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Gender and Technology

A Historical Perspective

The gendering of science and technology as a research topic originates in the 1980s with the work of Sandra Harding, Donna Haraway, Lynda Birke, Evelyn Fox Keller, Cynthia Cockburn, and others giving the emergent field a strong profile.[1] Since then, an impressive corpus of literature has evolved. Feminist scholars have explored a great variety of technologies, from classic machines to robots and AI-based technologies, practising what Judy Wajcman has termed *technofeminism*. While early feminist studies of ICTs focussed on office automation, computers in nursing, and the gendering of professional IT work, there is a plethora of new work about women's (and other genders') access to and use of social media and the Internet, feminist hackathons, as well as all kinds of technology-supported practices of 'making'. These studies describe instances of creative appropriation and empowerment, while at the same time stressing the continuation of patterns of (male) power and dominance, which seem often to persist even when prior work practices are significantly altered.

Key Approaches and Concepts: An Overview

The aim of this chapter is to demonstrate how the feminist critique of science and technology stimulated thinking about 'how the inclusion of women would change how scientists think about nature and the kinds of machines engineers build' (Balka and Wagner 2021). We first revisit some of the most salient feminist work that developed insights and concepts that were to shape the subsequent debates about the gendering of technology. As part of this debate Sandra Harding and Dorothy Smith developed feminist standpoint theory,

[1] Two anthologies about women, science, and technology were also published in 1983: Rothschild's *Machina ex Dea* and Zimmerman's *The technological woman*.

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which emphasized the need to take women's experiences as a starting point for any process of inquiry. Feminist scholars demonstrated that women's knowledge was excluded from the sciences based on an understanding of scientific objectivity as linked to autonomy and masculinity. We then draw a line from Cynthia Cockburn's seminal work about how technologies and gender mutually define each other, using the example of work in the factory, to the growing body of research on the gendering of technologies in everyday life and ICT-based workplace technologies, many of which still seem to be designed for a 'genderless user' (Bardzell 2010). The final part of this chapter looks into engineering practices from a feminist and postcolonial perspective, examining Wendy Faulkner's (2007) argument that 'heterogeneous engineering requires heterogeneous genders' (p. 351), an argument that opens up to the key question of this book – how a gender perspective and a focus on intersectionality can contribute to designing IT systems and artifacts.

A second strand of feminist research concerns technologies of the body – reprogenetics, reproductive, and other technological interventions in the body – that are based on the philosophical work on the body, subjectivity, and sex/gender by leading feminist theorists, including Judith Butler and Rosi Braidotti. What is often also called *cyberfeminism* has been stimulated by the work of Donna Haraway, in particular by the cyborg metaphor she introduced into feminist theorizing. Wajcman (2006) has stressed the liberating influence of the cyborg metaphor – 'the collapse of these oppressive binaries – nature/culture, animal/man, human/machine, subject/object – is liberating. The cyborg creature, a human–machine amalgam, fundamentally redefines what it is to be human and thus can potentially exist in a world without gender categories' (p. 13). The cyborg has become a sort of cipher for 'otherness' (of gender, culture, geographical position); and it evidences novel configurations of humans and machines. In discussion of this extensive body of work – philosophical/theoretical and empirical – about the gendering of science and technology, Sandra Harding's (1986) triad for analyzing gender relations (see the Introduction) is helpful. We will use this framework throughout the book.

The Feminist Critique of Science

Views about science and the nature of technology evolved in parallel with the emergence of science, technology, and society studies. Feminist scholars, such as Sandra Harding, Evelyn Fox Keller, Donna Haraway, and others, reflected on the gendered nature of science and engineering and influenced a whole generation of women. The early critiques of the dominant model of practising science articulated some points that are still of relevance. In *Reflections on* *gender and science* (1985) Evelyn Fox Keller formulated an insight that was formative for many feminist scholars in the 1980s:

> In a science constructed around the naming of object (nature) as female and the parallel naming of subject (mind) as male, any scientist who happens to be a woman is confronted with an a priori contradiction in terms. This poses a critical problem of identity: any scientist who is not a man walks a path bounded on one side by inauthenticity and on the other by subversion.
>
> (Keller 1985, p. 174)

Scholars from different scientific disciplines started almost in parallel to reflect on what Harding (1986) called a masculine bias in the sciences, delineating the consequences of such a bias and also musing about how the sciences could be changed from inside by women (and 'people of color and gays and lesbians and working-class people and people of various ethnicities'; Hirsh et al. 1995, p. 194). They identified some of the major problems of the sciences at this time. Pioneering biologists such as Lynda Birke and Anne Fausto-Sterling started academic critiques of biomedicine (Birke and Vines 1987; Fausto-Sterling 1985). They argued that processes of gender have an influence on the production of biomedical knowledge. They (and others) demonstrated how gender norms determine how women's (and men's) health problems are interpreted and treated, often exposing the predominance of the 'male' norm in research and treatment (Klinge and Bosch 2005).

Fausto-Sterling, from the very beginning, tried to understand 'the "minority experience" as endured by minority men, minority women, and white women' (1985, p. 30). She, like Keller, disputed 'the claim that science operates solely and successfully by separating the subjective and objective aspects of our experience' (Fausto-Sterling 1985, p. 31), anchoring its theories and its methodology in a mind/body dualism. She saw this dualism as connected to her personal experience that her work *about* science was much less visible and recognized among her male colleagues than her work *in* science. Birke and Vines (1987) criticized biological determinism in how gender development was conceptualized following a nature/nurture dualism that fails to recognize that gender development involves complex and variegated processes. They argued that this is mainly due to the fact that science proceeds 'by using a kind of methodological reductionism, by means of which factors are isolated and controlled' (p. 565), asking, 'But if development involves complex, multifarious processes, how and why does uniformity (such as a definably female or male gender identity) arise at all?' (p. 565). Hence, already in the 1980s Birke and Vines' work referred to the possibility of multiple gender identities.

The debate about gender issues in biomedicine continues, alongside efforts to attain gender equity. From the point of view of research, an important initiative was to develop tools for carrying out gender analysis in biomedical research (see e.g., Schiebinger 2012). For example, the position paper of the European Commission's Horizon 2020 Advisory Group for Gender (December 2016) emphasizes that

> addressing the gender dimension in research and innovation entails accounting for sex and gender in the whole research process, when developing concepts and theories, formulating research questions, collecting and analysing data, and using the analytical tools that are specific to each scientific area.

