curriculum and requested courses that contextualised technology.[510] Educators at a few other universities of technology had conducted similar surveys back in the 1980s.[511] But while the previous surveys had intended to "get to know" the female students and their perception of engineering studies, the present study focused on how to transform educational institutions. Actors interested in gender inequalities in science and technology education increasingly viewed masculine engineering culture rather than "women's faulty choices" as the main problem. At the conference, Agneta Göransson presented this perspective:

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507 Ibid., 4.

508 Ibid., 6.

509 Agneta G. Göransson, *Kvinnor & män i civilingenjörsutbildning* (Gothenburg, 1995).

510 "Tekniska högskoleutbildningar", 11.

511 This thesis Chapter 3, sub-chapter "Surveying the Female Engineering Student".

> The education and career choices of girls have often been regarded as irrational based on how people perceive them choosing low-paid female work with no opportunities to develop. Gendered education choices have been turned into a girls' problem. Another possible approach is to see girls' resistance to male-dominated careers and education programmes as a realistic assessment of the costs to them personally in the form of social isolation, a lack of job opportunities, difficulties balancing their work and family roles, etc. Based on this outlook, efforts should also be focused on changing the way studies are organised, as well as the environment and content, in order to attract girls/women. This study is intended to form a basis for bringing about changes in the study environment for engineering students.[512]

Göransson's study concluded that technical universities needed to rethink teaching practices, examination methods, textbook language and content, and curricular structures in order to increase the number of female students. Most importantly, the universities needed to communicate that those female students were just as welcome as the male students by giving all, independent of gender identity, an equal chance to influence the work environment and education.[513]

The gendered nature of engineering education was addressed from yet another angle at the conference. From her observations and interviews, social anthropologist Katarina Ek-Nilsson had found that many potential students refrained from enrolling at universities of technology because of their resentment towards the ragging or hazing (*nollning*) that went on during an initiation period.

> I have met several who, in fact, had decided against an engineering degree as an option because they don't want to expose themselves to the ragging or hazing they have heard takes place at the universities of technology. We can ask ourselves if this form of "screening" is helpful. There may be some among those opting out who *really* should become engineers. My view is that there should be an earnest discussion at the universities about *certain* student traditions as being too exclusive. The universities are both educational institutions and social communities and much of the socialisation takes place outside the lecture hall or lab and instead at formal and informal student social events, post-event organisational gatherings [*bludder*], and initiation rituals. It doesn't help that those already in the programmes and who

[512] "Tekniska högskoleutbildningar", 11.
[513] Ibid., 15.

> themselves have gone through the ragging/hazing rituals defend them in their current form. If we want to reach new groups of applicants, young people who ask new questions and are looking for new knowledge combinations – well then, these so-called traditions need to be looked into.[514]

Additionally, Ek-Nilsson criticised the one-dimensional focus on previous recruitment campaigns. She explicitly called for research with a gender perspective, particularly in historical studies, to inform future reform work.

> The percentage of female students has increased slowly but surely but there is still of course a lot to do. The technology and engineering programmes are still masculine environments. More *gender research* is needed here, in an historical perspective, so we can understand how the terms "technology" and "engineer" are loaded as masculine in our culture – these roots run too deep for it to be possible to achieve *lasting* change with individual campaigns.[515]

The conference lectures and subsequent materials produced from it indicated that universities of technology desperately needed pedagogical and curricular renewal, a process that had so far only just got started. For such reforms to take place, government support – financial as well as moral – was critical. In line with this message, the 1997 budget plan communicated the need for pedagogical reform at universities, particularly at universities of technology. As stated above, the most extensive measure was a grant proposal for 30,000 new spaces, mainly at the small and mid-sized institutions. About half of the spaces would be for science and engineering programmes at the universities.[516] At the minor institutions, innovative curricular and pedagogical measures could be tested. A smaller yet substantial grant was to fund the project at Linköping University for the renewal of engineering programmes in Sweden.

The launch of Project NyIng was a bureaucratic and institutional novelty. Normally, cabinet-appointed commissions, such as the one on the higher education (*Högskoleutredningen*), looked into large-scale reforms involving whole sections of the higher education system.[517] To assign such a task to a single university presented obstacles

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[514] Ibid., 32–33.

[515] Ibid., 33.

[516] *Högre utbildning och forskning*, 52.

[517] This thesis Chapter 4, sub-chapter "Reforming Curricula for Educational Quality".

as well as possibilities. According to the project's leaders, the structure was one reason why the long-term effects of the project became limited.[518] On the one hand it enabled Linköping University to appoint a small working group of individuals with shared values, thus enabling for a smooth process. On the other hand, the local arrangement put a damper on the initial hopes of widespread national enthusiasm and action. Spreading the ideas to other universities was more difficult than at first assumed. Why did the cabinet opt for this structure in the first place?

An apparent reason is the cabinet's aim to limit the number of public inquiries, a measure to cut public spending and decentralise decision-making. In the mid-1990s, Linköping University had positioned itself as a progressive and dynamic institution in terms of both education and research.[519] The new IT programme launched in September 1995 (Chapter 4) was poised to play out well. The curriculum renewal was an innovation in the engineering landscape as it applied problem-based learning (PBL) throughout. The recruitment target had been set at 50 percent female students. Although this was not achieved, it reached 37 percent, which was well above the national average for engineering and technology programmes and, as such, it was celebrated.[520] Additionally, Linköping University was known for its progressive organisation of research and education, especially at its interdisciplinary *Tema* (thematic) departments. This institution had been successful in terms of research grants since the 1980s.[521] According to Anders Flodström, Vice-Chancellor in the 1990s, the university had faculty members with progressive ideas on education and pedagogics.[522] Sociologist and research policy scholar Mats Benner points to Linköping University as the absolute winner in the research funding system developed in the 1990s.[523] It is, therefore, no major surprise that the cabinet chose Linköping University to rethink Swedish engineering education overall. If the university had found a successful strategy to raise educational quality and to attract both male and female students, hopefully it had a recipe that could be replicated. Two political goals – increased recruitment to engineering studies overall and an increased percentage of female engineering students – could thus be fulfilled in one go.

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518 Ingemarsson and Björk, eds., *Ny Ingenjörsutbildning*, 4; interview with Ingemarsson.
519 Ibid (interview): interview with Flodström.
520 Wistedt, *Gender-Inclusive Higher Education in Mathematics, Physics and Technology*, 33; interview with Ingemarsson.
521 Benner, *Kunskapsnation i kris?*, 84.
522 Interview with Flodström.
523 Benner, *Kunskapsnation i kris?*, 82.

Previous reform initiatives at universities of technology showed that substantial change was more likely to be achieved through entirely new programmes than by reforming existing ones.[524] This, of course, presented the universities of technology with a particular conundrum: either the number of programmes would just keep growing – something that Project NyIng would criticise – or traditionally structured engineering programmes had to be discontinued. But ending century-old programmes that enjoyed close to mythical status, was unlikely to happen, despite their outdated curricula. The higher technical education system was stuck with what literary and technology historian Rosalind H. Williams refers to as "expansive disintegration", an expanding educational system splitting up into ever-more subfields.[525] A report from a Swedish national agency for higher education (*Universitets- och högskoleämbetet, UHÄ*) had addressed this issue back in 1991 and suggested substantial reform to halt the process.[526] The agency proposed that engineering programmes be restructured so that the first year would have a similar structure across all the engineering subfields. This would provide the students with blocks of courses that integrated mathematics, natural sciences and engineering sciences. It would also simplify the process of switching between engineering programmes if the student had second thoughts about their first choice. However, before the new structure was put in place, Minister Per Unckel and the centre-conservative cabinet decided to decentralise decision-making in the Swedish higher education system (Chapter 4). From that time on, universities could do as they pleased with their curricular structure and content. Rather than taking the advice from the UHÄ agency, the universities of technology – eager to make use of their newly won freedom – established even more programmes. Programme profiling with an emphasis on "exciting" technical subfields was a method used to recruit new student groups, especially women.[527] For students who wished to switch their subfield, the process remained complicated, as did other criticised aspects of the engineering curricula. Some engineering educators argued that this was not sustainable.

There were engineering faculty members at Linköping University who shared these concerns. The university had a friendly relationship with the Ministry of Education.[528]

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[524] Ingemarsson and Björk, eds., *Ny Ingenjörsutbildning*, 23–24.

[525] Williams, *Retooling*.

[526] Universitets- och högskoleämbetet. *Civilingenjörs- och arkitektutbildning: antagning och organisation* (Stockholm, 1991); Ingemarsson and Björk, eds., *Ny Ingenjörsutbildning*, 24.

[527] Ibid. (Ingemarsson and Björk).

[528] Interview with Flodström.

Vice-Chancellor Anders Flodström and the new Minister for Education Carl Tham were on good terms. The Minister had decided to further expand engineering education, and Flodström ran a university that was a place for faculty members with progressive pedagogical ideas. Flodström intended to expand Linköping University to a new geographical location: Campus Norrköping.[529] The low level of education in the population of Norrköping, a city 40 kilometres east of Linköping, had been a cause of concern for the politicians there ever since the textile industry crisis of the 1950s. For decades, city politicians had wanted to split Linköping University between two campuses, one in Linköping and one in Norrköping.[530] Thanks to the crisis-related funding from Minister Tham, Flodström's and city politicians' vision could be realised.[531] From 1997 the former textile factories would no longer be a mere symbol of a prosperous past, but would be turned into a university campus. They would be greenhouses for the knowledge economy workforce of the new millennium.

In unofficial communication between Minister Tham and Vice-Chancellor Flodström, Flodström laid out his plans – his "empire dreams".[532] In the proposal, Flodström combined his ideas on new engineering programmes for the new campus and a national project for rethinking the entire higher technical education system. It included 3-year as well as 4.5-year engineering university degrees. To fulfil his dream, Flodström requested 48 million kronor. He did not suggest discontinuing existing programmes but rather to launch two new ones. His concrete suggestion was a six-step process – from preliminary study to pilot-program, evaluation and finally sharing the experience.[533] It included planning and a trial run of two new engineering programmes, one focusing on plant (factories) and environment and one on electronics and electronic production. The draft proposed cooperation between several Swedish universities of technology and colleges – some of the minor ones had already expressed interest. Flodström took his point of departure in the need for, on the one hand, increased recruitment to universities of technology and, on the other, substantially reformed engineering programmes. Since "positive development of Swedish business and industry, as well as the public sector,

529 Ibid.

530 Ann-Christin Cederborg, Björn-Ola Linnér and Roger Qvarsell, *Campus Norrköping: en studie i universitetspolitik* (Norrköping, 2005).

531 *Högre utbildning och forskning,* 53.

532 Interview with Flodström; letter from Anders Flodström to Lucie Mandaus, Carl Tham's state secretary, in the private archive of Kent Hartman.

533 Letter from Flodström to Mandaus.

required more engineers, including those with PhDs, expanded recruitment to universities of technology was needed.[534]

This expansion was not allowed to jeopardise educational quality. On the contrary, quality improvement and recruitment efforts would preferably go hand in hand. Progress on this required a radically transformed engineering education. Curricular content and teaching methods needed to change. Programmes that incorporated subfields of importance to the contemporary industrial expansion should be prioritised. Such subfields included computer engineering, environmental engineering, bioengineering and production engineering, but also what Flodström without further explanation referred to as "culture engineering" (*kulturteknik*). The future labour market demanded new skillsets among Swedish engineers, skills that the current engineering curricula did not provide. The draft emphasised the integration of social science and humanities subjects, increased creative and practical work, the importance of problem-based learning and an intensified use of information technology in education. It also mentioned life-long learning, integration of different engineering programmes, the need for work experience as part of engineering education and finally, gender equality.[535]

Gender equality appeared last on Flodström's list. In our interview, he openly admits that he can take no credit for this goal becoming prominent in the subsequent Government directive. Looking back, he refers to a vague personal idea of the benefits of broadening the engineering curricula. The industrial economics engineering programme, established in the early 1970s, had from start attracted both male and female students.[536] On this matter, Flodström refers to one of his former students at Linköping University, Carl-Henrik Svanberg, who he had recently met again. Flodström and Svanberg had a mutual understanding that the industrial economics programme had turned into a very successful "VP program".[537] When it came to academic gender equality work in the 1990s, Flodström instead refers to the JÄST advisory committee (Chapter 4, sub-chapter "Reforming Curricula for Gender Equality"). Flodström was a member of this committee but remembers it as focusing on other disciplines, such as clinical medicine, and on the

[534] Ibid.

[535] Ibid.

[536] Interview with Flodström.

[537] Ibid. VP = Vice President. Svanberg has for decades been an influential business leader in the global arena, most known for being the BP Chairman during the Deepwater Horizon oil spill catastrophe in the Mexican Gulf in 2010.

situation of female medical doctors, rather than engineering.[538] It is safe to assume that Flodström supported the proposal for a reform programme for science and engineering programmes, the FGIP initiatives, as it was formulated in the committee's proposal to Per Unckel's bill on higher education in 1992 (Chapter 4).

Now, in the second half of the 1990s, Flodström's lobbying work played out to his benefit. Campus Norrköping was inaugurated in 1997.[539] In addition, Linköping University was granted 10 million kronor for a national pedagogical renewal project, Project NyIng.[540] In light of the fact it now had the new campus, the renewal project perhaps diminished in importance for Linköping University management. The task assigned by the cabinet was to set up infrastructure for an exchange where the Swedish universities of technology could share reform initiatives that were already in progress – a kind of national best practice exchange.[541] In addition to the overarching objectives of increased recruitment and educational renewal, the cabinet directive highlighted themes to be given special consideration. It is possible to see traces of Flodström's ideas in the directive, as well as arguments presented at the 1995 idea conference outlined above. The directive emphasised problem- and project-based learning to put the individual student and the teacher-student-relationship at the centre. Next, after pedagogical renewal, the directive required "gender equality analysis" of engineering education and engineering workplaces. Such analysis was deemed necessary as a means of increasing the recruitment of women.

> To also increase the percentage of female professional engineers it is necessary for the heavily male-dominated engineering profession to be analysed based on a gender equality perspective and for the programmes to incorporate a gender perspective. The programmes should prepare the students for their career by giving both male and female students knowledge on both the obstacles that women face in the form of attitudes in the external environment as well as insight into the benefits of a better gender balance.[542]

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[538] Interview with Flodström; Departementsserien 1997:56, 11–12.
[539] "Campus Norrköping fyller 20 år", https://www.akademiskahus.se/aktuellt/nyheter/2017/03/campus-norrkoping-fyller-20-ar/, retrieved 9 Jan. 2023.
[540] "Uppdrag till Linköpings universitet". See interview with Hartman and meeting minutes in Hartman's private archive regarding the additional funding.
[541] "Uppdrag till Linköpings universitet"; Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*, 172.
[542] Ibid ("Uppdrag till Linköpings universitet").

The contrast in rhetoric from the 1980s initiatives was stark. No longer would only the female students and staff be informed about gendered mechanisms in engineering. This theme should be integrated into the engineering curriculum and taught to all students, male and female. Political scientist Katharina Tollin has shown how the 1990s gender equality debate differed significantly from that of the 1980s, which was dominated by women's employment opportunities.[543] The power perspective which now permeated the political debate also affected university engineering education. Analysis of the gendered power dynamics in engineering education and in the profession was said to be necessary but so far insufficient. Gender analysis should also be *taught* at the university at technology.[544]

Further, the directive recommended "testing opportunities for an increased focus" on incorporated perspectives from the humanities and the social sciences, and on "artistic" (*konstnärligt*) and "practical" work.[545] It also emphasised the need for life-long learning. The NyIng project management later followed up on all the paths laid out in the directive. Certain areas would, however, be given more weight than others.

MULTIDISCIPLINARY AMBITIONS: THE PROJECT NYING TEAM

Information theory professor Ingemar Ingemarsson was one of the first professors installed in the early 1970s at the new college in Linköping which offered engineering programmes.[546] In 1996, as soon as Ingemarsson found out that Linköping University would be granted yet another substantial sum of money to lead a national reform project, he stepped into the dean's office and requested the project manager position. With a long-term interest in pedagogical issues, and having created the newly inaugurated IT programme, Ingemarsson was determined to lead the new project that was to be launched.[547]

Ingemar Ingemarsson had obtained his education and conducted research at the two most prestigious Swedish universities of technology: he had a degree in Electrical

[543] Tollin, *Sida vid sida*, 115 ff.
[544] Two decades later, such teaching is not implemented. Discussions on how to proceed, similar to those suggested here, is on the agenda.
[545] "Uppdrag till Linköpings universitet".
[546] "History of Linköping University", https://liu.se/en/article/history-of-linkoping-university, retrieved 9 Jan. 2023.
[547] Interview with Ingemarsson.

Engineering from Chalmers University of Technology, a licentiate degree in Information Theory from the same institution, and a doctoral degree in Telecommunication Theory from the Royal Institute of Technology (KTH). Teaching and pedagogics had intrigued him from his early 20s. Ingemarsson's uncle, a teacher by training, had made an impression on him early by getting involved in his nephews' and nieces' schooling. In 1958, after telecommunication technology training during his military service, Ingemarsson was given a position as a teacher at the marine telecommunication school in Stockholm (*Beckholmens teletekniska*). Although teaching was a joyful experience, by then he already had his mind set on Chalmers University of Technology. Looking back as a man of 79, Ingemarsson views engineering studies, and particularly electrical engineering, as an obvious choice for him. With a father who was an electrical mechanic, and with his strong interest in technology from childhood, he reflects upon himself as being "destined" for engineering. He landed in electrical engineering subfield more by chance; while his early interest was in chemistry, this changed in school, largely due to the ability (and inability) of his early teachers to engage him.[548]

During his student years at Chalmers, Ingemarsson's interest in pedagogy grew. This was mainly a result of the poor teaching skills of his professors. In contrast to many of his fellow classmates, Ingemarsson did not consume strong liquor. Growing up in a home without strong liquor this was a choice he did not dwell much upon. Not being caught up in the alcohol-fuelled student rituals at Chalmers, he instead involved himself in the work of the educational programme committee.[549] Here he got his first experience of discussing the engineering curriculum and teaching methods with his professors. This experience would come in handy when, a decade later, he was given a position as professor at Linköping University. At this young institution, Ingemarsson's first major task was to set up a new 4-year engineering programme, the Y-programme, which would combine electrical engineering and engineering physics. While heavily involved in curricular development in the early years, Ingemarsson also found time to conduct research. In 1978, he founded the company Sectra in partnership with three of his postgraduate students. This research spin-off grew significantly in the following decades.[550] Having a lifetime professorial chair – where he stayed for 35 years – he reasoned that because of his earlier

[548] Ibid.

[549] On the programme committees, see this thesis Chapter 4, sub-chapter "University Programme Committees as Curricular Battlefields".

[550] Webpage on Sectra's history, https://investor.sectra.com/this-is-sectra/sectras-history/, retrieved 26 Jan. 2023.

achievements, he was entitled to spend less time on science and engineering research and more on pedagogical research. From the early 1990s Ingemarsson therefore made a conscious decision to invest most of his efforts in developing teaching methods. Once again, he took a different path from that of his faculty colleagues. By now his wife's career had become a major pedagogical inspiration. She taught at the Health University in Linköping (*Hälsouniversitet*), where entire programmes were structured along the lines of problem-based learning, PBL. A few years after being introduced to the method, Ingemarsson decided to try it out in his own teaching within engineering education.[551]

He gave the first PBL course in 1990. Three years later, the Government's council for the renewal of undergraduate education announced funding for reform projects, including PBL, the FGIP initiative analysed in Chapter 4. Two decades after setting up the Y-programme, Ingemarsson repeated the process by developing the IT programme, now applying problem- and project-based learning. Decades later he proudly recollects the programme's first years. It successfully integrated new pedagogics and, at least initially, attracted a gender-diverse student body. A few years after its launch, Ingemarsson requested the project manager position for the new national reform programme, Project NyIng. After some initial persuasion, his dean Mille Millnert, gave in and approved the post. But Millnert also expressed concerns regarding Ingemarsson's research contributions and his doctoral student supervision responsibilities. There was a reason for this. By now, Ingemarsson had essentially abandoned his own research ambitions. From 1993 and until his retirement in 2005, Ingemarsson held several distinguished positions in terms of pedagogical development in higher education: project manager of the IT programme within the Five Gender-Inclusive Projects initiative, project manager of Project NyIng and, from 2000, head of administration within the Government's council for the renewal undergraduate education, the council that funded Ingemarsson's proposal for the new IT programme in the first place.[552]

Lecturer (*universitetsadjunkt*) Kent Hartman was the second person to be appointed to the project management group.[553] As the enthusiast behind a recently inaugurated laboratory designated for students only, Hartman was well-known within Linköping University leadership. In Laboteket, his vision of a student-only laboratory had

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551 Interview with Ingemarsson.

552 Ibid.

553 Interview with Hartman. See also Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*, 2. "Presentation of the project leadership" in invitation to "idea conference", in the private archive of Hartman.

materialised. Here, students could familiarise themselves with technological equipment without the time pressure of 4-hour lab as part of their course.[554] Hartman had a T4 education diploma (a former upper secondary school engineering diploma) and his practise-based view of engineering, his outspoken scepticism towards the extensive scientification of engineering curricula and his unconventional perspectives on multiple "exits", i.e. types of degrees, at universities of technology was attractive to university leadership. The universities of technology would not just produce professional engineering graduates, Hartman visualised, but teachers, librarians and journalists as well. The flexible programmes would attract more students to these institutions and hopefully also to engineering.[555] His visions would become central to Project NyIng's final proposals. As a member of the project management team, Hartman would push for raising awareness about engineering as being intimately linked to the arts. Rather than the mathematical equation, he argued for the centrality of the artefact, the physical object, in engineering education.[556]

In an interview two decades later, project manager Ingemar Ingemarsson refers to Kent Hartman and himself as the enthusiasts "with the wild ideas that had to be tamed by the project group".[557] A priority for Ingemarsson – in developing the IT programme in the past and in Project NyIng – was an interdisciplinary project team structure. Instead of the typical male-only, engineering-only constellation, Ingemarsson requested diverse professional skills and backgrounds. He was keen to involve both men and women. And certainly, according to engineering standards, the NyIng project group was an unorthodox constellation. In this sense it more closely resembled the public commissions normally appointed to oversee and draw up proposals for large-scale reform. Ingemarsson vividly retells how he and Hartman selected the project team members. With no rigid guidelines from above to observe, the two enthusiasts prepared a list of suggestions for possible candidates, prioritising a variety of skills and experience. First and foremost, Ingemarsson wanted a trained pedagogical scholar in project leadership. To this end, he recruited Håkan Hult, Associate Professor in Pedagogics. Hult was involved in training university educators, but had no previous experience from a university of technology.[558]

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554 Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning* , Chapter 7.

555 The same argument is raised in Sverker Sörlin, *Universiteten som drivkrafter: globalisering, kunskapspolitik och den nya intellektuella geografin* (Stockholm, 1996), 124–125.

556 Interview with Hartman.

557 Interview with Ingemarsson.

558 "Presentation of the project leadership".

In collaboration with Kent Hartman, Håkan Hult was elected as the second executive member (*verkställande ledamöter*) in the project organisation. Four more members were appointed to fill the remaining spots on the team. Åke Frisk, former head of administration at Linköping University, was just about to retire. According to Ingemarsson, his deep knowledge of the university's structure made him a suitable candidate to include on the team. The project team, which would meet weekly, gathered three more individuals, two women and one man: Swedish language scholar Karin Mårdsjö, with whom Ingemarsson continued to work on several occasions after Project NyIng; industry representative Helén Trolle; and Professor in Machine Building Karl-Olof Olsson, who had a special interest in practical learning.[559] While he was concerned about the balance between men and women in the project team, the male majority reveals that to Ingemarsson, passion and disciplinary background, rather than gender, were the decisive factors. The interdisciplinary nature came to permeate project workshops, conferences, publications and the proposed measures for future curricular reform.

A CURRICULUM FOR THE MODERN ENGINEER

Overall, Project NyIng reached a few hundred individuals. Most of them were professional engineers and engineering faculty members, but people outside engineering also got involved. Conferences and project management presentations became the main outreach channels. Ingemarsson and Hartman travelled the country talking about their work with university administrations and faculty.[560] To reach the largest possible audience, the project team also announced open calls for small-scale reform projects. Some engineering faculty members thus ran local projects and published their results as project reports. The national conferences that took place aimed to rethink the overall educational structure and to share information on ongoing efforts. The scope was broad and no area was sacred enough to be left untouched. The length of degree programmes, the curricular structure, subjects included, teaching methods – anything directly relating to education was up for reconsideration. The project challenged one professional norm after another.

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[559] Interview with Ingemarsson; interview with Hartman. Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*, 175, and Chapter 7 on Olsson's technical workshop "Mekoteket".

[560] The conferences are shortly summarised in Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*, 176–177. Additional conference material in the private archive of Hartman. The conferences gathered between 20 and 130 participants. On travels see interview with Hartman.

It is however worth noticing that student culture was left untouched, despite the growing critique among gender scholars studying engineering profession and education.

Several publications, short reports and more voluminous edited texts summarised the intellectual output of Project NyIng.[561] The extent to which these publications reached engineering faculty members is difficult to evaluate at this stage. While faculty in the humanities and social sciences departments at universities of technology knew about them, those in traditional engineering departments have not mentioned them during my years of work on this thesis.[562] The topics addressed by the project management team in the project's final report showed their core concerns: the limited flexibility of existing engineering curricula and the need for pedagogic and curricular renewal, work experience, incorporating the social aspects of technology, engineering as art and practice and gender diversity in engineering education.[563] At the time, young students, often fresh out of upper secondary school, had to choose a professional career path from day one of their time at a university of technology. Switching between different engineering programmes and degrees was complicated and costly in terms of the number of years of study. A priority within Project NyIng was therefore to limit the large variety of 3-year and 4.5-year engineering programmes available and instead introduce open entrances and, especially, multiple exits.[564] Aligned with Kent Hartman's ideas, students would not have to choose a subfield, or even a career path, until after a few years into their education. This structure was already in place in Germany and Denmark. All students would start their degree in the same way and then they would choose a degree and an engineering subfield or, in the project's most utopic vision, have the option to choose another technology-based career path e.g., teaching, journalism or archival studies.[565]

This structure was expanded on under the working name X-IT.[566] But judging from the internal minutes, university management found the multiple exit strategy too bold. In

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561 The published output of the project was a final report written by the project group, two edited volumes discussing the role of the engineer and engineering work in society and 19 smaller reports.

562 I have not conducted any specific study to investigate this situation. The conclusion is based on informal conversations with engineering faculty at Chalmers and at a few other universities of technology.

563 Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*.

564 Ibid., 6. Nationally, 60 different 3-year programmes and 32 4.5-year programmes were offered. In the 6 years between 1992 and 1998, the number of different 4.5-year programmes had grown from 15 to 32.

565 Ibid., 7–8, 29–32.

566 The private archive of Hartman.

the final publication, the prior discussions are reflected in the name change; the new structure was not called X-IT, but the Y-model. The Y-model had one foundation with two "exits" – the 3-year engineering programme and the 4.5-year engineering programme. Other possible exits, or degrees, were mentioned, but not elaborated on further.[567]

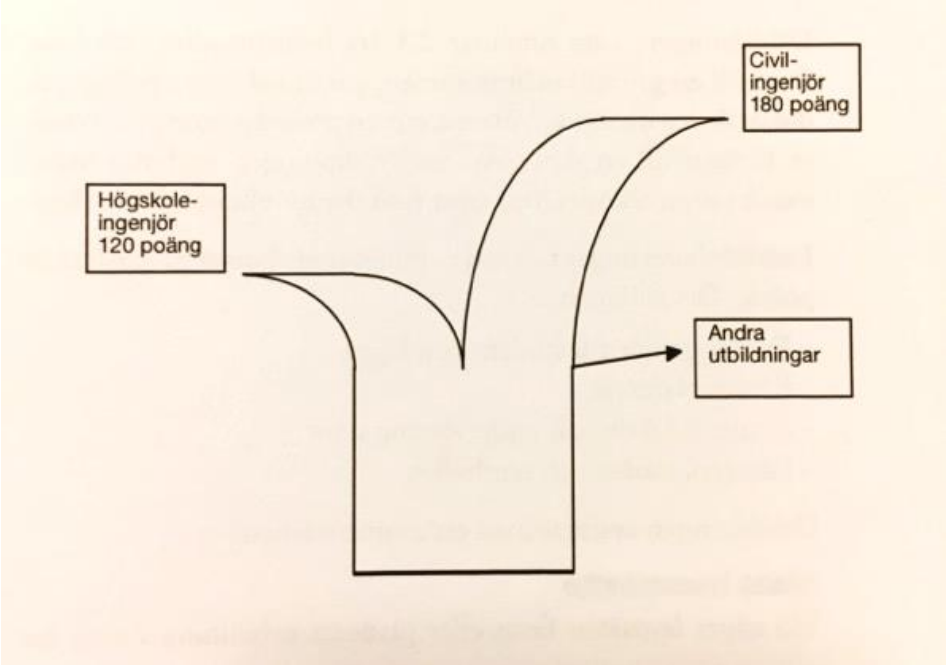

Figure 5.1. The "Y-model". In Ingemarsson and Björck, eds., Ny Ingenjörsutbildning, 30. A shared programme start could either lead to a 3-year (120 higher education credits) engineering degree, a 4.5-year (180 higher education credits) engineering degree, or a professional degree other than engineering. Reprinted with permission of the editors.

In the proposal, humanities and social science perspectives on technology and engineering would be a significant aspect of the engineering programme right from start. Courses would be taught according to project- and problem-based principles. The students would be offered engineering sciences blocks, preferably with the necessary mathematics and natural scientific theory integrated, instead of having to take several separate courses during their first years at the university. Of critical concern to project management was the fact that the "scientification" or "academic drift" of engineering curricula had limited the practical aspects of engineering education over the course of the twentieth century.[568]

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[567] Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*, 29–32.

[568] The relationship between the older T4 upper secondary school diploma and the newer 3-year engineering degree was discussed in the final report and in two smaller project reports; Jonathan Harwood, "Understanding academic drift: On the institutional dynamics of higher technical and professional education", *Minerva* 48, No. 4 (2010): 413-427.

The project addressed the practical aspects of engineering in various ways. Several project reports and chapters in published edited volumes highlighted the close links that had existed between the arts and engineering.[569] Engineering owed just as much to fine arts and design thinking than to natural sciences and mathematics – perhaps ever more. Project management seemed united in their opinion that science and mathematics had been placed at the centre of engineering curricula for no justifiable reason. A renewed curriculum needed to reconsider such hierarchies. The project team had a number of influential supporters in this area. The most prominent among them was Vice-Chancellor Anders Flodström who questioned that physics had to be understood fully before the physical properties of materials. He did not believe that "God created physics before materials".[570] The project management team also referred to the ideas of Jan Hult, Professor in Mechanical Engineering at Chalmers, who argued that it was time for the engineering sciences (*teknikvetenskaperna*) to have the same status as natural sciences in the curriculum.[571] This would not only be positive from a learning perspective but would free up space on the curriculum for the increasingly important humanities and social sciences aspects.