The Canadian Institutes for Health Research (CIHR)

> is a signatory on the Government of Canada's Health Portfolio Sex- and Gender-Based Analysis Policy, as well as the Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans. Both policies underscore the importance of integrating sex and gender into health research when appropriate. As such, CIHR expects that all research applicants will integrate sex and gender into their research design and practices when appropriate.
>
> (https://cihr-irsc.gc.ca/e/50833.html, last accessed 12/19/2022)

In her widely influential book *The science question in feminism* (1986) Sandra Harding addressed the issue of women/gender in science from the point of view of the philosophy of science. She used feminist standpoint theory to categorize epistemologies that emphasize women's knowledge. Feminist sociologist Dorothy Smith (1987), who is often credited as the founder of feminist standpoint theory, reflected insights which were also being raised in the social sciences, concerning the need to take women's experiences as a starting point. Another significant contribution to this debate was Belenky et al.'s (1986) *Women's ways of knowing: The development of self, voice, and mind*, in which they proposed a new model of education that accounts for women's experiences.

With respect to the sciences, Harding's (1986) key argument was that the only way to increase the objectivity of scientific findings is by starting from the lived experiences of people who have been traditionally excluded from the production of scientific knowledge. Already Donna Haraway (1988) had stated, 'Feminist objectivity means quite simply situated knowledges' (p. 581). Harding took up this notion, asking, 'Now, what does it mean to have socially situated knowledge, to use the place from which we speak as a resource, a part of the method, a part of the instruments of inquiry?' (Hirsh et al. 1995, p. 206). In a conversation with Elizabeth Hirsh and Gary A. Olson in 1995, Harding restated the other key concept of feminist standpoint theory – 'strong objectivity' (Harding 1992) – as something scientists should strive for: 'Strong objectivity requires that the subject of knowledge be placed on the same critical, causal plane as the objects of knowledge. Thus, strong objectivity requires what we can think of as "strong reflexivity"' (p. 458). Harding also made clear that the 'masculine bias' that entrenches scientific practices and results 'lies in the selection of problems for inquiry and in the definition of what is problematic about them' (Harding 1996, p. 652). Similar concerns were raised by Kathryn Addelson, a philosopher of science, in her piece 'Man of professional wisdom' (1983). She also pointed to the necessity of focussing on the activities of science and how those contributed to bias.

Other feminist writers, such as Evelyn Fox Keller, who is a scientist herself, have used gender as an analytical tool for elaborating and concretizing the idea of difference and dissent within the sciences. Built into science and technology, Keller argued, is a dualistic worldview which excludes otherness and difference as non-scientific while claiming the universality, objectivity, and value-neutrality of its own cognitive structures and methods. Science has defined its way of knowing in a gender-based language. The focus on gender, Keller wrote, 'enables us to see the values that have been excluded from the norms of universality because they were identified with women' (Keller 1987, p. 45). Keller put forward strong arguments for 'the inclusion of difference – in experience, perceptions, and values – as intrinsically valuable to the production of science' (p. 40).

One of Keller's examples is Barbara McClintock, whose biography, *A feeling for the organism*, she had published in 1993, a decade after McClintock was awarded the Nobel Prize in Physiology and Medicine. McClintock was a geneticist, who as a young scientist achieved a level of recognition that few women could then imagine. She then retreated into obscurity. Her extraordinary findings – she invented the concept of 'transposition' of genetic elements – clashed with what her scientist fellows were prepared to understand. They thought her bizarre and difficult, yet after years of obscurity she later became famous again and connected with the revolution in biological thinking. When Evelyn Fox Keller came to talk to her, she did not see how her life could be of possible interest to the world:

> On this she was adamant; she was too different, too anomalous, too much of a 'maverick' to be of any conceivable use to other women. She had never married, she had not, as an adult or as a child, ever pursued any of the goals that were conventional for women . . . Barbara McClintock has lived most of her life alone – physically, emotionally, and intellectually. But no one who has met her could doubt that this has been a full and satisfying life. . . . Where has this extraordinary 'capacity to be alone' come from?
>
> (Keller 1993, p. 17)

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McClintock had learned very early in her life to, as she says, 'handle her difference', and gives many accounts in her biography about her unusual behavior others did not understand and often did not appreciate at all. She worked with maize, planting the young seedlings, watching them grow. She told how she became apt at recognizing structural alterations in chromosomal composition by simply looking at the plants. She never made a mistake!

In reflecting on McClintock's story, Keller asks, 'What then do we make of the fact that so much of what is distinctive about that vision and practice – its emphasis on intuition, feeling, connectedness, and relatedness – conform[s] so well to our most familiar stereotypes of women? And are, in fact, so rare among male scientists?' (1987, p. 42). Keller sees this as a consequence of science being named as masculine, while intuition (one of McClintock's resources) is named as feminine and repudiated. The 'difficulty so many of us have in thinking about difference in any other terms than – either duality or universality' she argues, is 'rooted not in biology but in politics: not a consequence of any limitations in the way in which our brains are constructed, but rather the consequence of an implicit contest for power' (p. 44). This insight, that 'the ideological ingredients of particular concern to feminists are found where objectivity is linked with autonomy and masculinity, and in turn, the goals of science with power and domination' (Keller 1982, p. 594), is an ongoing theme in feminist discourse about science and technology.

These key insights about how the gendering of science rests on the exclusion of women's knowledge (and the knowledge of other genders) prepared the philosophical and methodological grounds for the feminist critique of technology. Many of the feminist scholars who got involved in research on the gendered nature of different technologies – from machines in the factory to ICTs – read and debated the work of women who had pioneered feminist science studies. Many of the concepts which emerged in discussions about the gendering of science (including the importance of standpoint and context) have played a significant role in related areas, such as queer theory and critical race theory.