To project management, including humanities and social sciences aspects in engineering education was imperative to producing the Modern Engineer, an engineer for the twenty-first century. In fact, this theme was important enough for a separate edited volume to be produced.[572] Building on lessons learnt at Chalmers, which had established a Human – Technology – Society Centre back in the 1980s referred to as the MTS Centre (*centrum för människa, teknik, och samhälle*) Project NyIng stressed that "the meeting between the two cultures" was critical for the Modern Engineer.[573] Not only their professional engineering role but also their civic role in society would benefit from a broadened education. It was not sufficient for an engineer's professional toolbox to consist merely of technical skills. The job market for engineers was increasingly requiring different skillsets. Project NyIng highlighted communication skills – both oral and written – as critical to the work of the Modern Engineer. But universities of technology should also

569 E.g. Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning,* 107 ff.; Jan Sjögren, "Konstnärliga och praktiska inslag: erfarenheter och visioner", in *Människa, teknik, samhälle i högre teknisk utbildning*, ed. Karin Mårdsjö (Linköping, 1998).

570 Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning,* 36.

571 Ibid.

572 Mårdsjö, ed., *Människa, teknik, samhälle i högre teknisk utbildning*.

573 Ibid., 6.

educate students for citizenship. For this reason it was not just engineers who should have a say in the structure of engineering education, but stakeholders from other parts of society as well.

To this end a conference was organised during the early stages of Project Nyling to assemble and determine on how to move forward.[574] Industry representatives as well as journalists, authors, and other social commentators were invited to attend. One of the keynote speakers was Bishop Emeritus Martin Lönnebo, an example of how the multidisciplinary ambitions permeated the project. Lönnebo rewarded the project initiative by flirting with the audience, stating: "I like technicians, because humanities scholars are sometimes befuddled (*flummiga*)".[575] A relevant question at this point is how the plethora of proposed reforms aligned with the gender equality ambitions of the project? It is fair to say that many proposed measures were based on the project management's ideas on educational quality rather than on gender equality. An underlying assumption was still that raising overall educational quality and modernising the curriculum would draw both men and women into engineering education. At Chalmers the Project D++ team published its final report the same year as Project NyIng published its concluding report. They made a similar argument: what was good for women was good for all.[576]

Project NyIng's engagement with the gendered aspects of engineering education did, however, reach a new level compared to prior Swedish engineering reform projects. Katarina Ek-Nilsson's call for gender analysis at the 1995 "idea conference" arranged by the Ministry of Education was echoed to some extent. While not involving professional gender scholars in the project management team or even in the project group, project management consulted such scholars to review the literature on behalf of the NyIng project. In addition to a growing body of research on gender, science and engineering in Sweden and abroad, this can be related to specific institutional developments at the Swedish universities of technology, and also in particular at Linköping University.

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[574] Project group meeting minutes and conference documentation in the private archive of Hartman.

[575] "Idea conference, 22–23 Oct. 1997, some quotes", private archive of Hartman.

[576] Jansson, *D++ Projektet* (1998).

GENDER ANALYSIS ENTERS THE UNIVERSITY OF TECHNOLOGY

Among Swedish and Anglo-Saxon scholars, the second half of the 1990s saw a flood of studies on gendered engineering. They included stories of "hidden" female engineers and analyses of engineering's male heritage and perpetuation of masculine norms. Studies within the Swedish context included monographs, edited volumes, doctoral theses and master's theses. Boel Berner's *Sakernas tillstånd*, published about 15 years after her doctoral thesis on the content and ideological grounds of engineering, examined historical gender and class dimensions at universities of technology and the lower level engineering colleges.[577] Berner's analysis of male homosocial professional relationships became influential in national and international research. Anna Karlqvist wrote a master's thesis at KTH on women's entrance and the subsequent obstacles they faced in university engineering education over the twentieth century.[578] Gender and class aspects also dominated Katarina Ek-Nilsson's doctoral thesis, an exploration of professional engineers' biographies.[579] Ulf Mellström's doctoral thesis, an ethnographic study on the life trajectories of engineering graduates, included gender analysis.[580] Minna Salminen-Karlsson completed her doctoral thesis analysing the Five-Gender Inclusive Projects initiative at Chalmers and Linköping University (see Chapter 4).[581]

Studies of this kind grew in number beyond Sweden's borders. Historians increasingly highlighted the gendered histories of science and technology. The well-renowned science history journal *Osiris* published a special issue on gender and science in 1997. In it historians of technology in the US such as Ruth Oldenziel and Nina Lerman contributed articles on the gendered history of technology. Only two years later, in 1999, Ruth Oldenziel published *Making Technology Masculine*, a book that would become a trendsetter for decades to come in scholarship on gender and engineering. In 2000, the edited volume *Crossing Boundaries, Building Bridges* was published by an international community of historians of technology interested in the various national histories of female engineers. In it Berner gave her account of male Swedish engineering education in the late nineteenth and early twentieth centuries. In parallel and adjacent to this area of

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577 Berner, *Sakernas tillstånd*; Berner, *Teknikens värld*. In the early 2000s, and at a rapid pace, Berner continued with a number of publications on the gendered dimensions of science and engineering. Berner, *Vem tillhör tekniken*; Boel Berner, *Ifrågasättanden: forskning om genus, teknik och naturvetenskap* (Linköping, 2004); Berner, "Educating Men".

578 Karlqvist, *Från eftersatt till eftersökt*.

579 Ek-Nilsson, *Teknikens befäl*.

580 Mellström, *Engineering Lives*.

581 Salminen-Karlsson, *Bringing Women into Computer Engineering*.

history, the feminist branch of science and technology studies, FTS, grew. Publications that gained widespread respect from this period included work by feminist technology scholars Judy Wajcman and Wendy Faulkner.[582]

The growing number of publications was, however, not the only academic novelty. Swedish universities of technology established professorial chairs and research groups in gender and technology. In 1993 Luleå Technical University established a professorial chair in Gender and Technology.[583] As such, it was the first university in Sweden (technical and non-technical institutions included) to establish a research chair, and a research school, in gender studies. Blekinge Technical University installed a chair combining IT and gender research. Both chairs were the outcome of strategic initiatives by the Minister of Education in 1993 and 1996, the latter often referred to as the "Tham professors".[584] Another example is Linköping University where thematic divisions were established back in 1980.[585] In the 1990s, *Tema Teknik* (Technology) housed interdisciplinary researchers such as Boel Berner, Ulf Mellström and Minna Salminen-Karlsson.[586]

According to science historian Londa Schiebinger, this type of institutional development is important for gendered knowledge to make a difference to engineering and engineering education. In her 1997 contribution to the *Osiris* journal, Schiebinger emphasised the problems inherent in gender equality policies in science and technology.[587] The body of knowledge from scholars of gender in science and technology had grown substantially over the last two decades. However, a disturbing lack of communication between social science scholars on the one hand and science and engineering faculty and educators on the other halted any substantial practical changes. Furthermore, a few years later, Minna Salminen-Karlsson concluded from her participatory studies at Chalmers and Linköping University that external gender scholars would most likely face problems of being accepted by engineering faculty. To many engineering faculty members, qualitative research was not valid as objective science. As already noted in Chapter 4 this presented

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[582] References in this thesis Chapter 1, sub-chapter "Previous Research".

[583] Trojer, *Genusforskning inom teknikvetenskapen,* 19. Personal communication with Trojer.

[584] Ibid. See also Maria Törnqvist, *Könspolitik på gränsen*.

[585] "History of Linköping University". The establishment of *Tema Genus* was announced by the Ministry of Education at the same time as it announced funding for Project NyIng in 1996. Press communication in the private archive of Hartman.

[586] Salminen-Karlsson belonged to a different department at the university, but discussed her work with scholars from *Tema*, see her acknowledgement in *Bringing Women into Computer Engineering*. Mellström participated in NyIng's start up conference, the small idea conference in Oct. 1997, private archive of Hartman.

[587] Schiebinger, "Creating Sustainable Science".

a paradox: for gender equality reform to take place, external qualitative knowledge on gender dynamics was critical. At the same time, external qualitative scholars were likely not to receive the necessary authority. It was thus critical to establish gender research *within* the university of technology.[588]

In this sense, Project NyIng was progressive. By involving qualitatively oriented humanities and social sciences scholars to review the literature and suggest a way forward, a bridge was being built. While engineering faculty members wrote many of the project publications, the edited volumes assembled social sciences and humanities scholars associated with universities to various extents. Around 10-15 percent of the project publications focused entirely on gendered analysis.[589] Minna Salminen-Karlsson, who at the time was following the progress of Project D++ at Chalmers and the new IT programme at Linköping University (Chapter 4), wrote two reports for Project NyIng. The first was a shorter unpublished report from a two-day WEPAN (Women in Engineering ProActive Network) working session in London on how to recruit more women into engineering.[590] The second, which was the most comprehensive NyIng report of the 19 published, was entitled "How to teach women engineering students". It was a review of the research literature on gendered pedagogy in engineering education.[591] In addition to Salminen-Karlsson's reports, Fredrik Palm reviewed literature on the reasons for women's underrepresentation in engineering education.[592]

Palm's report argued that image was not the only reason why women were opting out of engineering and came to three conclusions. First, the problems of women's limited representation were "many, complex and strongly linked".[593] Several obstacles that were far from arbitrary interacted to direct women's interests away from engineering. Second, the most important aspect for educators to consider was to remove problems *within* engineering education, mainly in the form of informal structures. Changing only formal structures would not do the trick. Finally, the report argued, the view of women as a problematic group making the wrong choices needed to end immediately. Palm stressed that this view had no truth to it. Research had found that the reasons why women rejected

588 Salminen-Karlsson, *Bringing Women into Computer Engineering*, 239.
589 A few additional contributions discussed gender aspects of their topics in indirect ways.
590 The private archive of Hartman.
591 Salminen-Karlsson, *Att undervisa kvinnliga ingenjörsstudenter*.
592 Ibid; Palm, "Det är inte bara image"; the reviews by Salminen-Karlsson and Palm were also summarised in Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*.
593 Palm, "Det är inte bara image", 27.

engineering education were both relevant and real.[594] In the same way as Salminen-Karlsson's analysis of Project D++ at Chalmers and the IT programme at Linköping University, as well as Londa Schiebinger's call for communication over disciplinary boundaries, Palm's advice largely escaped engineering educators in the new millennium. This is further discussed in the concluding Chapter 6.

A SHORT HISTORY OF INTEGRATING THE HUMANITIES

The 1990s reform projects were by no means the first initiatives – neither in Sweden nor internationally – to express ideas on a broadening engineering education. There is historical background to Project NyIng, just like the earlier Five Gender-Inclusive Projects initiatives.[595] Engineering education had close ties with private industry from the start, but since the nineteenth century professional engineers have occasionally also highlighted technology's social values. What these social values entailed and how they should be incorporated into the engineering curriculum varied.

From the early 1800s, the Swedish State bureaucracy established technical colleges and other educational institutions in the vicinity of emerging Swedish industries. Their purpose was to provide factories and workshops with skilled labour. Svante Lindqvist argues that what became the Swedish higher technical education system should be understood as something inherently different to the established university system, i.e. a critical part of Swedish industrialisation.[596] In stark contrast to the universities, which educated people for positions within the bureaucracy, trained engineers were from the start intimately linked to industry or the military.[597] Still, since the creation of the engineering professional elite in the late nineteenth century, individual engineering educators have highlighted the importance of the social responsibility of engineers rather than any national or industrial obligation. The focus on a "scientific" curriculum and a broader range of courses to secure the *Bildung* central to being a "gentleman" was at the

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[594] Ibid., 27.

[595] Björck, *Chalmers, staten och vetenskapen*; Henrik Björck, "Teknisk bildning och bildade tekniker", in *På spaning efter teknisk bildning*, ed. Åke Ingerman et al., 1. ed. (Stockholm, 2009); the "vice-chancellors' battle" at Chalmers in Svante Lindqvist, ed. *En pizza technologica och en sexa humaniora: pressdebatten kring rektorsvalet på Chalmers 1983* (Stockholm, 1985); Marie Arehag and Tor Kihlman, "MTS vid Chalmers – idéer och utveckling", in Mårdsjö, ed., *Människa, teknik, samhälle i högre teknisk utbildning*; Per Jacobsson, *Den bildade ingenjören: bildning, utbildning och teknik*, 1. ed. (Lund: Studentlitteratur, 2019), 33 ff. For the international context see e.g. Seely, "Patterns in the History of Engineering Education Reform".

[596] Lindqvist, "Ideology and Institutional Structure", 184–185.

[597] This thesis Chapter 2.

centre of engineering debates in the second half of the nineteenth century when engineers strived to raise their professional status. The transformation of the Technical Institute in Stockholm to a university in the 1870s institutionalised these ideas.[598]

The debates on engineering *Bildung*, or technical literacy, continued throughout the twentieth century, although often overshadowed by the dominant industrial-modern narrative.[599] Historians often refer to a committee, *Kommittén för humanistisk orientering vid teknisk utbildning* (Committee for the humanities in technical schools, that existed between 1943 and 1964 and aimed to promote the humanities perspectives in technical education.[600] Although the committee initially focused on upper secondary education, its visions and debates spread to the engineering universities. These aspects being increasingly placed on the agenda in the 1970s was intimately linked to other social movements. As noted by technology historian Maja Fjæstad, growing criticism of technology in Swedish society was problematic for the engineering community as early as the 1960s.[601] The environmental, peace and women's movements were united in their criticism of technology. In internal discussions and also in external communication, engineering associations had to balance their own technocratic visions with the urge to stay professionally relevant in a changing social environment. In the late 1970s, social movements were no longer only an external concern. A new generation of engineering faculty brought them into the higher technical education system.

In 1979, a Chalmers professor called Tor Kihlman arranged a conference on the theme of "Technology for a Moderate Society" (*Teknik för ett lagom samhälle*).[602] The conference focused on technologies used in our daily lives, such as in food, housing and various kinds of personal transportation, including the bicycle. In 1983, the Chalmers Vice-Chancellor at the time, Sven Olving, was challenged by Kihlman who aimed to

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598 Ibid.

599 See Björck "Teknik och bildning i begreppshistorisk belysning" and Burman, *Pedagogikens idéhistoria*, for a historical exposition of the Swedish concept of *bildning*.

600 The committee was first explored by Gunnar Richardsson in 1987 in *Tekniken, Människan och samhället*. His study is recapped in: Björck, "Teknisk bildning och bildade tekniker", 242 f, 251 f; Ann-Sofie Axelsson, "Bildning i den tekniska högskolan", in *På spaning efter teknisk bildning,* Ingerman et al., eds.; Jacobsson, *Den bildade ingenjören*, 33 ff.; Arehag and Kihlman, "MTS vid Chalmers – idéer och utveckling"*,* 14 ff.

601 Maja Fjæstad. "Ingenjörerna och miljön: Profession och debatt i Svenska Teknologföreningen 1965–1972", *Scandia* 82, No. 1 (2016).

602 Tor Kihlman, ed., *Teknik för ett lagom samhälle: en rapport från en konferens på Chalmers tekniska högskola den 9-10 februari 1979* (Gothenburg, 1979). Translating *lagom* is difficult, as it is intimately linked to Swedish self-image and culture. "Good enough" is perhaps the most correct translation.

introduce social aspects of technology into the engineering curriculum. Contemporary commentators referred to the process in media as "the vice-chancellors' battle".[603] Defeated by Olving, Kihlman was instead elected Pro-Vice-Chancellor and immediately given a mandate to launch the Human – Technology – Society Centre, CMTS (*Centrum för Människa – Teknik – Samhälle*).[604] The issues raised at the conference, and at the centre, would increasingly gain ground at the Swedish universities of technology in the coming decades.

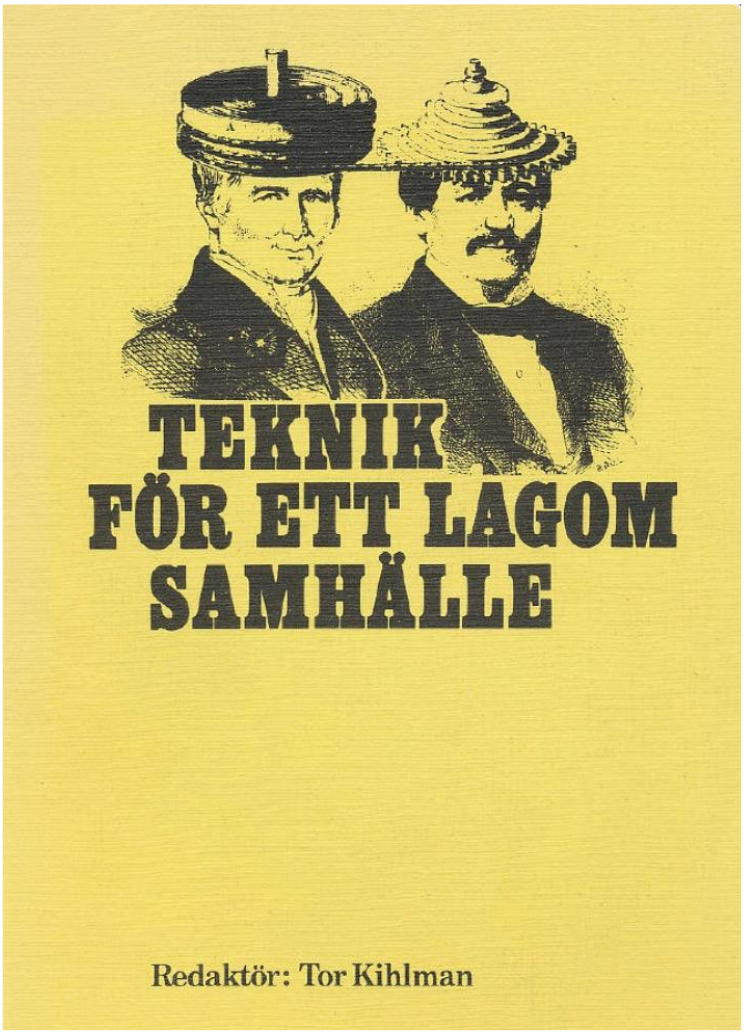

Figure 5.2. Front cover of conference proceedings "Technology for a moderate society". Kihlman, ed., Teknik för ett lagom samhälle.

[603] Lindqvist, *En pizza technologica och en sexa humaniora*; Axelsson, "Bildning i den tekniska högskolan", 227.
[604] Vice-Chancellor's office meeting minutes No. 43 1983/84, 20 June 1984, CTH C-archive, A1DA:3; Arehag and Kihlman, "MTS vid Chalmers – idéer och utveckling", 17.

At the start the CMTS overlapped with another, by now familiar, Chalmers unit. Chapter 3 examined how gender equality advocates at Chalmers were still struggling in the background at the university in the early 1980s. But one person, Christina Ullenius, took part in both arenas. In 1984 Vice-Chancellor Sven Olving appointed her to chair the Chalmers Gender Equality Group. In the same year Ullenius was appointed as a board member of the new CMTS.[605] In the years to come, she became more committed to the issue of gender inequalities as her position at Chalmers gained in strength. She broke the "glass ceiling" more than once, becoming the first woman ever to hold several influential positions at Chalmers. As noted in Chapter 4, she was one of the first women to sit on the Chalmers faculty council (*fakultetsnämnden*). In February 1987 she was appointed as Deputy Dean on the faculty council, the second-highest position in the Chalmers faculty hierarchy.[606] In the early 1990s she entered university management when she was elected Pro-Vice-Chancellor with responsibility to initiate renewal in undergraduate education. Social aspects in engineering thus not only became institutionalised at Chalmers through the new CMTS, but they also acquired representation in Chalmers management from the early 1980s. To Ullenius, gender equality and broadened education programmes would become intimately linked. Alongside this, Inga Alander, another important member in the Chalmers Gender Equality group worked on pedagogical development at Chalmers during the entire 1980s. When the computer science and engineering program board launched Project D++ (Chapter 4), her competence and experience was critical to the project management.

Although Chalmers was a forerunner, similar processes had taken place at other universities of technology as well, with varying results.[607] Within the technical faculty at Luleå University, mandatory non-technical courses had been discussed and tried out since the 1970s. By the 1990s they had been added to a pool of elective courses. In the engineering programmes at Linköping University, courses in communication had been mandatory for a few years. In addition, engineering students were offered a range of elective courses in ethics, history, theory of science and leadership.[608]

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[605] Ibid. (meeting minutes).

[606] Chalmers Board meeting minutes 23 Feb. 1987, CTH C-archive, A1AA:6.

[607] See Mårdsjö, ed. *Människa, teknik, samhälle i högre teknisk utbildning*. On Chalmers as predecessor, see Arehag and Kihlman, "MTS vid Chalmers – idéer och utveckling". Seminar series were initiated at several univerisities of technology, see e.g. Per Jacobsson, ed., *Ingenjören , vetenskapen, värderingarna: seminarieserie på KTH våren 1988* (Stockholm, 1988).

[608] Ingemarsson and Björck, eds., *Ny Ingenjörsutbildning*, 67–68.

Looking across the Atlantic, similar discussions have a strong tradition in the US engineering education system. The outcome of the discussions have however varied with time and place. Historian of engineering Bruce Seely argues that since the year 1900 there has been a constant focus on broadening engineering education in the US to include humanities and social sciences, often discussed under the heading of the "humanistic stem" in contrast to the "technical-scientific stem" (in the sense of humanistic "track", not to be confused with the later abbreviation STEM – science, technology, engineering, mathematics).[609] The historical reasons for doing so have largely shifted. US-based engineering education reformers have stressed the need for a liberal arts education to raise the professional status of engineers. They called for the inclusion of economics courses to contribute to the profitability of corporate employers or to save the economy in the years after the Great Depression. Some saw the need to promote democratic values to combat the lurking communist threat in the interwar years. Others created courses in the history of science and technology to highlight prominent engineering role models, but also to inculcate the importance of technical development for social development. In the post-war years, which were dominated by intensive criticism of technology among the public after the atomic bombing of Hiroshima and Nagasaki, reformers emphasised the need for ethical perspectives in technical development.

Before the 1950s, US engineering universities and colleges launched large-scale reform programmes and inventory reports. The Carnegie Plan of 1936, the Hammond Report of 194 and the Lewis Report at MIT in 1947 are all examples of these types of programmes and reports. The Carnegie Plan was a response from the President of the Carnegie Institute of Technology, Pittsburgh, to the challenges of the Great Depression. His recipe was curricular reform that increased humanities and social sciences content with the intention of fostering a sense of urgency for continued technological development.[610] The Hammond Report from 1940 coined the term "humanistic STEM". The report author(s) noted that since engineers "frequently entered management and assumed duties outside the realm of technical decision-making, courses in the liberal arts were clearly important to their success".[611] In the Lewis report, conducted at MIT just after the end of WWII, chemistry professor and report author Lewis emphasised the importance of social and ethical aspects of engineering education. Technology historian

[609] Seely, "Patterns in the History of Engineering Education Reform". See also Wisnioski, *Engineers for Change*.
[610] Seely, "Patterns in the History of Engineering Education Reform", 123.
[611] Ibid., 121.

Rosalind Williams, Professor Lewis' granddaughter, has described at length her grandfather's deep commitment to serving the community.[612] Indeed, at MIT the humanities and social sciences became integral parts of engineering curricula.

A LOST MOMENTUM?

Project NyIng, as well as the Five Gender-Inclusive Projects initiative examined in Chapter 4, were national examples of an international trend. Through conferences on engineering education as well as on gender in higher education, engineering education reformers collected evidence to support their reform goals. A professionalisation process for actors interested in the development of engineering education had begun through conferences and journal articles. The emerging international fields of engineering education research and gender in higher education, integral also to the FGIP initiative, provided research results to back up the project groups' ambitions.[613] The *reform logic* thus matured in the 1990s but it was also split into different fractions. The NyIng ideas were but one course of development. Another movement which would soon gain in strength was CDIO (conceive, design, implement, operate). The pedagogical concept was developed by aeronautic engineering faculty at MIT in the mid-1990s and soon adopted at both KTH and Chalmers. Twenty years later, CDIO would dominate the teaching at these two universities. However, in the words of former KTH and Linköping University Vice-Chancellor Anders Flodström, while NyIng represented a social movement for fundamental change, CDIO was more about "following a pedagogical manual".[614]

Influences from Project NyIng and earlier projects would impact universities of technology in more indirect ways. In the twenty-first century, Swedish engineering education, the values of the NyIng reformers and the "human–technology–society" movement have been expressed at seminars and in compulsory courses, in divisions or departments of social sciences and technology, as well as in interdisciplinary engineering programmes such as STS engineering and programmes that provide engineers with a double degree, for example in engineering and upper secondary school teaching. Several

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612 Most extensively in Williams, *Retooling*, Chapter 1.

613 Bertil Svensson (Chapter 4) participated in conferences on engineering education research. On the field, see the introduction to Aditya Johri and Barbara M. Olds, eds., *Cambridge Handbook of Engineering Education Research* (Cambridge, 2014). European conferences on the theme of gender in higher education have been arranged since the 1990s. See also Oskar Hagvall Svensson, *What's Wrong with Engineering Education? Comparing and Combining a Teaching-Problematization and a Culture-Problematization* (Gothenburg, 2021).

614 Interview with Flodström; Williams, *Retooling,* 51, 210.

new programmes have been developed which lean on the practical aspects embedded in Project NyIng. KTH reformed its civil engineering programme in 2008, changing name from civil engineering to the built environment. It also extensively reformed the curriculum, one of several examples of reforms at Swedish universities of technology since the year 2000.[615] Other universities of technology followed suit. Some created degrees for upper secondary school teachers, often by combining engineering and teaching in one degree. At Uppsala University, progressive engineering educators created a engineering degree combining humanities, social sciences, and engineering in the late 1990s. Twenty years later the Sociotechnical Systems Engineering programme is popular among applicants.[616] Several universities run programmes in technical or industrial design. The curriculum of these, which are closely linked to the practical, artefactual and artistic aspects of engineering, is in line with the ideas promoted by NyIng. The reformed or newly created curricula mentioned above are attractive to students of any gender. To former Vice-Chancellor Anders Flodström, the legacy of NyIng and the social movement that it was an expression of can be found in the currently required "soft skills" in engineering education and in the engineering profession. This applies at Swedish and at European universities of technology.[617]

Project NyIng is thus perhaps best understood as an expression of the *reform logic* gaining national momentum. Curricular reform for gender equality and educational quality had, by the mid-1990s, become hegemonic in Swedish STEM educational policy. In contrast to images of the engineer as a (male) elite individual – the lone brilliant inventor, the successful industry leader, the entrepreneur, Project NyIng represented a different notion: the possibility, and necessity, of policies and engineering education for citizenship and service to the community. While the dominant strands of 1990s' Swedish state policy emphasised minimal state intervention, Project NyIng, as well as the earlier Five Gender-Inclusive Projects initiative (Chapter 4), represented a different conviction.[618] A stream of

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[615] "V och L läggs ner", Byggindustrin (e-journal), https://www.byggindustrin.se/affarer-och-samhalle/bygghistoria/v-och-l-vid-kth-laggs-ner/, retrieved 17 Dec. 2021. The Department name is still Architecture and Civil Engineering (ACE).

[616] "Master's programme in Sociotechnical Systems Engineering", https://www.uu.se/en/admissions/master/selma/program/?pKod=TST2Y, retrieved 22 Jan. 2023.

[617] Interview with Flodström.

[618] For large-scale state-run programs in the 1960s and 1970s see Sörlin and Törnqvist, *Kunskap för välstånd*, and Benner, *Kontrovers och konsenus*, regarding sectorial research funding agencies (*sektorsforskning*).

commentators has since the 1990s discussed the idea of a broadened engineering education in terms of technical *Bildung*.[619] Large-scale STEM reform initiatives sponsored by the Government in this direction would not be repeated in the coming decades. In retrospect, the 1990s therefore looks like as a period of utopia and bold action in terms of engineering reform visions.

Why did these visions – this *reform logic* – gain momentum in Sweden in the final years of the twentieth century? The explanation is complex. It certainly depended on engineering educators who came of age in the 1960s and 1970s – a time of radical politics – and who found themselves in influential positions in the 1990s. It was also a decade in which previously separate trajectories at the universities of technology merged. Calls for gender equality, pedagogical renewal and incorporating the social aspects had, before the 1990s, been made in separate arenas. In the 1990s engineering actors saw that these goals could be productively combined. In their internal and external communication, *quality* became the obligatory passage point.

The funding was however heavily dependent on external factors. The Ministers of Education, first Per Unckel and then Carl Tham, perceived the universities of technology as the saviours that would carry the nation through the economic crisis. Expanding the higher education system, especially engineering education, could remedy high unemployment levels. This was the message of industry and it was the message of the cabinet. The funding for Five Gender-Inclusive Projects and for NyIng aimed to secure educational quality in times of expansion.

CONCLUSION

While aware of the curricular battlefield and the inertia connected to it, the Project NyIng reformers severely underestimated the difficulties associated with implementing comprehensive curricular renewal.[620] Although their values and ideas had support in both university management and among policymakers, their immediate impact on the engineering majority was limited. Their *professional boundary work* encountered solid

[619] Svante Lindqvist, "Teknik, bildning och kultur: den svenska ingenjörskårens förvandling', i *Bildningsgång*" (Stockholm, 1997); Åke Ingerman, Karin Wagner and Ann-Sofie Axelsson, eds., *På spaning efter teknisk bildning*, 1. ed. (Stockholm, 2009); Jacobsson, *Den bildade ingenjören*. See also Sörlin, *Universiteten som drivkrafter*, Chapters 4 and 7.

[620] In fact, there was yet no Swedish studies to grasp the magnitude of inertia, although the reformers had plenty of personal experience. Historian of technology Arne Kaijser only introduced his thoughts on the curricular battlefield in "Ingenjörer i takt med tiden?" in 1998.

professional norms. Most engineering programmes kept their century-old content and structure. Comprehensive change of existing programmes has proven difficult to achieve. Several factors explain this situation. First, the engineering curriculum issue is a battlefield for numerous stakeholders. Striving for position and status is a built into the system of these universities, thus reinforcing the battlefield. To engineering faculty and students, status in the 1900s and 2000s meant recognition by the industry. No other stakeholder has yet been able to compete with industry's promise of a professional career, high salary, and increasingly, also research funding. Project NyIng took much of its inspiration from new demands communicated by industry, but if industries kept hiring engineers who were educated in the traditional engineering curriculum, incentives for reform were limited.

The second aspect concerns the low status of teaching compared to research at universities of technology. Whereas innovative research projects likely brought in funding (and hopefully fame as well) through public research councils and private foundations, funding for educational renewal was not similarly forthcoming. Pedagogical development was less visible and usually carried out free-of-charge by dedicated faculty members. The Government's intention in setting up the council for the renewal of undergraduate education in 1990 (Chapter 4) was to create source of funding similar to the research councils. It was discontinued after about 15 years. No other institution took its place to reward innovative curricular development by providing public funding.