Technology as Material of Male Power

While the debate about the gendered nature of technology evolved alongside the feminist criticism of science, there are some differences. These are to do with the fact that technologies are not only produced with particular purposes in mind, but they will be used in different contexts, and how users appropriate a technological artifact, integrating it into their practices, is a question that has to be investigated empirically. Suchman and Wynn (1984) argued that the design of technology is only fully completed in its use; hence we need to focus on processes of appropriation that have to be observed. They used two methods – ethnographic studies and interaction analysis – in their research. Judith Wajcman (2006) uses the term *technofeminism* to express the need to combine feminist thinking with observational studies of technology use: 'My own perspective, technofeminism, fuses the insights of new streams of gender theory with a thoroughgoing materialist approach to the social studies of technology' (p. 15). She also stands for combining a historical perspective on how feminist thinking about technology developed with an interest in understanding new and future technologies. Referring to Donna Haraway's famous take on the figure of 'cyborg' – 'a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction' (Haraway 1990, p. 190) – she argues,

> The most influential feminist commentator writing in this vein is Haraway . . .. She too argues that we should embrace the positive potential of technoscience, and is sharply critical of those who reject technology. Famously, she prefers to be a 'cyborg' – a hybrid of organism and machine parts – rather than an ecofeminist 'goddess'. She notes the great power of science and technology to create new meanings and new entities, to make new worlds. She positively revels in the very difficulty of predicting what technology's effects will be and warns against any purist rejection of the 'unnatural', hybrid, entities produced by biotechnology. Genetic engineering, reproductive technology, and the advent of virtual reality are all seen as fundamentally challenging traditional notions of gender identity.
> (Wajcman 2006, p. 13)

Early feminist thinking about technology at times had a tendency towards being dichotomous. It either reflected the liberating potential of technology (e.g., Shulamith Firestone's *The dialectic of sex: The case for feminist revolution* [1970] where she posited the possibility of reproduction without men) or its destructive tendencies – reflected in many ecofeminist views, which built on the notion that women are closer to nature than men.

Taking up a historical perspective inevitably leads to the work of Cynthia Cockburn, who had an enormous influence on feminist thinking about the gendering of technologies, which she combined with her socialist engagement. She pointed out that most research into the workplace prior to the 1980s could be characterized by its focus on men: it was about men, gave pre-eminence to men's experiences, and assumed that the relations between capital and labour were relations between bosses and men. Additionally, she pointed out that prior to the 1980s most workplace studies focussed on labour and wage relations but neglected gender relations. After *Brothers: Male dominance and technological change* (1983a), which was based on observational work in the printing industry, she went on to study the use of three technologies: computerization of pattern and cutting processes in the clothing industry; computerization of goods handling and merchandizing processes in mail order warehouses; and computer tomography (CT) scanning in radiology departments. In her next book, *Machinery of dominance: Women, men and technical know-how* (1985), she looked at computerization as a process by which men asserted their power through the control of technology.

Cockburn argued that neither an ideological nor an economic explanation could provide 'an adequate account of male supremacy or female subordination' (Cockburn 1985b, p. 138). She emphasized the need to look at the material conditions of women's work, 'narrating also the concrete practices through which women are disadvantaged' (p. 137). She used her fieldwork material to demonstrate how technologies become gendered and are at the same time used to define gender relations. She did this first by looking at the introduction of computerized photocomposition in printing. She described how this technology threatened the power of the highly skilled and well-organized compositors – most of them male – as the technology 'wipes out many of the aspects of the work which have served as criteria by which "hot metal" composition for printing has been defined as a manual skill and a man's craft' (Cockburn 1985a, p. 136). Cockburn saw the technology in this case as producing both class and gender relations. While before the new technology was introduced, unskilled or semi-skilled labourers had not been allowed to enter the composing room, the craft workers now formed an alliance with the union of unskilled workers, in order to fend off women. Cockburn identified a combination of physical power and technical effectivity ('relative familiarity with and control over machinery and tools') as sources of male power at the workplace, arguing that it is important

> to study the way in which a small physical difference in size, strength and reproductive function is developed into an increasing relative physical advantage to men and vastly multiplied by differential access to technology. The process, as I will show, involves several converging practices: accumulation of bodily capabilities, the definition of tasks to match them and the selective design of tools and machines. The male physical advantage of course interacts with male economic and socio-political advantage in mutual enhancement. *The appropriation of muscle, capability, tools and machinery by men is an important source of women's subordination, indeed it is part of the process by which females are constituted as women.*
> (Cockburn 1985b, p. 140)

Cockburn's analysis identifies two steps in the process of constituting gender: the mutual definition of men and women through their relation to the same

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technology; and the distinction between skilled and unskilled workers. Looking back at her fieldwork in clothing manufacture, warehousing, and the hospital X-ray service, she observed,

> The significance of the role we've found women playing in the three new technologies is simple: they are operators. They press the buttons or the keys. They are the ones who do with the machine what it is made for: they produce on it . . . Their role is output, not input. What women cannot be seen doing in any of these three kinds of workplace is managing technology, developing its use or maintaining and servicing it.
>
> (Cockburn 1993, p. 113)

Cockburn's focus was on how technologies at the workplace were used to define men's work versus women's work based on a gendered definition of technical competence, thereby ensuring men's power position relative to women. Her next study, with Susan Ormrod, was *Gender and technology in the making* (1993), 'a gender analysis of the life cycle of a microwave oven, from design through production to sales, marketing, and consumer use, to see how gender relations shape technology while technology relations shape gender' (p. 271). The Science, Technology and Society (STS) approach Cockburn and Ormrod assume in this study was highly influential among feminists studying technologies, their production and use. For example, Judy Wajcman's work on gender and technology has been shaped by STS, as is the case with Lucy Suchman, who has brought attention to STS and feminist theory to the field of computing, clarifying the relationship between them:

> I take it that a virtue of STS is its aspiration to work across disciplines in constructing detailed and critical understandings of the sociality of science and technology, both historically and as contemporary projects. Feminist scholarship, similarly, is organized around core interests and problems rather than disciplinary canons, and comprises an open-ended and heterodox body of work. The aspects of feminist STS [that I trace out in this chapter] define a relationship to technoscience that combines critical examination of relevant discourses with a respecification of material practices. The aim is to clear the ground in order to plant the seeds for other ways of configuring technology futures.
>
> (Suchman 2008, p. 140)

The Case of Computer-Based Technologies

It took some time until the rich discourse on the gendering of technologies initiated by feminist theory and STS came to the attention of computer scientists, although issues around women and ICT had already gained prominence in the 1980s, with the advance of office automation (OA) (Marschall and Gregory 1983) and with emergent computer networks. The contributions in Cheris Kramarae's edited book *Technology and women's voices: Keeping in touch* (1988) put forward a nuanced view of computer technologies and their (potential) uses.