Finally, engineering faculty members have often expressed scepticism in the ability of the humanities and social sciences – like pedagogics and gender studies – to produce knowledge on a par with the natural and engineering sciences. This gap in outlook, and more importantly in what counts as valid professional knowledge, between the minority of elite reformers and the engineering majority was large in 2000. Twenty years later, many engineering faculty members are either ignoring such qualitative knowledge or expressing similar suspicion.

The tension demonstrated by the Chalmers "vice-chancellors' battle" of 1983, and at the Department of Computer and Electrical Engineering in 1993 (Chapter 4), had by no means dissipated. The engineering majority of the post-industrial era holds on to their conviction that universities of technology skills should primarily provide industry-specific technical knowledge. Other skills might be of use but are not essential to professional development. The *recruitment logic*, which stated that women's limited participation in engineering education stemmed from external factors, outside the universities' control, is thriving. The radicalised *reform logic* as expressed by Project NyIng, and previous MTS

actors, is complemented – or challenged, depending on perspective – by the persisting recruitment logic. These continuous acts of professional boundary work lead gender equality advocates of the twenty-first century in various, sometimes opposing, directions. The next chapter and the thesis epilogue elaborate on these parallel pathways.

6
Conclusions

This study interlinks two parallel phenomena: the development of Swedish engineering education and the engineering profession, and the evolution of a national, gender equality policy field. It examines how the engineering profession – represented by the universities of technology – from the mid-1970s, responded to the demands for gender diversity and reform, from both national policies and from within the engineering communities. The push to act went in two directions; national policies pressured universities of technology to take measures, and representatives from the engineering communities often shaped gender equality policies. How engineering educators steered definitions of gender equality and the corresponding solutions in directions that suited their professional needs – i.e. how they conducted *gender equality politics* – are at the heart of the analysis here. The thesis shows the gap between intended reforms and actual outcomes when engineering professionals responded to and navigated the policy requirements. Through the analysis of interpretations and activities, the thesis highlights the plasticity of the proud Swedish label of gender equality.[621]

The period in focus – the two final decades of the twentieth century – was marked by substantial political, economic and social change. To Swedish engineering graduates, it presented a new economic, social and professional status. Mass education, women's increasing enrolment, and the reorganisation of professional associations challenged old privileges.[622] In a political and cultural landscape where the authority of engineers was no longer guaranteed, the rhetorical claims from their representatives remained. Engineering representatives and industry leaders constantly reactivated century-old arguments in which engineering education at university formed the professional core. As such, they argued, it was also the basis for national competitiveness and economic growth. Education bureaucrats and members of parliament reinforced this message. Through acts of *professional boundary work*, engineering educators invoked gender equality for different reasons and in various ways. In this, they often succeeded in catching the Government's

[621] For previous research challenging this label see this thesis Chapter 1, sub-chapter "The Proud National Label of Gender Equality"; Martinsson et al., eds., *Challenging the myth of gender equality in Sweden*.

[622] The professional organisation STF merged with the trade union organisation CF in 1973–1974, which challenged old hierarchies. See e.g. Berner, *Teknikens värld*, 222.

attention. This thesis thus provides a new perspective on Swedish industrial modernity: it demonstrates how the hope placed on engineers as national saviours during economic turbulence, and the development of a national gender equality policy field were deeply interconnected.

The interplay between governmental and professional actors produced specific definitions of the problems and solutions relating to gender inequality. These were transformed over time. Chapter 3 analyses how the *recruitment logic* gained momentum in the early 1980s. Chapter 4 shows how an educational elite challenged that logic in the early 1990s, introducing ideas for curricular and pedagogical reform – reform that they argued would simultaneously increase educational quality and gender equality. The *reform logic* in turn developed over time: the first phase involved reform of science and university engineering programmes, specifically, curriculum and teaching methods.[623] The second phase institutionalised new research divisions integrating gender analysis and science, technology and engineering. The new research groups introduced methodologies, research topics and educational perspectives that differed from those at the traditional engineering research departments. To distinguish between these two rationales I will refer to them as *educational reform logic* and *research reform logic*. The three logics identified in this thesis – recruitment logic, educational reform logic and research reform logic – align well with Londa Schiebinger's "three fixes" in international policies for STEM diversity, outlined in Chapter 1: fixing the number of women, fixing the institutions and fixing the knowledge. The two overarching approaches – recruitment and reform – can be framed as individual and structural approaches, or as quantitative and qualitative.[624]

At first look, this schematic framing indicates a progressive, linear transformation of gender equality policies at Swedish universities of technology. However, from a gender analytical perspective, this was not the case. From the 1970s, the three arguments, or logics, existed in parallel to each other. In terms of development in the twenty-first century, these logics continue to co-exist this way.[625] I interpret the situation as constant, ongoing negotiation of professional boundaries. In negotiating the definitions and

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[623] This phase included the institutionalisation of Engineering Education Research, and the CDIO methodology. E.g. Williams, *Retooling*, 51, 210.

[624] Cecilia Svantesson outlines individual versus structural approaches in Svantesson, *Tjejer till tekniska utbildningar eller tekniska utbildningar för tjejer?*.

[625] I build this interpretation on 6 years' reading of contemporary engineering organisational journals such as *Ny Teknik*, technical university webpages, The Royal Swedish Academy of Engineering Sciences' (IVA) newsletter and daily national newspapers in a non-systematic but frequent manner.

solutions for problems relating to gender inequality, engineering graduates have succeeded in maintaining their professional status, privilege and power while simultaneously presenting themselves as dedicated to gender diversity. The three arguments were useful for different purposes. Over time, the engineering majority has favoured the recruitment argument. The recruitment logic and its underlying assumptions will therefore be explored thoroughly below.

The recruitment logic builds on a specific way of defining the problem, namely gender inequality as numerical imbalance, and individual women's "faulty" choices. To the engineering majority, the problem of gender inequality has always been quantitative, a problem that places the number of females represented at the centre. The problem is thus exteriorised, i.e. placed outside the university. At the same time, the technical universities' core activities of research and education, the basis of the professional status of engineering professionals, have been protected. Research focus, the programme curriculum, pedagogical methods, student culture and hiring processes – none of these were to be addressed according to the recruitment logic. By doing outreach work such as marketing campaigns, the engineering educators were at the same time imagining themselves fulfilling a professional ethical commitment: serving the community. But the recruitment logic has inherent problems when it is the sole means of explaining and solving gender inequalities. Ideologically it builds on the idea that women constitute a homogenous, and in some sense problematic – technophobic – group of potential students. Women are perceived as a "talent reserve" (*begåvningsreserv*) or a "competence resource" (*kompetensresurs*) for Swedish society, but with little motivation to study engineering. Women's educational choices must therefore be corrected through recruitment activities that inform them about the "fun" in technology and engineering studies. This type of logic directs attention in specific directions; it defines the problem in a way that produces specific solutions for it. It divides men and women into two distinct and separate groups, with men being "naturally" inclined towards engineering, and the "female engineering student" as "the other", the different one, a potential engineering talent *despite* her gender. It disregards the differences within groups of men and groups of women. The recruitment logic is also blind to intersectional perspectives that take into consideration other factors such as race, class, abilities, sexual orientations, gender identities, ethnicities and religion – aspects that deeply affect how individuals understand

themselves and are perceived by the world they inhabit.[626] It is ignorant about research on the co-construction of gender and technology, demonstrating that modern technology and large technological systems are coded as masculine, whereas technology such as sewing machines, irons and hairdryers are coded as feminine. The latter has traditionally been excluded from technological discussions and engineering education.[627] Still, the recruitment logic views technology as gender-neutral.[628] It thus places the burden of change on the "outsiders"; on the potential female applicants, rather than addressing internal subtle inclusion and exclusion mechanisms inherent in the masculine engineering culture.[629] This argument is optimal if the ambition is to keep the status quo in the profession. It does nothing that affects the professional core activities. If gender inequality is understood as a quantitative problem, and one that can only be solved outside the bounds of the profession, gender equality can be highlighted and celebrated as a professional goal.

The recruitment logic was not exclusive to the engineering profession. In the 1980s the gender equality and education ministers embraced this argument, although with more caution than the engineering majority. The cabinet argued that if women could be convinced that they had a place in the engineering and technology industries, they could secure their hard-won position in the job market (Chapter 3). If only more women entered engineering programmes at university, the high-status profession of engineering graduates would become gender-equal. But the cabinet ministers warned that the misogynistic environment at universities of technology and related industries might become a problem. Such insights did not, however, stop the Government from encouraging recruitment activities. On the one hand, in the early 1980s the Minister for Gender Equality Anita Gradin pushed for solutions based on the recruitment logic when she encouraged the universities of technology to build on previous recruitment models. At the same time, Gradin's "More Women into Industry" campaign required a focus on pedagogical

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[626] It does not reflect upon the (dis-)connection between an engineering worldview and student worldview as explored in Hansson and Lindahl, "Apropå Fuglesang". Crenshaw, *On Intersectionality*; Donna Riley, Alice L. Pawley, Jessica Tucker, and George D. Catalano, "Feminisms in Engineering Education: Transformative Possibilities" *NWSA Journal* 21, No. 2 (2009): 21–40.

[627] Lerman et al., *Gender and Technology*; this thesis Chapter 1, sub-chapter "Making Technology Masculine". See also Marçal, *Att uppfinna världen.*

[628] See this thesis Chapter 1, sub-chapter "Three Fixes: Women, Institutions, Knowledge".

[629] Wendy Faulkner, "Doing gender in engineering workplace cultures. II. Gender in/authenticity and the in/visibility paradox", *Engineering Studies* 1, No. 3 (2009): 169–189, 187.

development, but only in the science and technology lesson plans at secondary schools (year 7, 8 and 9). The universities of technology were asked to assist secondary school teachers to develop their classroom material but were not required to reform their own programmes. The university curricula were left alone. This was a measure that the universities of technology could accept, even embrace, as it did not affect professional status arenas. It was a matter of "fixing the number of women", and of *fixing the women*, transforming what were assumed to be technophobic girls into tech- and industry enthusiasts. This thesis suggests that a certain professional trait – the ideal of professional autonomy – prevented politicians from interfering more extensively. Professional autonomy, i.e. the freedom to apply professional knowledge without interference from non-professionals such as politicians, is one of the central norms upon which professionals have historically built their status – as individuals and as professional associations.[630] When professionals practise boundary work by invoking their knowledge monopoly, Government intervention, such as in the form of education and research reforms, can be deflected.

In the 1980s engineering representatives lobbied intensively for the necessity of getting more students into engineering and technology programmes at university, and for the Government to institute mechanisms to achieve that goal. Recruitment campaigns and conferences such as "More Women into Industry" and "More Women into Technical Education" were the result.[631] In this manner, the engineering profession efficiently avoided any substantial change. The governmental will to political reform from the 1970s, as outlined in Chapter 3, was no more.[632] Anita Gradin, Minister for Gender Equality, launched the "More Women into Industry" campaign in 1983, partnering specifically with universities of technology. The campaign continued in the form of follow-up projects in subsequent years, financed by the Government and the universities. In parallel with this, "*Bryt*" (break in) projects took place in various arenas; projects that used various means to support the underrepresented gender to enter gender-segregated occupations and workplaces.[633] Their focus was, however, on getting women to enter male-dominated workplaces and not the other way around, i.e. more men in female-dominated

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[630] This thesis Chapter 1, sub-chapter "Practises of Gendered Boundary Work in the Engineering Profession".

[631] See Sundin and Göranson, *Vad hände sen?* for a summary and analysis of national gender equality initiatives in the labour market in the 1980s and 1990s; this thesis Chapter 3, Figure 3.5.

[632] Tollin, *Sida vid sida,* 49 ff.

[633] E.g. Drude Dahlerup, ed., *Køn sorterer: kønsopdeling på arbejdspladsen* (Copenhagen, 1989), 181.

workplaces.[634] The early successes of Swedish gender equality politics were thus intimately linked to a strong belief in expansion of engineering and technology industries for national economic growth, and in the possibility of achieving a gender-equal society through numerical balance in the industrial workplace. The recruitment logic, which guided national gender diversity efforts in the 1980s, has held a solidly dominant position in terms of being a solution to gender inequality in STEM and still does.

As discussed in Chapter 3, the post-war decades strengthened the belief in science and technology for national economic growth and welfare in Sweden and other countries in the Global North. The Swedish Social Democrats, who were closely connected to the LO trade union organisation, had affinities with the working class, while Swedish engineering graduates had historically joined forces with industrial capital and employer organisations. But the idea of technological modernisation had also become a key consideration within the Social Democratic party and the workers' movement. Swedish post-war governments, independent of political stripe, have responded to the siren song of engineers and industry.[635] Historical research demonstrates that when industry representatives lobby for public funding, the Government acts. As this thesis has aimed to show, such responses have had implications, not only in the Swedish labour market and for education policies but also in national gender equality politics.

One specific trait in the Swedish engineering professional identity aligned particularly well with the emerging objective of politicians and bureaucrats in the 1980s and 1990s: the self-image of the engineer as a problem-solver. No problem is too big, nothing is impossible. The confidence with which engineering educators approached the issue of gender inequalities is apparent throughout the period studied.[636] In the twentieth century, the Government trust in engineering skill and knowledge reshaped Swedish infrastructure, the built environment, weapon production, resource extraction and energy consumption, turning Sweden into a "welfare and warfare" nation.[637] Like everywhere else in the Global

[634] Sundin and Göranson, *Vad hände sen?*.

[635] Siren songs, because the argument that nations are lacking engineers have been questioned. See Godin, *Measurement and statistics on science and technology*; Godin, "The Linear Model of Innovation. For an overview of Godin's argument, see Lövheim, *Naturvetarna, ingenjörerna och valfrihetens samhälle,* 28 f.

[636] On the engineer as problem-solver see Williams, *Retooling*, and David Kaiser, ed., *Becoming MIT: moments of decision*, (Cambridge, MA, 2010).

[637] Lundin et al., eds., *Science for Welfare and Warfare.*

North, it created a fossil fuel dependency.[638] The autonomy claims of professional engineers – their knowledge monopoly through their specialised education and professional ethics – often made politicians and the public accept their statements without scrutiny. This engineering hubris, or professional optimism, in combination with the solid Government belief in engineering expansion as a secure path to increase the gross domestic product, have created a fertile ground for project funding in various areas.[639] Political rationales, rooted in three- or four-year terms of office, combined with a will to demonstrate action and political muscle, kept money flowing towards fragmented, short-term engineering-run projects, even when social issues such as gender equality were at stake.

The consequences of the Government's trust in engineers became conditioned by contemporary market-oriented ideology. In the period here studied – the 1980s and 1990s – labour market, educational, and gender equality policies increasingly aimed to shrink the public sector. Public expenses were cut in many areas but also directed towards measures that could expand private industry. One such measure was expansion of engineering education. While the critique of the inefficiency of the public sector was spearheaded by the centre-conservative opposition in the 1980s, major parts of the Social Democratic party increasingly viewed the public sector as too large, and too expensive (Chapter 3, sub-chapter "War of the Roses"). The early 1990s' economic recession and the centre-conservative cabinet that came into power in 1991 consolidated this agenda (Chapter 4, sub-chapter "Pedagogical Renewal for Post-Industrial Times). The turn towards the *educational reform logic* among cabinet ministers, educational bureaucrats and engineering educators must be understood in this perspective.

Through the educational reform logic these actors attracted Government funding based on the argument that reforming pedagogics and curriculum at universities of technology would make engineering education gender inclusive. As outlined in Chapter 4 the engineering reformers were stuck in what Minna Salminen-Karlsson calls an "engineering gender contract".[640] The reformers intended to make engineering education

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[638] Jens Millkrantz, Anna Åberg, Kristoffer Ekberg and Susanna Lidström. "Scandia introducerar: Petrokultur och energihistoria." *Scandia: Tidskrift för historisk forskning* 88, No. 1; Martin Hultman and Jonas Anshelm. "Masculinities of global climate change: exploring ecomodern, industrial and ecological masculinity", in *Climate change and gender in rich countries* (Routledge, 2017), 19–34.

[639] For the hybris of natural scientists and engineers, see Myrdal, *Om humanvetenskap och naturvetenskap*, 100–102.

[640] Salminen-Karlsson, *Bringing Women into Computer Engineering*, 215 ff.

inclusive by changing the order of subjects taught and increasing the amount of problem- and project-based teaching.[641] In this way, engineering's social relevance would become apparent, a fact that was perceived as important to attract female students. This would not only benefit the potential female students who were seen a national "competence resource", but male students as well. What was good for women was said to be good for all. Again, this was a binary logic that divided men and women in two separate and respectively homogenous groups. According to this logic women could appreciate technology only in its social context. The educational reform logic built on the idea that fulfilling women's perceived requirements would raise educational *quality*. Calls for a raised educational quality in university programmes overall had been voiced since the late 1980s. Industry representatives, student organisations and public commissions on higher education argued that the standards of university teaching were too low (Chapter 4, sub-chapter "Reforming Curricula for Educational Quality"). This was especially true for the universities of technology. In times of economic downturn and high unemployment rates, engineering educators and educational bureaucrats combined diverse arguments that reinforced each other. They stressed that raising the educational level of the Swedish population, expanding universities of technology, and increasing the number of female engineering students would go hand in hand with reform of engineering curricula. Not only had Sweden entered a "knowledge society" where higher education was becoming increasingly necessary in the labour market – the knowledge taught at the universities of technology also had to align with new industrial demands. A narrow technical and scientific curriculum would no longer suffice in a global world with strong international competition. Curricular reform would attract potential female students, the actors argued, and as such steer the female population towards an educational field with great career prospects. In comparison to the public sector, that according to an increasing number of political actors "locked women in", engineering education and the private industry would liberate women. Engineering education reform was thus an imperative gender equality measure.

Project NyIng, the focus of Chapter 5, took its point of departure in this fact. The Government appointed project team aimed to evaluate and come up for reform suggestions for the entire higher technical education system. Project NyIng suggested far-reaching changes. In the realms of engineering education, their visions were utopic. To these reformers, engineering education had to be rebuilt from the ground. What was called

[641] Ibid., 26.

the scientification of the curriculum had gone to far. Engineering had always been a practise-based discipline and profession, more related with the arts than with mathematics and the natural sciences. This base had to be rediscovered, the actors argued. To regain its social relevance, engineering education had to integrate not only the arts, but the humanities and the social sciences. Engineering was about building a human-friendly society, not foremost about solving differential equations. To make engineering education truly inclusive, gender analysis of science and technology had to become integrated into education. It also had to permeate the research conducted at universities of technology. What this thesis calls a *research reform logic* gained momentum at a few local universities of technology (Chapter 5, sub-chapter "Gender Analysis Enters the University of Technology"). The majority of the Swedish engineering faculties were however not affected.

The fact that this logic did not gain traction is explained by the engineers' professional autonomy, and the respect for the same: the engineering faculty had autonomy to steer the content of their research. As discussed in Chapters 4 and 5, gender analysis, as many disciplines and methods within the social sciences and the humanities, have been treated with skepticism by natural scientists and engineers. Disciplines that are based on qualitative knowledge have been ignored, dismissed or treated with ridicule by these quantitative-oriented scholars. To integrate gender analysis in their own research would require a leap of faith that most engineering faculty did not see as an option.

THE HIERARCHIES OF GENDER EQUALITY WORK

The three phases of the gender equality responses – recruitment activities, educational reform and research reform – corresponded to different groups of staff. There was a status scale – from low to high – associated with these groups and the activities carried out. In general the Swedish universities of technology in the 1980s had women working in administrative positions, in human resources and as non-faculty educators – positions with traditionally low status at these institutions – and they were the ones who developed and implemented gender equality measures. In the initial, confused phase at Chalmers University of Technology in the late 1970s, the formal responsibility fell on university directors and human resources staff. The directors soon handed over their responsibility to a group of HR and non-faculty educators, silently supported by faculty representatives. The gender equality advocates' work was guided by their enthusiasm rather than being based on their position within the university. From the perspective of university

management, systematic gender equality efforts were among the required duties of administrators, but they were not intended to impact or reinforce the university's core activities.

The second phase – the curricular reform phase – which gained momentum in the early 1990s, looked different. Now, well-established engineering faculty members were to ensure implementation, and do so by developing *education*, i.e. involving one of two core activities at the university. The third phase, in the late 1990s, was dominated by education reform, but also included gender analysis as part of the *research* taking place. Analysis of what engineering was and creating a vision for what it could be, was expanded significantly in Project NyIng, elaborated in Chapter 5, which involved developing new engineering programmes, and in the institutionalisation of research departments for gender and technology at Luleå University of Technology, Blekinge Institute of Technology and the interdisciplinary structure of *Tema Teknik* and *Tema Genus* in Linköping. The interpretation of gender equality and how gender affected engineering and engineering education changed significantly over the period studied, but the majority of those in engineering were not affected in their day-to-day work. The education reform initiatives only affected a small number of existing programmes. Most of the experimentation took place within new programmes. The same was true for the research divisions. New research areas were established with researchers dedicated to examining gendered technology and engineering but, overall, no transformation took place within research at universities of technology. There has still therefore been no adequate response to Schiebinger's third fix, *fixing the knowledge*. Comprehensive change has been proven difficult to achieve.

From the analysis in this thesis there are three findings that can explain this. First was something historians of engineering education has already noted, that the engineering curriculum is a battlefield involving numerous stakeholders. On this battlefield everyone is striving for a position and for status. To engineering faculty and students, status means – in 1920 and in 2020 – recognition by the technology and engineering industries. No other stakeholder has yet been able to compete with the industry promise of a professional career and a high salary for students, and a reliable source of research funding for engineering faculty members. The second finding concerns the low status of teaching relative to research at universities of technology. Whereas innovative research is likely to be rewarded by acclaim and funding from public research councils and private foundations, funding for renewal in education and teaching has never been similarly institutionalised. Renewal in teaching is thus less visible and most often something done

free of charge by faculty members dedicated to their teaching work. The council established by the Government in 1990 for the renewal of undergraduate education (*Högskolans grundutbildningsråd*), which was intended to function as a funding supplier in the same way as the research councils, was discontinued in 2005.[642] Teachers and faculty are nowadays required to take teaching courses and demonstrate teaching skills, but without the support of any comprehensive national reform projects. New engineering programmes have, instead, been created since the 1990s. Also starting in the 1990s, an internal movement for curricular reform based on CDIO (conceive, design, implement, operate) has been visible within Swedish universities of technology. However, this movement has attracted similar criticism as that of Salminen-Karlsson and Wistedt in the late 1990s who asserted that existing reform attempts are deeply characterised by the internal reasoning of the engineering profession (Chapter 4, sub-chapter "…But Missing the Target") .[643] Third, as discussed above, within the engineering communities there is scepticism towards the humanities and social sciences – including disciplines such as pedagogics and gender studies – and a lack of faith in their ability to produce knowledge on par with that of the natural and engineering sciences.[644] These different worldviews, and more importantly views on what counts as valid knowledge, between the majority in engineering and social science researchers focusing on the engineering and science professions is still steep.

Inspired by historian of literature and technology Rosalind Williams, this thesis suggests that integrating engineering education with the humanities, the social sciences, and the arts should be reconsidered if engineers want to play a role in solving global challenges and be of relevance for more than a small minority of mainly young, white middle-class men.[645] Williams argued already 20 years ago that an engineering profession which reduces engineering to a matter of pure technical advancement and market share is insufficient in a world facing complex challenges.[646] The inherent social, cultural, political, economic and historical aspects of technologies and technological development must also be acknowledged by engineers. This has been expressed within the MTS

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642 Interview with Ingemarsson; this thesis Chapter 4, sub-chapter "Reforming Curricula for Educational Quality".

643 This thesis Chapter 4, sub-chapter "…But Missing the Target". On CDIO see this thesis Chapter 5, sub-chapter "A Lost Momentum?"; Williams, *Retooling,* 51, 210.

644 Myrdal, *Om humanvetenskap och naturvetenskap*, 100–102.

645 Williams, *Retooling*, e.g. 85–89, 215 ff; this thesis Chapter 5.

646 Ibid. (Williams).

(human, technology, society) courses and centres at the various universities of technology since the 1980s (summarised in Chapter 5, sub-chapter "A Short History of Integrating the Humanities"), and in Project NyIng in the late 1990s. Instead of targeted recruitment campaigns that label women as a homogenous and misinformed group, comprehensive education reform might lead to greater success in attracting a diverse group of students. Increasing the number of women in engineering is "both fine and irrelevant, if the cult of innovation defines a distinctive technological creativity where men and masculinity dominate".[647]

As repeatedly argued by science historian Londa Schiebinger, the work must not stop at curricular reform. For STEM education and academia to become truly gender-inclusive, new questions must be asked, for example within the university organisation – within research, hiring and education.[648] Furthermore, it is vital not to lose sight of the material circumstances and experiences of people of all genders, social groups, ethnicities, sexual orientations, ages and abilities when entering engineering education and the profession. This work was initiated by the gender equality council in CF back in 1970.[649] Revisiting these forerunners, such as Alfred Nettelbrandt with his initiative in 1969 mentioned in the introductory chapter of this thesis, illustrates how engineering associations five decades ago addressed issues that the profession is still struggling to come to terms with today. As we look back it is plain to see how the structures that exist – the professional norms, values and ideals embedded in universities of technology as well as in the organisation of engineering workplaces – have kept on limiting people's opportunities to take part in professional life on equal terms. While the nuances may change and labour market reforms may be implemented, many of these structures remain in place.

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[647] Ibid., 210. Current research would add "where *white* men and *specific* masculinities dominate". See Ensmenger, "Beards, Sandals and Other Signs of Rugged Individualism"; Slayton, *Race rigor and selectivity in US Engineering*; "Black Inventors and New Perspectives", Lemelson Center for the Study of Invention and Innovation webinar series, Nov. 2020, https://invention.si.edu/black-inventors-and-innovators-new-perspectives, retrieved 27 Jan. 2023.

[648] E.g. Schiebinger, "Creating Sustainable Science"; Londa Schiebinger, TedX Gendered Innovations, 2013, https://tedxcern.web.cern.ch/video/2013/gendered-innovations, retrieved 12 Nov. 2021. See this thesis Chapter 1, sub-chapter "Three Fixes: Women, Institutions, Knowledge".

[649] TAM, SAGE archive, F 10Fa:1–6; Nordvall, "The Resistant Profession".

Epilogue: Searching for a Fix

In the early 2020s gender inequality is again, or is still, a hot topic in the Swedish engineering profession. Tech corporations and universities of technology that do not take such issues seriously are quickly questioned. Womengineer, KTH Giants, Chalmers' GENIE, and The Code Pub are a few examples of contemporary ventures.[650] New recruitment initiatives are often justified as solutions to an old problem, but a problem that no one has cared about – until now, that is. The novelty claims frame inequality between men and women in engineering education and in the engineering job market as a problem that exists within well-defined borders and one that can be solved with a straightforward "gender fix". The high-profile engineering actors engaged in the issue, such as representatives of multinational tech corporations and administrative heads of universities of technology, see inequality as a remnant of a pre-modern society that can be erased if adequate attention is paid to it. This attitude aligns with the problem-solving spirit in engineering – an approach deeply rooted in the modern industrial era belief in technological fixes.[651] A technological fix transforms a complex societal problem into a straightforward technical solution. The Swedish engineering profession communicates this approach through the Royal Swedish Academy of Engineering Sciences, the Association of Graduate Engineers and the marketing apparatus of the universities of technology.[652] The fact that the engineering communities, and in particular the engineering profession populated by engineering graduates, have launched an incalculable number of projects since at least the mid-1970s to "attract women to technical education", "increase gender equality at universities of technology" or make the "engineering profession more gender-equal", is something these actors seldom reflect upon, at least not in public.[653] The situation can be interpreted as a sign of professional amnesia, be it conscious or

[650] Webpages: Womengineer, https://womengineer.org; KTH Giants, https://www.kth.se/utbildning/giants; Chalmers Genie, https://www.chalmers.se/en/about-chalmers/Chalmers-for-a-sustainable-future/initiatives-for-gender-equality/gender-initiative-for-excellence/Pages/default.aspx; The Code Pub, https://codepub.netlight.com. All retrieved 1 June 2021.

[651] Rosner ed., *The Technological Fix*.

[652] See e.g. the union weekly magazine *Ny Teknik*, and the respective web page of each institute and organisation.

[653] As stated in the introduction, between 1985 and 1994, 946 projects with the purpose to increase gender equality at Swedish colleges and universities were carried out. About one third was located at technical colleges and universities. Most projects lasted one year or less. Departementsserien 1994:130. See also Heikkilä and Häyrén Weinestål, *Kartläggning och analys av jämställdhetsinsatser vid svenska universitet och högskolor 2000–2009*.

unconscious.[654] There are however recent exceptions. At KTH, senior gender and organisational professor has been given a mandate to "work with faculty development and gender equality, and to develop methods and measures to integrate gender studies and gender equality in the educational programs".[655] Starting in 2017, Anna Wahl was elected the Deputy Vice-Chancellor position at the university. As such, KTH has given gender equality, inclusion, and diversity a prominent organisational position. Chalmers has recently hired professors and associate professors that integrate gender analysis in their research, such as architecture historian Isabelle Doucet, and STS scholar Lisa Lindén. But instead of making strategic decisions that are informed by gender analysis of science, technology, and organisation, Chalmers launched a project-based initiative called "Gender Initiative for Excellence", GENIE, in 2019, led by engineering faculty. The university has yet to develop an overarching strategy from a gender analytical standpoint.

There is, however, another reason for the memory gap of the engineering majority. When the extent of gender equality is quantified in numbers, such as the average percentage of women in technology and engineering research and industries, and especially in leadership positions, the long-term results of all recruitment and "gender-inclusive" projects have been disappointing. According to the statistics, the average ratio of women at universities of technology remains low.[656] Such statistics do, however, hide some relevant details. First, the absolute number of people in technology and engineering programmes whose legal gender is female has increased significantly since the 1970s. According to Statistics Sweden, nearly 23,000 women in the Swedish workforce in 2010 had a Master of Science in engineering.[657] This should be compared with a few hundred in the early 1970s.[658] That is a massive increase. There are many reasons behind this transformation, the most salient among them being overall growth in the number of women at university and in the workforce, transformation in the labour market, and

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[654] E.g. Faulkner, "The Technology Question in Feminism"; Ottemo, "Rekryteringsarbete: Rådande utgångspunkter och alternativa strategier".

[655] Online profile of Anna Wahl, https://www.kth.se/profile/awahl, retrieved 17 Jan. 2023.

[656] Appendix B. The data producers - public authorities and technical universities- collect data on legal gender (man/women). There is no data on non-binary gender identities.

[656] 22,957 MSc engineers among women between 20 and 74 years old (men 81,602). In Statistics Sweden, *Ingenjörerna*, 9.

[657] Ibid. Within the Swedish population (appr. 10 million), 28 percent (men and women) had a university degree in 2020 (3 years or longer), see Statistics Sweden (SCB), "Utbildningsnivån i Sverige", https://www.scb.se/hitta-statistik/sverige-i-siffror/utbildning-jobb-och-pengar/utbildningsnivan-i-sverige/, retrieved 1 June 2021.