While in the 1980s many feminist scholars saw ICTs as perpetuating masculine images and privileges, some such as Margaret Benston (1988, 1989) began exploring the relationship between the design of ICTs and women's options and agency. By the 1990s there was some optimism about the possibilities of ICTs to empower women and change gender relations. Feminist writers such as Sadie Plant (1997) perceived digital technologies that are 'based on brain rather than brawn, on networks rather than hierarchy' as a chance to revalue 'the feminine, bringing woman's radical alterity, her difference, into being' (Wajcman 2007, p. 291).

The important series of 'Women, work and computerization' conferences that were organized as part of IFIP (International Federation of Information Processing), the first of which took place in Riva del Sole, Italy, in 1985, offered women (and men) a forum for presenting and discussing mostly empirical work about how computers were used in different areas of work and the challenges and opportunities they brought with them. The emergent paradigm of participatory design made researchers think about how to design ICT systems in ways that they could be easily adapted to the needs of users in a particular context.

ICT-based systems and artifacts are indeed different from traditional machines. A specific characteristic of systems and artifacts that have been developed in a context-aware and participative way is their technical tailorability and malleability. Carla Simone (2018) defines malleability as a prerequisite of a system that can be appropriated by users in a particular context and made useful:

> . . . the overall socio-technical system needs to be continuously re-designed to cope with different requirements and constraints, and must then be malleable at both the community and organizational levels. According to any good engineering approach, to make continuous re-design of (Socio-Technical ST) systems effective we have to take design for malleability at any level as a basic and unavoidable principle for the construction of (ST) systems.
>
> (Simone 2018, p. 3)

Hence, in principle computer-based artifacts and systems can be made to include the experiences and specific needs of women (and other genders and marginalized groups); with some limitations. Margaret Benston (1988) argued that technology itself

> can be seen as a 'language' for action and self-expression with consequent gender differences in ability to use this 'language'. . . . [M]en's control over technology and their adherence to a technological world view have consequences for language and verbal communication and create a situation where women are 'silenced'.
>
> (Benston 1988, p. 12)

The challenge was in providing women with a vocabulary for action. Benston (1988) – who taught computer science – contended that with computers 'new styles, embodying more of the things women value, may in fact be possible' (p. 18).

From the point of view of the design disciplines HCI, CSCW, and PD, the question 'Is there a gendering of computer technology?' is intimately related to the question of methodology: whether women's voices (and those of other genders) are included in generating design ideas and whether they participate in the shaping of technological artifacts. Fundamental to PD is the inclusion of future users through having them participate in the conception, design, and evaluation of an artifact or system that supports their practices. However, in the early days of PD gender was not an issue and very few projects at that time actually engaged in systems design in support of women's work. Only one of the early participatory design projects, the *Florence* project (Bjerknes and Bratteteig 1986, 1988), had women – nurses – as its main user group. Marja Vehviläinen developed the study circle method, which she used with women office workers in defining their requirements for a computer system that would be useful for them (1991). Eileen Greene, Jenny Owen, and Den Pain (1993) used the study circle method with women library assistants, pointing to important changes:

> For the first time, large numbers of women library assistants took part in detailed discussions and assessments of IT possibilities, both through the study circles and through the subsequent systems demonstrations. Their views were formally expressed through study circle reports, evaluation questionnaires and contributions to the systems specification.
>
> (Greene et al. 1983, p. 141)

There are several possible reasons for the absence of women from early PD projects: women's work frequently remained unrecognized and invisible; it was often considered simple, routine and 'of too little consequence to warrant the attention of system designers' (Balka 1997, p. 101); and women had difficulties finding time to participate in a design project and to have their voices heard, given their family responsibilities (Hales and O'Hara 1993). An additional reason also may be that most designers were men with a tendency to focus on areas of work that they considered interesting to contribute to. The trade unions, the key cooperation partners in PD projects in the

Nordic countries, had an interest in strengthening workplace democracy in the industrial sector. The situation in Germany was similar, where industrial sociologists mainly studied workplaces in manufacturing, the metal and automotive industry, mining, and shipbuilding, with typical areas of women's work not entering their field of vision (Balka and Wagner 2021). This is confirmed in a paper by Clement and Van den Besselaar (1993), in which they take stock of PD projects in the 1970s and 1980s:

> The list of projects shows a shift from PD in manufacturing industry in the 1970s and early 1980s to PD in offices and service industries in the late 1980s. In the earlier projects, the emphasis was on male-dominated crafts in unionized environments. This stands in sharp contrast to the later projects, which focus on settings in which women workers and traditionally female occupations dominate. As a consequence, in the later PD projects, more attention is paid to gender issues than to union issues.
>
> (Clement and Van den Besselaar 1993, p. 32)

The absence of women also has deeper methodological and epistemological roots, Lucy Suchman (2002) argued. She brought her engagement in feminist STS and the sciences of the artificial to PD by taking up Haraway's notion of partial translations, proposing

> a shift from a view of objective knowledge as a single, asituated, master perspective that bases its claims to objectivity in the closure of controversy, to multiple, located, partial perspectives that find their objective character through ongoing processes of debate.
>
> (Suchman 2002, p. 92)

Suchman suggested that we need to 'locate' design, by identifying the participation of all the implicated actors in the production and use of a technology so as to make their contributions and responsibilities visible – to make clear that a design presents a 'view from somewhere'. But what if this 'somewhere' excludes women and, as Shaowen Bardzell (2010) critically points out, design activities work with the assumption of a 'genderless user' or practitioner?

From an HCI perspective, Bardzell (2018) proposes to strengthen the connection of PD with feminist/queer theory by developing 'a cooperative engagement between feminist utopianism and PD at the levels of theory, methodology, and on-the-ground practice' (p. 1). The HCI research community has come a long way, with feminist and queer theory being currently strongly present in research and design committed to social justice, as numerous recent projects show; such as the work of Dombrovsky et al. (2016) on social justice-oriented interaction design; Bennet and Rosner's (2019) critical examination of empathy as a concept leading design work with people with disabilities; as well as Strohmayer and others' work with charities that provide services to women who are sex workers or have experienced sexual exploitation (2017, 2020).