[658] See Appendix A and this thesis Chapter 2, sub-chapter "Reaching Critical Mass".

changing cultural gender norms. The increase also reflects the fact that gender equality efforts within the engineering profession have usually focused on increasing the number of women. As outlined in this thesis, external outreach, most often in the form of recruitment campaigns targeting women, has been the "go to" measure for universities of technology to achieve gender equality. This should be contrasted with the less common internal initiatives, such as gender analysis and structural reforms within existing engineering programmes. And as gender and organisational scholar Anna Grzelec has recently shown, it is not uncommon for organisations to make efforts to change the numerical balance between genders, while at the same time continue to reproduce inequality within the organization.[659]

Moreover, when the education programmes are studied more closely, patterns emerge that complicate the quantitative aspect. Recently established engineering programmes, such as those in biotechnology and industrial design, recruit a high percentage of women and also attract many men (Appendix B). Older but reformed programmes, such as civil engineering, have a gender-equal distribution of students.[660] However, computer science and engineering, information technology, automation technology, electrical engineering and engineering physics programmes are still predominantly male. This nuance is seldom discussed other than superficially when "women's lack of interest in technology" is mentioned. Instead, engineering actors, perhaps inadvertently, continue to recreate the image of women as detached from technology, while more diffuse, internal and likely more uncomfortable problems are not addressed. Historical, ethnographic and organisational studies have demonstrated the prevalence of masculine engineering cultures within universities of technology, created in an elitist, male-exclusive environment over 100 years ago. Since the earliest attempts by women to enter the Swedish engineering profession in 1892, these women have challenged the idea of who can become an engineer. Researchers and journalists have repeatedly found that female engineering students have been ignored, dismissed, questioned, ridiculed and harassed. These findings suggest that patriarchal structures are pervasive at universities of technology and that this complicates efforts to achieve a diversified engineering profession. To address these persistent issues, new strategic

[659] Grzelec, "Doing Gender Equality and Undoing Gender Inequality–A Practice Theory Perspective".

[660] After the year 2000, KTH and Chalmers have reformed their 5-year civil engineering program curriculum. As part of the reforms, the universities changed the Swedish program title from "Väg- och vattenbyggnad" (*Civil Engineering*) to "Samhällsbyggnad" (*Built Environment*).

measures rather than short-term, disconnected projects, are necessary. This includes building strategies and policies based on systematic, qualitative research on structural inequalities in educational institutions and professional life, paired with long-term commitment and leadership.

Glossary

Arbetslivscentrum	Swedish Centre for Working Life
Arbetsmarknadsstyrelsen (AMS)	Former national labour market board
CF:s Likställighetsråd	Gender equality council of the Swedish Association of Graduate Engineers (CF)
Chalmers tekniska högskola (CTH)	Chalmers University of Technology (1980s–)
Chalmers tekniska högskola	Chalmers Institute of Technology (1937-1980s)[661]
Chalmers tekniska institut	Chalmers Technical Institute (1914-1937)[662]
Chalmers tekniska läroanstalt	Chalmers Technical School (1882) [663]
Chalmersska slöjdskolan	Chalmers School of Arts and Crafts[664]
Delegationen för arbetstidsfrågor (DELFA)	A commission on working hours
Delegationen för jämställdhet mellan män och kvinnor	A commission on equality between men and women[665]
Fredrika-Bremer-Förbundet (FBF)	Fredrika Bremer Association
Försvarets forskningsanstalt	Swedish Defence Research Institute
Högskolans grundutbildningsråd	Swedish council for the renewal of undergraduate education
Högskoleutredningen	Government commission on higher education
Ingenjörsförbundet	A former union for engineers
Inrikesdepartementet	Sweden's home office, former ministry
Jämställdhetsombudsmannen (JämO)	Equality Ombudsman
JÄST-gruppen, Arbetsgruppen för jämställdhet i högre utbildning och forskning	JÄST committee, Advisory committee on gender equality in higher education and research
Kungl. Ingenjörsvetenskapsakademin (IVA)	Royal Swedish Academy of Engineering Sciences
Kungliga Tekniska Högskolan (KTH)	Royal Institute of Technology
Kungl. Vetenskapsakademien (KVA)	Royal Swedish Academy of Sciences
Landsorganisationen i Sverige (LO)	Swedish Trade Union Confederation
Pappersindustriförbundet	A national paper industry association

661 On the Chalmers transformations including name changes see Björck, "A Distinguished Scientific Field?".

662 Ibid.

663 Ibid.

664 Ibid.

665 Florin and Nilsson, "'Something in the Nature of a Bloodless Revolution…'", 68.

Skolöverstyrelsen (SÖ)	A former national board of education
SMHI	Swedish Meteorological and Hydrological Institute
Statens arbetsmarknadsnämnd (SAMN)	A former government labour market committee
Statens skogsindustrier	State forest industry company
Stockholms gatukontor	Stockholm roadworks agency
Styrelsen för teknisk utveckling (STU)	A former board of technical development
Svenska arbetsgivareföreningen (SAF)	Swedish Employers' Confederation
Svenska Industritjänstemannaförbundet (SIF)	Swedish Union of Clerical and Technical Employees in Industry
Svenska Teknologföreningen (STF)	An association of engineers and architects
Svenskt Näringsliv	Confederation of Swedish Enterprise
Sveriges Akademikers Centralorganisation (SACO)	Swedish Confederation of Professional Associations
Sveriges Civilingenjörsförbund (CF)	A former Swedish association of graduate engineers (union organisation)
Sveriges Industriförbund	A national federation of industry associations
Sveriges Ingenjörer	Swedish Association of Graduate Engineers
Sveriges lantbruksuniversitet (SLU)	Swedish University of Agricultural Sciences
Technologiska institutet (TI)	A former name of the Royal Institute of Technology (KTH)[666]
Tekniska högskolan vid Linköpings universitet (LiTH)	Institute of Technology at Linköping University
Tjänstemännens centralorganisation (TCO)	Swedish Confederation of Professional Employees
Universitets- och högskoleämbetet (UHÄ)	Swedish National Board of Universities and Colleges
Universitetskanslersämbetet, UKÄ	Swedish Higher Education Authority
Yrkeskvinnors riksförbund	Business and Professional Women Sweden

[666] Björck, "A Distinguished Scientific Field?".

Appendix A

Number of engineering graduates between 1937 and 1977.

	Engineering degree (Civilingenjörsexamen)		Tech. Licenciate degree (Tekn. Lic.examen)		PhD in Engineering (Tekn. Dr. grad)		PhD in Engineering (Tekn. Dr. examen)	
	Total no.	No. of women	Total no.	No. of women	Total no.	No. of women	Total number	No. of women
1936/37–1940/41	1404	9	-	-	8	-	-	-
1941/42–1945/46	1768	24	17	-	19	-	-	-
1946/47–1950/51	2221	24	82	-	27	-	-	-
1951/52–1955/56	2553	38	152	2	51	1	-	-
1954/55	552	8	33	-	7	-	-	-
1955/56	517	9	24	-	14	1	-	-
1956/57	528	11	32	-	8	-	-	-
1957/58	527	9	33	1	7	-	-	-
1958/59	533	9	46	-	14	-	-	-
1959/60	594	12	48	1	15	2	-	-
1960/61	708	16	48	1	16	-	-	-
1961/62	723	22	66	-	11	-	-	-
1962/63	916	29	64	1	15	-	-	-
1963/64	841	33	81	3	20	-	-	-
1964/65	913	44	91	1	18	-	-	-
1965/66	1009	45	109	4	21	-	-	-
1966/67	1031	61	111	3	22	-	-	-
1967/68	1212	64	99	2	29	-	-	-
1968/69	1425	68	146	4	18	-	-	-
1969/70	1584	109	130	3	33	-	15	-
1970/71	1711	129	194	10	20	-	37	1
1971/72	1577	82	117	10	12	-	47	1
1972/73	1546	89	92	3	7	-	88	3
1973/74	1857	123	51	3	35	-	130	6
1975/76	1752	177	2	-	1	-	132	5
1976/77	1923	185	-	-	-	-	97	3

Sources:

- 1936/37–1955/56 in *SOS Högre studier 1956/57*, p. 69, tabell 2 (*Avlagda examina och disputationsprov vid universitet och högskolor läsåren 1936/37–1955/56*).
- 1956/57 in *SOS Högre studier 1956/57*, p. 84, table 15 (*Examina vid fackhögskolorna läsåret 1956/57 efter den examinerades kön*).
- 1957/58–1958/59 in *SOS Högre studier 1957/58–1958/59*, p. 63, tablel 17 (*Examina vid fackhögskolorna läsåren 1957/58 och 1958/59 efter den examinerades kön*).
- 1959/60 in *SOS Högre studier 1959/60–1960/61*, p. 37, table 15 (*Examina vid fackhögskolorna läsåren 1959/60 efter den examinerades kön*).
- 1960/61–1969/70 in *Utbildningsstatistisk årsbok 1978*, table 15.12 (*Avlagda examina och disputationsprov vid universitet och högskolor fördelade efter examen och kön läsåren 1960/61–1969/70*). Note: Engineering degrees includes architecture and mining engineering degrees (*bergsingenjörer*).
- 1970/71–1976/77 har hämtats från *Utbildningsstatistisk årsbok 1978*, s. 503, tabell 15.31: Avlagda examina och disputationsprov vid universitet och högskolor fördelade efter examen och kön läsåren 1970/71–1976/77. Note: Engineering degrees includes architecture and mining engineering degrees (*bergsingenjörer*).

Appendix B

Statistics on first-year student enrolment in 2021 from Chalmers University of Technology and Linköping University. The data producers collect data on legal gender (man/women). There is no data on non-binary gender identities.

CHALMERS UNIVERSITY OF TECHNOLOGY

In the university's yearly report for 2021, Chalmers University of Technology displays statistics distributed on programme degrees. The left table shows the percentage of women in the first study year, distributed on degree programmes (page 17). The right table shows the total number of students in the same programme, first study year (page 20). The avarage distribution of women/men was 31/69 percentage (33/67 in 2020) (page 17). Högskoleingenjör = 3-year engineering degree (BSc). Civilingenjör = 5-year engineering degree (MSc). In "Chalmers årsredovisning 2021". Retrieved 16 Jan. 2023. https://www.chalmers.se/SiteCollectionDocuments/om%20chalmers%20dokument/Chalmers%20årsberättelse/Chalmers%20Årsredovisning%202021.pdf

ANDEL KVINNOR I ÅRSKURS ETT

		Andel i procent
De	Design och produktutveckling, högskoleingenjör	66
Bt	Bioteknik, civilingenjör	62
Gs	Globala system, civilingenjör	59
A	Arkitektur	58
Td	Teknisk design, civilingenjör	57
Ae	Affärsutveckling och entreprenörskap inom samhällsbyggnadsteknik	55
Ki	Kemiteknik, högskoleingenjör	50
Md	Medicinteknik, civilingenjör	49
At	Arkitektur och teknik	46
Sc	Samhällsbyggnadsteknik, civilingenjör	46
Ep	Ekonomi och produktionsteknik, högskoleingenjör	43
K	Kemiteknik, civilingenjör	40
Sh	Samhällsbyggnadsteknik, högskoleingenjör	38
Kf	Kemiteknik med fysik, civilingenjör	38
Il	Internationell logistik	32
It	Informationsteknik, civilingenjör	27
I	Industriell ekonomi, civilingenjör	26
Di	Datateknik, högskoleingenjör	24
M	Maskinteknik, civilingenjör	23
Sk	Sjökapten	20
Tm	Teknisk matematik, civilingenjör	17
E	Elektroteknik, civilingenjör	17
F	Teknisk fysik, civilingenjör	14
D	Datateknik, civilingenjör	14
Mi	Maskinteknik, högskoleingenjör	11
Ei	Elektroteknik, högskoleingenjör	11
Z	Automation och mekatronik, civilingenjör	10
Si	Sjöingenjör	10
Me	Mekatronik, högskoleingenjör	8

ANTAL REGISTRERADE STUDENTER I ÅRSKURS ETT

		Antal
M	Maskinteknik, civilingenjör	168
D	Datateknik, civilingenjör	152
Sc	Samhällsbyggnadsteknik, civilingenjör	142
Z	Automation och mekatronik, civilingenjör	136
It	Informationsteknik, civilingenjör	135
F	Teknisk fysik, civilingenjör	129
I	Industriell ekonomi, civilingenjör	122
Sh	Samhällsbyggnadsteknik, högskoleingenjör	109
A	Arkitektur	96
Mi	Maskinteknik, högskoleingenjör	83
E	Elektroteknik, civilingenjör	78
Gs	Globala system, civilingenjör	69
K	Kemiteknik, civilingenjör	68
Md	Medicinteknik, civilingenjör	68
Il	Internationell logistik	66
Me	Mekatronik, högskoleingenjör	63
Bt	Bioteknik, civilingenjör	63
Ep	Ekonomi och produktionsteknik, högskoleingenjör	56
Di	Datateknik, högskoleingenjör	55
Ae	Affärsutveckling och entreprenörskap inom samhällsbyggnadsteknik	53
Tm	Teknisk matematik, civilingenjör	52
Ei	Elektroteknik, högskoleingenjör	47
Td	Teknisk design, civilingenjör	46
Sk	Sjökapten	46
Kf	Kemiteknik med fysik, civilingenjör	40
Si	Sjöingenjör	39
At	Arkitektur och teknik	39
De	Design och produktutveckling, högskoleingenjör	32
Ki	Kemiteknik, högskoleingenjör	32

5-YEAR PROGRAMMES (MSc)

Bt	Bioengineering	62 % W/38 % M, 63 students
Gs	Global systems	59 % W/41 %, 69 students
A	Architecture	58 % W/42 % M, 96 students
Td	Industrial Design	57 % W/43 % M, 46 students
Md	Medical Engineering	49 % W/51 % M, 68 students
Sc	Civil Engineering	46 % W/54 % M, 142 students
K	Chemical Engineering	40 % W/60 % M, 68 students
Kf	Chemical Engineering with physics	38 % W/62 % M, 40 students
It	Information Technology	27 % W/73 % M, 135 students
I	Industrial Economy	26 % W/74 % M, 122 students
M	Mechanical Engineering	23 % W/77 % M, 168 students
Tm	Engineering Mathematics	17 % W/83 % M, 52 students
E	Electrical Engineering	17 %/83 % M, 78 students
F	Engineering Physics	14 % W/86 % M, 129 student
D	Computer Science	14 % W/86 % M, 152 students
Z	Automation and Mechatronics	10 % W/90 %, 136 students