The fact that women's voices are often not included in the design of ICT-based artifacts and systems has also been debated by feminist scholars in Germany (see e.g., Schmitz and Schinzel 2004; Draude and Maaß 2018). Corinna Bath (2009) describes several mechanisms that contribute to the gendering of computational artifacts: the assumption that technology is basically neutral; gendered structures, symbols and stereotypes that are inscribed in IT systems and artifacts – the ways 'the human' is represented – in them; as well as 'decontextualization and disputable epistemological and ontological assumptions' (p. 1). While not explicitly referring to Sandra Harding's triad for analyzing gender relations, Bath's approach has some similarities with this framework. Bath also uses the notion of 'gendered scripts', a term that goes back to Madeleine Akrich (1992), meaning that 'like a film script, technical objects define a framework of action together with the actors and the space in which they are supposed to act' (p. 208). Technological objects may thus reinforce existing 'geographies of responsibilities' (pp. 207–208) but also transform them or create new ones. This argument echoes Margaret Benston's (1988) view that technologies provide a means of expression, in that the constraints of technologies could limit alternate ways of doing things.

Gender has also been largely absent from CSCW research, for a variety of reasons. Central to the practice-based tradition of (mostly European) CSCW is the understanding of work practices with a view towards designing better systems. However, historically the focus of many fieldwork studies carried out in this tradition was (and still is) on work practices 'as they occur' and unfold situationally. This does not categorically exclude but also not oblige researchers to pay heed to the larger context of work, including working conditions and the gender subtext in organizations. This wider context also comprises 'the wider engagements that people have', for example, their family responsibilities, as well as 'the politics of work, the gender politics of work' (Suchman, interview 04/22/22). We think that the tradition of 'ethnomethodologically informed ethnography' in the context of European CSCW makes it difficult to identify or see most aspects of gender articulated by Harding (1986): gender structures – which often operate at a macro level – can easily elude detection with a focus on practices. Similarly, gender identity and gender symbolism may both come to bear on work practices, but when focussing on these practices can easily recede from view.

However, ethnomethodologically informed workplace studies in the European CSCW tradition have indirectly contributed to understanding gender

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issues at work because they make the often-invisible skills in work visible. In 1999, *JCSCW* (*Journal of Computer-Supported Cooperative Work*) published a special issue with papers that were to become highly influential, among them Leigh Star and Anselm Strauss' 'Layers of silence, arenas of voice: The ecology of visible and invisible work' and Yrjö Engeström's 'Expansive visibilization of work: An activity-theoretical perspective' that presented different frameworks for analyzing invisible work in CSCW systems. The main motivation behind this special issue was that 'understanding the nature and structure of invisible work is crucial to designing and managing organizations' (Nardi and Engeström 1999, p. 1), hence also to the design of computational artifacts.

Balka suggested that

> there are at least three different kinds of invisible work. Work can be invisible because it is non-standard, because of the political consequences of acknowledging it, or because the configuration of technologies used to complete a constellation of tasks was unable to capture all aspects of the work, requiring that a worker complete either articulation work[2] or a workaround in order to accomplish a set of tasks.
>
> (Ellen Balka 1997, p. 166)

Dave Randall (2022, p. 556) argued that 'work cannot be either invisible or visible in and of itself, but will be so in virtue of certain interests, for certain purposes'. This leads back to women's work and the invisibility and undervaluation of skills, one of the major concerns of feminist scholars with considerable implications for the design of computational artifacts. One of the scholars who brought this issue to the attention of CSCW research early on is Toni Robertson, who proposed to use the notion of 'language as embodied skill' within CSCW:

> The aim is to use this feminist work categorising women's language skills as key workplace skills to emphasise the centrality of these skills to core workplace activities – particularly the successful use of CSCW technology. This can then provide a valuable resource to those technology designers seeking to build technology that enhances the capacities of those who use it to control their own work practices. At the same time feminist theory gains an opportunity to be applied within technology design practice.
>
> (Robertson 2000, p. 214)

Although deeply interested in a feminist perspective on technology design, Robertson is skeptical of the idea of designing for any specific group of people, which poses the risk of essentializing differences. She emphasizes the

[2] Articulation work, a term that goes back to Anselm Strauss (1988), is work needed in the orderly accomplishment of cooperative work. It involves activities such as to distribute work, align contributions, clarify issues, provide instructions, and point out errors.

importance of designing for ‘flexible use’ – ‘it seemed to me if you were designing for people who worked in different ways, then you . . . you just designed the technology differently, and people could appropriate it as normal’ (Robertson, interview 05/18/22). This is an important stance, we think, that points to the practice of PD, which, starting out from a deep understanding of a specific workplace and practice and the context in which it is embedded, joins forces with the practitioners in the field in developing computational artifacts. It also emphasizes the significance of aiming at tailorability and malleability with a view to ‘flexible use’.

The Configuring of Technology and Gender in Everyday Life

While there are numerous empirical studies about the role of technologies in different workplaces, they do not necessarily take a design perspective, showing how work-related computational artifacts are gendered and how they shape women’s work. A number of recent cultural studies focus on the gendering of technologies that are designed for use in everyday life: heat pumps and solar stations, radio tinkering, electronic music-making, and, more generally, ‘making’ have been objects of both STS and cultural studies. While feminist scholars working within an STS framework are interested in understanding how technologies and gender mutually define each other, following technical artifacts from their conception to their uses in different contexts, cultural studies look into how on a symbolic level, gender is

> attached to actions, things, and people. In addition to being part of individual identities and institutional structures, gender functions symbolically and metaphorically: to say that a particular technological activity is symbolically ‘gendered female’, for example, does not mean that male people never participate in it.
>
> (Lerman et al. 1997, p. 2)

Cultural studies of technology, which address how technologies and gender mutually define one another, can help us understand what Harding (1986) has identified as gender symbolism. Some of these studies fail to address the making of technological artifacts but explore gender in situations of technology use. De Wilde (2021) looked at gender relations in maintenance and repair work, carrying out ethnographic fieldwork about interactions between households, technologies, and technicians around heat pumps and solar power stations. Her observations were led by the analytical lens of care – taking care of and caring about technologies. De Wilde saw ‘technicians creating settings that encouraged conversations about main components, specialized high-tech

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features, and the technical rationale for renewable energy technologies' (p. 1269). But they also

> actively engaged female users, as they held women responsible for and knowledgeable about the domestic routines that affect a heat pump's performance, such as securing thermal comfort, creating a pleasant living environment, or cleaning its parts. Just as gendering in engineering practices is not as binary as it may appear, technician–user relationships are likewise multifaceted.
>
> (De Wilde 2021, p. 1280)

This study points out the co-existence of hegemonic and heterogeneous gender–technology relations – technicians pay heed to the needs of both men and women with their traditionally different roles in the home.

Another interesting case is prestigious technical objects, such as the electric guitar, which have been defined by male rock stars, and became physically as well as symbolically gendered:

> Through body positioning and flamboyant physical displays, players like Jimi Hendrix fortified male dominance over the electric guitar with a large dose of phallic symbolism. Male electric guitarists often handle their instruments in ways that recall sexual acts or emphasize the phallic symbolism of their guitars.
>
> (Bourdage 2010, p. 3)

Of course, women can play the electric guitar and there are female rock bands, but the barriers they face when trying to get onto the stage are enormous. Bourdage contends that many people consider 'low-slung guitars as the only positioning that looks right. Therefore, even on women, the instrument appears as an extension of the male body, reinforcing the idea that the electric guitar should be left to male hands' (p. 3).

That gendered notions of technology are persistent and make it difficult for women to move to some fields of activity that are attractive to them is also demonstrated by recent studies of radio tinkering and, more generally, 'making'. A fascinating study by Dunbar-Hester (2008) depicts radio tinkering as a site of masculine identity construction. She engaged in participant observation in the so-called 'Geek Group', a small US-based 'radical pedagogical activity, which constitutes an aspect of activism surrounding citizen access to low-power FM radio' (p. 201). Although the group was conceived as a place for both women and men to learn technical skills, Dunbar-Hester found a division of labour 'about which the participants were uneasy, and which specifically hinged on technical skill' (p. 201). While the women were radio activists, few of them attended the group meetings and possessed the technical skills related to the hardware. On the other hand,

> Women who do have technical skills related to FM or more 'hardcore' electronics tinkering claim to feel empowered by these skills, and some women who do not have them have expressed regret, or to some extent resentment. Janet said how exciting it was for her to 'demystify' FM production technology by learning to use it, and stated that the next step in the process of 'demystification', which she would find interesting if she had more time, would be something akin to learning 'to look under the hood'.
>
> (Dunbar-Hester 2008, p. 221)

Even men that were open to feminist ideas were not averse to displaying masculine identities when tinkering. This is consonant with an earlier study by Susan Douglas (1999) of amateur operators' work with radio. She observed that for men,

> radio colonized and reinforced new and old territories of masculinity. Tinkering with machines was nothing new for men. but radio brought such tinkering into the safety and comfort of the domestic sphere and of leisure time. It made being a nerd almost glamorous.
>
> (Douglas 1999, p. 99)

Men's practices of radio tinkering led to a reinterpretation of masculinity. This observation indicates a tendency of men to appropriate new technologies that would on principle also be open to women associating them with ideas about masculinity, as is the case with for example the digitization of parts of mining (see Chapter 4).

Hence, although in particular young women have started appropriating technical artifacts, for example in electronic music-making (e.g., Abtan 2016, Parsley 2022), and are increasingly participating in male-identified maker cultures or starting their own maker projects, they continue to be confronted with masculine symbolisms as well as the fact that full participation in these activities requires hard-core technical skills that many of them did not have the opportunity to develop. This gender messaging is often reinforced by an absence of appropriate tools (e.g., safety gear) required to participate fully. Moreover, some kinds of technologies are valued over others, with those that are involved in feminist making, such as 'zine making, meme propagation, hashtags, and textile crafting' (Rentschler 2019) assigned lower cultural value.

In FabLabs and hacker- and makerspaces these topics become manifest and have increasingly attracted the attention of researchers in HCI, CSCW, and related communities. Studies exploring the reasons for the low diversity in such spaces (Lewis 2015; Davies 2017; Smit and Fuchsberger 2020; Campreguer et al. 2021) find them along social and material lines. Smit and Fuchsberger (2020) describe the social fabric of the makerspace community to be a strong factor that is making the place uninviting to a more diverse audience:

> . . . communities, and their implicit rules and social norms can be 'wicked ways of closing a system', turning a makerspace into an impenetrable fort. If we want to design (interventions in) makerspaces to make them more inclusive and welcoming, we might relate the norms and rules of communities of practices that already exist, to how women* (are unable to) enter these communities. By understanding the communities, we can then co-create, evolve, design and build makerspaces to be inviting to anyone who considers or would like to consider themselves a maker.
>
> (Smit and Fuchsberger 2020, p. 8)

The way maker identity has developed over time is rather constricted. Quoting Dunbar-Hester (2014), Cid Cipolla emphasizes

> that the maker movement's appeal to universality only appeals to those who feel universal to begin with – those whose identities are unmarked and that activists should both consider the fact that making technology 'has long been associated with white masculinity' and remember that it is not enough to simply express an embrace of egalitarianism'.
>
> (Dunbar-Hester 2014, quoted in Cipolla 2019, p. 267)

Cipolla stresses that such a view is not easy to overcome, as it also touches upon factors that may reside well outside of the makerspace itself.

Efforts to achieve more diversity and inclusivity are varied. They are seeking to challenge dominant categorizations of what making is, arguing for an inclusion of crafting (Kafai and Peppler 2014) and tinkering (Cipolla 2019), bricolage, fixing, and maintenance (Jackson et al. 2012). Along material and technology lines, a range of technologies and tools are developed to further challenge established notions of 'hard and soft engagements with technology' (Cipolla 2019), creating links with traditional crafts like sewing (Weibert et al. 2014; Strohmayer 2021) or origami (Qi et al. 2018).

Gender and the 'Pleasures of Engineering'

In an article with a question in the title – 'The power and the pleasure?' (2000) – Wendy Faulkner discusses studies of engineers and the links between modern technology and hegemonic masculinity. Starting out from what Harding (1986) has proposed as the triad for analyzing gender relations, she argues that while technologies are a source of male power, men also have an expressive relationship with technologies. While this is not a new insight, Faulkner uses it to develop the notion of heterogeneous engineering.

Well-known early studies of engineering are Samuel Florman's *The existential pleasures of engineering* (1976), Sally Hacker's *Pleasure, power and technology* (1989), and Gideon Kunda's *The culture of engineering: Control and commitment* (1992), each taking a different stance. Florman described the

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rewarding experiences of being able to solve difficult problems, mastering formidable obstacles, as well as the intimate contact with technical artifacts engineering affords. Although the book was criticized as directed against the anti-technologist movements of his time (and hence as being basically apologetic of engineering work), Florman made an important point, as Ina Wagner (1994) argues:

> Science and technology provide actors with an environment (a lab, a mathematical theory, a computer screen) in which they can act out without being held back by concerns that provide guidelines in real life. Samuel Florman (1976) defines this distance as a central source of the pleasure of engineering.
>
> (Wagner 1994, p. 260)

Wagner interprets this distance as a source of social irresponsibility, as it encourages engineers to blend out social issues (of use) and suspend social norms.