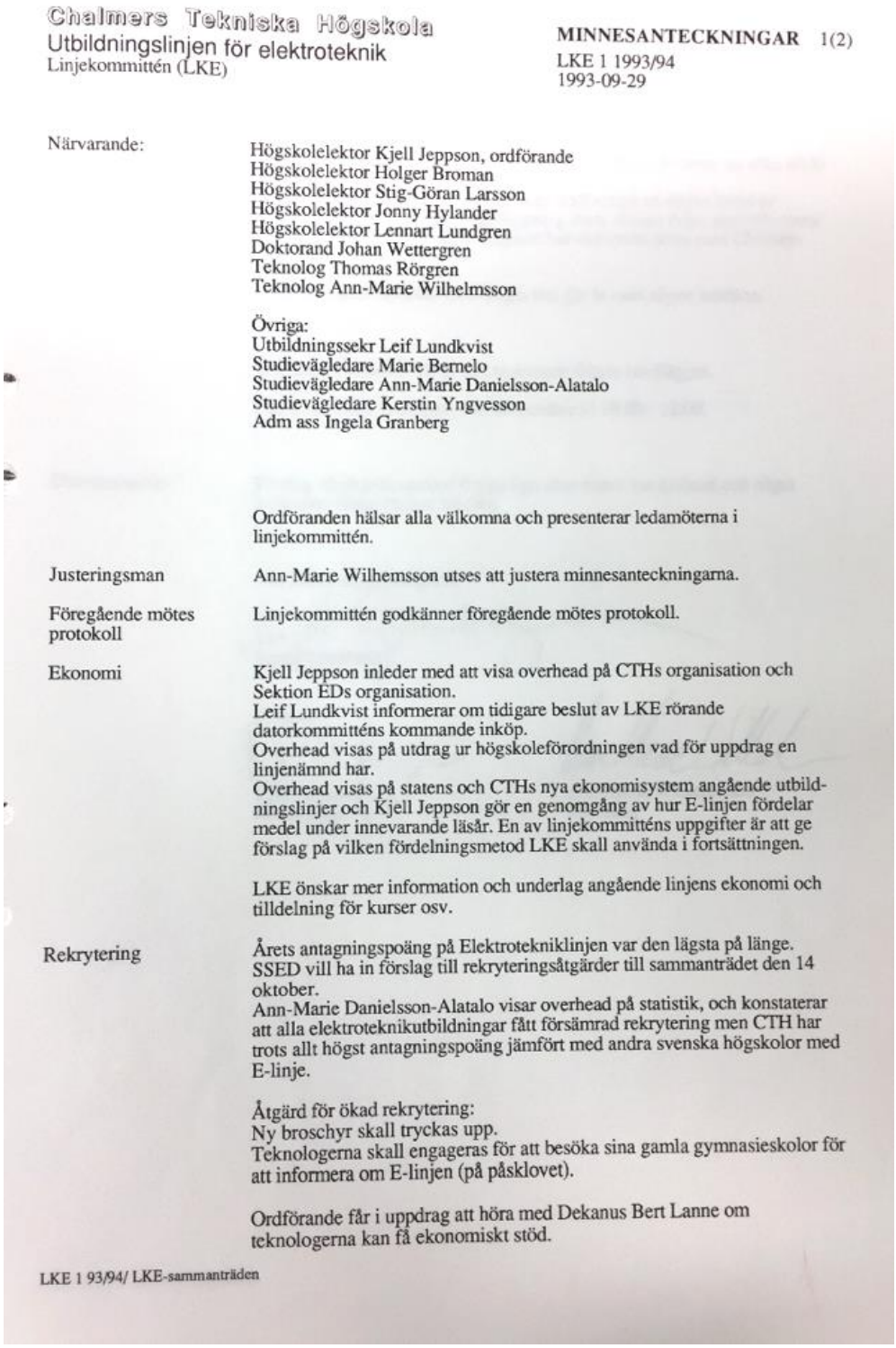
LINKÖPING UNIVERSITY

Linköping University displays statistics on faculty level in their yearly report. The total number of students in 5-year engineering degree programmes was 1036 in 2021 (32 % W/66 % M). For statistics distributed on separate engineering degrees, se SCB's database. Linköping Univeristy, "Årsberättelse 2021". Retrived 16 Jan. 2023. http://liu.diva-portal.org/smash/get/diva2:1639612/FULLTEXT01.pdf

	Antal nybörjare			Antal HST		
	2019	2020	2021	2019	2020	2021
Civilingenjörsutbildning	**1 029**	**1 086**	**1 036**	**4 231**	**4 392**	**4 461**
kvinnor/män (%)	31/69	34/66	32/68	33/67	33/67	33/67
Högskoleingenjörsutbildning	**265**	**251**	**253**	**632**	**617**	**624**
kvinnor/män (%)	24/76	20/80	19/81	19/81	21/79	22/78

Appendix C

Meeting minutes (2 pages) LKE No. 1 1993/94, 29 Sep. 1993, CTH C-archive, SSED, A2:10. Courtesy of the Chalmers central archive.



Chalmers Tekniska Högskola
Utbildningslinjen för elektroteknik
Linjekommittén (LKE)

MINNESANTECKNINGAR 1(2)
LKE 1 1993/94
1993-09-29

Närvarande:	Högskolelektor Kjell Jeppson, ordförande Högskolelektor Holger Broman Högskolelektor Stig-Göran Larsson Högskolelektor Jonny Hylander Högskolelektor Lennart Lundgren Doktorand Johan Wettergren Teknolog Thomas Rörgren Teknolog Ann-Marie Wilhelmsson Övriga: Utbildningssekr Leif Lundkvist Studievägledare Marie Bernelo Studievägledare Ann-Marie Danielsson-Alatalo Studievägledare Kerstin Yngvesson Adm ass Ingela Granberg
	Ordföranden hälsar alla välkomna och presenterar ledamöterna i linjekommittén.
Justeringsman	Ann-Marie Wilhemsson utses att justera minnesanteckningarna.
Föregående mötes protokoll	Linjekommittén godkänner föregående mötes protokoll.
Ekonomi	Kjell Jeppson inleder med att visa overhead på CTHs organisation och Sektion EDs organisation. Leif Lundkvist informerar om tidigare beslut av LKE rörande datorkommitténs kommande inköp. Overhead visas på utdrag ur högskoleförordningen vad för uppdrag en linjenämnd har. Overhead visas på statens och CTHs nya ekonomisystem angående utbildningslinjer och Kjell Jeppson gör en genomgång av hur E-linjen fördelar medel under innevarande läsår. En av linjekommitténs uppgifter är att ge förslag på vilken fördelningsmetod LKE skall använda i fortsättningen. LKE önskar mer information och underlag angående linjens ekonomi och tilldelning för kurser osv.
Rekrytering	Årets antagningspoäng på Elektrotekniklinjen var den lägsta på länge. SSED vill ha in förslag till rekryteringsåtgärder till sammanträdet den 14 oktober. Ann-Marie Danielsson-Alatalo visar overhead på statistik, och konstaterar att alla elektroteknikutbildningar fått försämrad rekrytering men CTH har trots allt högst antagningspoäng jämfört med andra svenska högskolor med E-linje. Åtgärd för ökad rekrytering: Ny broschyr skall tryckas upp. Teknologerna skall engageras för att besöka sina gamla gymnasieskolor för att informera om E-linjen (på påsklovet). Ordförande får i uppdrag att höra med Dekanus Bert Lanne om teknologerna kan få ekonomiskt stöd.

LKE 1 93/94/ LKE-sammanträden

Kvinnliga studenter till E-linjen.

Åtgärder diskuterades om hur man skall kunna få fler kvinnor att söka till E-linjen.
Grundutbildningsrådet har pengar som skall satsas på någon form av förändring av utbildningens uppläggning inom sådana linjer som rekryterar få flickor, t ex E och D. Kjell Jeppson har diskuterat detta med Christina Ullenius.

Linjekommittén föreslår att E-linjen inte går in med någon ansökan.

Ordförande avslutar mötet och resterande frågor bordlägges.

Nästa möte blir Onsdagen den 20 oktober kl 10.00 - 12.00.

Datorkommitté

Förslag till datorkommitté E togs upp efter mötet var avslutat och några ledamöter börjat lämnat lokalen.

Vid Minnesanteckningarna

Ingela Granberg

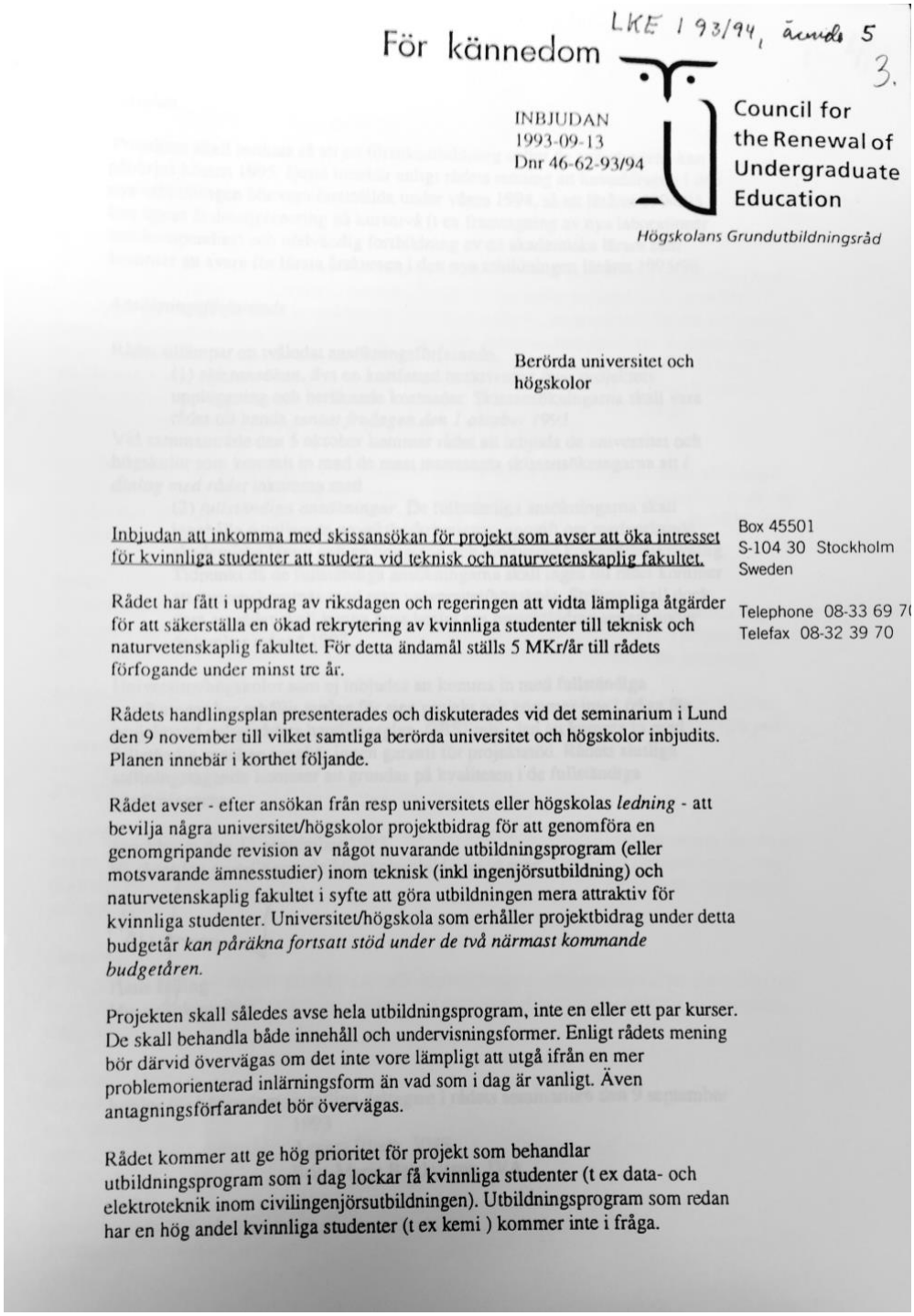
Justeras

Kjell Jeppson
Ordförande

Ann-Marie Wilhelmsson
Teknolog

Appendix D

Project call (2 pages) from the council for renewal of undergraduate education (*Högskolans grundutbildningsråd*), attachment to meeting minutes LKE No. 1 1993/94, 29 Sep. 1993, CTH C-archive, SSED, A2:10. Courtesy of the Chalmers central archive.



För kännedom LKE 1 93/94, ärende 5 3.

INBJUDAN
1993-09-13
Dnr 46-62-93/94

Council for the Renewal of Undergraduate Education

Högskolans Grundutbildningsråd

Berörda universitet och högskolor

Box 45501
S-104 30 Stockholm
Sweden

Telephone 08-33 69 7(
Telefax 08-32 39 70

Inbjudan att inkomma med skissansökan för projekt som avser att öka intresset för kvinnliga studenter att studera vid teknisk och naturvetenskaplig fakultet.

Rådet har fått i uppdrag av riksdagen och regeringen att vidta lämpliga åtgärder för att säkerställa en ökad rekrytering av kvinnliga studenter till teknisk och naturvetenskaplig fakultet. För detta ändamål ställs 5 MKr/år till rådets förfogande under minst tre år.

Rådets handlingsplan presenterades och diskuterades vid det seminarium i Lund den 9 november till vilket samtliga berörda universitet och högskolor inbjudits. Planen innebär i korthet följande.

Rådet avser - efter ansökan från resp universitets eller högskolas *ledning* - att bevilja några universitet/högskolor projektbidrag för att genomföra en genomgripande revision av något nuvarande utbildningsprogram (eller motsvarande ämnesstudier) inom teknisk (inkl ingenjörsutbildning) och naturvetenskaplig fakultet i syfte att göra utbildningen mera attraktiv för kvinnliga studenter. Universitet/högskola som erhåller projektbidrag under detta budgetår *kan påräkna fortsatt stöd under de två närmast kommande budgetåren.*

Projekten skall således avse hela utbildningsprogram, inte en eller ett par kurser. De skall behandla både innehåll och undervisningsformer. Enligt rådets mening bör därvid övervägas om det inte vore lämpligt att utgå ifrån en mer problemorienterad inlärningsform än vad som i dag är vanligt. Även antagningsförfarandet bör övervägas.

Rådet kommer att ge hög prioritet för projekt som behandlar utbildningsprogram som i dag lockar få kvinnliga studenter (t ex data- och elektroteknik inom civilingenjörsutbildningen). Utbildningsprogram som redan har en hög andel kvinnliga studenter (t ex kemi) kommer inte i fråga.

4.

Tidsplan

Projekten skall inriktas så att en försöksutbildning enligt de nya planerna kan påbörjas hösten 1995. Detta innebär enligt rådets mening att huvuddragen i den nya utbildningen bör vara fastställda under våren 1994, så att läsåret 1994/95 kan ägnas åt detaljplanering på kursnivå (t ex framtagning av nya laborationer och kompendier) och nödvändig fortbildning av de akademiska lärare som kommer att svara för första årskursen i den nya utbildningen läsåret 1995/96.

Ansökningsförfarande

Rådet tillämpar ett tvåledat ansökningsförfarande.

(1) *skissansökan*, dvs en kortfattad beskrivning över projektets uppläggning och beräknade kostnader. Skissansökningarna skall vara rådet till handa *senast fredagen den 1 oktober 1993.*

Vid sammanträde den 5 oktober kommer rådet att inbjuda de universitet och högskolor som kommit in med de mest intressanta skissansökningarna att *i dialog med rådet* inkomma med

(2) *fullständiga ansökningar*. De fullständiga ansökningarna skall innehålla detaljerade projektbeskrivningar, uppgift om medverkande akademiska lärare och en noggrann och motiverad kostnadsbeskrivning. Tidpunkt då de fullständiga ansökningarna skall inges till rådet kommer att överenskommas med resp universitet/högskola. Strävan skall dock vara att rådet skall kunna fatta beslut om projektbidrag senast under december månad 1993.

Universitet/högskolor som ej inbjudes att komma in med fullständiga ansökningar har erhållit avslag för sina projekt och kommer inte i fråga för projektstöd enligt rådets handlingsplan. OBS! inbjudan att komma in med fullständig ansökan innebär ingen garanti för projektstöd. Rådets slutliga ställningstagande kommer att grundas på kvaliteten i de fullständiga ansökningarna.

Stockholm den 13 september 1993
På rådet för grundläggande högskoleutbildning vägnar

Hans Jalling
Huvudsekreterare

kopior för kännedom: samtliga deltagare i rådets seminarium den 9 september 1993
Agneta Bladh, VHS
Britt-Marie Berthilsson, IVA

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