In an entirely different spirit, Sally Hacker (1989) described engineering as an archetypal masculine culture and the pleasure and power men derived from it, stating, 'It is as though an intricately controlled erotic expression finds its most creative outlet today in the design of technology' (pp. 45–46). Among the pleasures that the engineering students she interviewed mentioned were

> 'The best hard science is flawless with simple systems [so large] you can deal with them by statistical methods'; 'The mathematical symbology seems to me very pretty . . . can represent to many different things and subtle connections; it's very hard to remember enough to put order into nature. You have to have some structure for it always, and that structure is beautiful': 'reducing to rationality although it is right on the border, just barely rationalizable'; . . . 'Some degree of elegance, aesthetically and technically': 'The beauty of finding that single equation that sums up everything, that explains everything'.
>
> (Hacker 1981, pp. 345–346)

Hacker asked how it can be that the pleasures of engineering got gendered and how it was possible that making things work had turned into a process of domination. She tied the feminist discussion of 'eroticism, domination, and the subordination of women to the development of a technology that is a central aspect of core institutions, the economy and the military' (Acker 1996, p. 441).

Wendy Faulkner proposes a 'shift' to men/masculinity and technology wondering why masculinity studies have not looked at engineering practices. She points to Bob Connell's notion of hegemonic masculinity 'as the pattern of practice (i.e., things done, not just a set of role expectations or an identity) that allowed men's dominance over women to continue' (Connell and Messerschmidt 2005, p. 832). It emphasizes a particular version of masculinity that is connected with (white) men who are in power, while acknowledging 'the plurality of masculinities and the complexities of gender construction for men' (p. 832). Faulkner argues that while the masculinity–technology connection had contributed to the exclusion of women, a closer look at engineering practices points to 'contradictory constructions of masculinity in the detail of engineering knowledge and practice' (p. 92). She suggests that we examine cultural images of technology and the dualisms inherent in these images from the point of view of masculinity studies; and also that we look at the mismatches between images of masculinity and actual practices of engineering.

One of the core dualisms, in addition to the mind–body dualism, is that of 'hard' and 'soft' technologies. While the former ones are considered the real powerful ones, 'soft' technologies are 'smaller scale, like kitchen appliances, or more organic, like drugs' (Faulkner 2000, p. 73). The hard/soft distinction, while quite pervasive in engineering, has been defined in various ways. Soft technologies are thought of being those that embody 'psychological, social and cultural factors' (Jin 2005, p. 51), while 'hard technologies are based on natural science knowledge aiming at 'changing and control the nature and substance of materials' (p. 52). In the field of computing the hard–soft dualism is still quite dominant, with areas such as software engineering, HCI, and CSCW being contrasted with the highly mathematical and engineering-based areas of research.

The hard–soft dualism is not only problematic because it reduces the heterogeneities that characterize different fields of engineering (which differ with respect to the required mathematical rigor, the importance of hands-on 'tinkering' work, as well as the distance from the complexities that arise with the uses of a technology in different contexts). Ashcraft (2022) has argued that the 'hard–soft' split is a *gender binary*. So too are notions of hard and soft, which are associated with a different style of thinking, juxtaposing a hard male style with a soft female style. Holth's (2014) interview study with male and female engineers discards dualisms such as these. She found 'passionate men' and 'rational women', challenging essentializing assumptions of gender and technology. Women may choose engineering as a profession for the same reasons as men and experience the same kinds of pleasure that solving difficult problems and making things that work offer.

However, for some time the notion of gendered styles in engineering had been quite popular in the early days of gender and computing studies. It had been taken up by Turkle and Papert (1990) who identified two ideal-type programming styles: the style of the bricoleur who works in an associative mode, negotiating and rearranging his/her way through a program; and the structured programmer who thinks in an analytic and rule-oriented way. These different styles became associated with men and women respectively, based on

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characterizations of femininity and masculinity that were often 'not read as symbolic constructs or as power-stabilizing ideologemes, but as sets of empirically identifiable properties in a binary social code' (Wagner 1994, p. 258).

While problematic in the ways it has been associated with stereotypical images of masculinity and femininity, the recognition of a diversity in learning styles had an important liberating effect on teaching practices. It led to a refocussing of a discourse that had started out with the acknowledgment of coding skills as central in a world that has become increasingly digital. Jeannette Wing has famously conceptualized the skill set needed as *computational thinking*. She is taking a broader view that is also concerned with concepts and analytical thinking, as a complement to mathematical and technical logics (Wing 2006, 2008) – as a means 'for everyone', inside and outside of computing. This universal approach entails a focus in STEM education on learners instead of contents to be learned, asking how access to skills could be ensured for a spectrum of learning styles. Subsequently, the acquisition of computing and programming skills is seen as closely related to matters of the self and as embedded in social context and community, thus motivating learning as 'computational participation' fostered by 'wider social networks and a DIY culture of digital making' (Kafai and Burke 2014):

> Participation in computing is more than just having access; it also involves the quality of what a child actually does with the computer. This issue extends beyond gender, race and socioeconomic equity. Even many schools in high-income communities remain entirely on the receiving end of computer screens and are unacquainted with how programming allows users to become multimedia creators themselves.
>
> (Kafai and Burke 2014, pp. 11–12).

This approach has been linked to craftsmanship and questions of aesthetics (e.g., Buechley et al. 2008), marking a turn from STEM to STEAM, explicitly including the Arts (Boy 2013). Rode et al. (2015) have argued for an inclusion of aesthetics, creativity, constructing, visualizing multiple representations, and understanding materials as physical skills, allowing to embrace more learner styles (such as creative, hands-on, less linear) in computing. Faulkner's (2000) argument that the distinction between styles can be pursued without falling into the trap of essentialism is highly relevant in this context:

> But it seems to me that both the potential for pluralism in technological design and the actual suppression of some styles and voices are extremely interesting politically. It would be very useful to explore further which 'styles' get suppressed and whether this is gendered at all.
>
> (Faulkner 2000, p. 103)

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She contends that 'many dualistic epistemologies found in engineering practice are gendered in contradictory ways and that many fractured masculinities within engineering are sustained simultaneously – among engineers as a group and, to varying degrees, by individuals: they coexist in tension' (p. 98).

Scholarship about technology and gender undertaken from a cultural studies perspective points to the ways that gender and technology are constituted at a symbolic level. Work by Faulkner (2000) and others that addresses gender and engineering, however, helps us to see and understand that while these dichotomies exist and are predominant, engineering practices are gendered in contradictory ways. This insight is important both because it signals on the one hand the existence of broader role possibilities for women than dichotomous views imply, and on the other hand, it points to the ways that gendering is manifest at an ideological level. Acknowledging and understanding these contradictions is an important aspect of understanding how gender works in relation to Harding's (1996) articulation of individual gender and symbolic gender.

Sources of Heterogeneity: Postcolonial Gender and Technology Studies

Postcolonial gender and technology studies have helped to take the acknowledgement of heterogeneous engineering a step further. The masculinization of technology, Ruth Oldenziel (1999) argued, is largely a product reflective of racial, gender, and international relations in the twentieth century. Increasingly, researchers from the non-Western world voice criticism of some of the main arguments about science and technology developed by feminist scholars. They sketch a much more nuanced picture of technology and women's participation in its production and use.

For example, Ong (1987) describes how the gendering of microchip production jobs in Malaysia is less indicative of male privilege than of profit maximization and labour control. The 'electronics' women working in high-tech factories 'were stamped with a negative "electronics" image implying low-grade labour and cheap female sexuality. For working-class men, the new technology was also tainted by its manual and female associations. Men instead aspired to white-collar employment in the government bureaucracy' (p. 622). Ong sees the fact that office jobs, whether performed by men or women, have high status in Malaysia as defying the assumption that simply 'working on machines' rather than developing, configuring, and maintaining them 'invalidates universalizing feminist logic about the links between gender, technology, and meaning' (p. 622).

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While men and women may relate differently to different technologies (e.g., Benston 1988; Livingstone 1992), this is not necessarily culturally universal. In many Asian countries, neither computing nor engineering are considered masculine areas of work (see Chapter 9), as witnessed by the predominance of Indian women programmers in the IT industry and the effort of companies to make the work attractive to them, including free transportation to work and generous maternity leave: 'This is understood by women and men alike who perceive working in IT as a highly desirable career, regardless of gender' (Corneliussen et al. 2018, p. 5). The Philippine's ICT industry as well has 'female spaces', in particular in areas that are characterized by disciplinary hybridity, requiring a mix of ICT skills with non-technical skills. Saloma-Akpedonu (2005) argues that this is in part also due to the fact that 'women's epistemic privilege and standpoint' (p. 102) are recognized by industry.

Other studies suggest that this is not a new phenomenon but that women in traditional non-Western societies, even though not necessarily enjoying gender equality, regularly and competently have been using and still use different kinds of technologies. For example, Twagira's (2020) historical examination of technology use in grain mills in rural Mali shows 'not only women's concern for labour-saving technologies, but also women's ability to shape the infrastructure of their work. In so doing, they gender their tools as women's things and assert control over the meanings of their own work and status' (p. 77).

Studies such as these point to the need to explore the 'huge spectrum of variations in gender subjectivities in relation to artefacts and technology' (Mellström 2009, p. 888). They advocate more context-sensitivity and focus on the different meanings gender–technology relations may have assumed in different cultures. It is precisely this type of context-sensitivity when focussed on gender–technology relations that has yielded important insights about the nature of women's work and technology, which in turn have had significant impact on CSCW and PD in particular. Research concerned with queer gender identities (in Harding's (1986) terms, both projected and subjective gender identity) and how queer gender identities may both be influenced by technology and influence our views of technologies is in its infancy, and warrants further examination. Recent years have seen the formation of a queer special interest group in the HCI community. However, papers addressing gender and queer issues remain limited, and largely focussed on areas other than paid employment. These topics also remain on the outskirts of CSCW and PD (for an exception see Rizvi et al. 2022).

Summary

In this chapter we went back to the feminist discourse on science/technology and gender, which started in the 1960s and 1970s and was led by women scientists as well as scholars of STS and cultural studies. Very early on, feminists criticized the gender binary and other dualisms and brought forward an understanding of 'scientific objectivity' as being rooted in the multiplicity of experiences. Feminist criticism of science and technology was later enriched by queer theory and a focus on intersectionality. It serves as a reminder that our gender expressions are not dichotomous, can change over time, and take myriad forms of expression, which has implications for how we both think about gender and think about technology. Of particular influence on a feminist approach to science and technology were feminist standpoint theory and, connected with it, Donna Haraway's notion of 'situated knowledge' – that we use the place from which we speak as a resource – that juxtaposed prevalent connotations of science and technology with hegemonic masculinity that is associated with domination and control.

Cynthia Cockburn, in an STS tradition, analyzed the gendering of technologies – or the mutual shaping of gender and technology – using a wide range of examples, from computerized photocomposition in printing to the microwave oven. Judy Wajcman (2006) coined the term 'technofeminism', insisting on a 'thoroughgoing materialist approach to the social studies of technology'. While researchers in the field of cultural studies have followed the STS tradition with empirical studies of how gender plays out in activities such as radio tinkering or in makerspaces, this tradition has not been taken up with respect to computational artifacts in support of work. Although there is a large body of literature on women's work and technology, what is missing are analyses of the processes underlying the gendering of these technologies. Thinking about how to better understand these processes from the perspective of intersectionality is one of the challenges the book seeks to meet.

We touched on the challenges that practice-based research poses in relation to seeing gender relations, and highlighted the contributions that practice-based research has made to understanding the invisibility of women's work.

One of the important insights on this way to a gender/intersectional perspective on design is Faulkner's work on engineers and her understanding that the gendering that occurs in engineering practices is complex and heterogeneous. She emphasizes the importance of promoting heterogeneous images of engineering which, to be more inclusive,

> must also challenge the gendering of 'the social' as feminine and 'the technical' as masculine – and thus promote new 'co-constructions' of gender and engineering simultaneously . . . *heterogeneous engineering requires heterogeneous genders* – in the sense that it requires various mixes of stereotypically masculine and feminine strengths.
>
> (Faulkner 2007, p. 351)

Part III of this book will look into this notion of heterogenous engineering done by those of heterogenous gender with a view to the design of workplace technologies.

We now turn to the ethical-political perspective, outlining the contributions it has made to developing insights about the gender–work–technology nexus.

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